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Theory of Knowledge

2nd Edition

SUE BASTIAN • JULIAN KITCHING • RIC SIMS

Supporting every learner across the IB continuum

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Dedications

I salute my students, fellow teachers, IB colleagues, friends, and family who have taught me so much. I am still learning.
Sue Bastian

I would like to thank the teachers of TOK at the SOS Hermann Gmeiner International College in Ghana for their support and insightful contributions to some of the ideas in this book. I dedicate the book to my wife, Harriet, who has graciously tolerated my erstwhile inattention, and my twin daughters Sophia and Olivia who have started to teach me so much about the capacities of the human mind and what it means to learn.
Julian Kitching

I would like to thank all those students and teachers who were unwitting guinea pigs in the classroom experiments that led to the content and exercises in my parts of this book. In particular, Artur, Rebecca and Maria Zacharia for looking at parts of the manuscript, and my own TOK team at Katedralskolan in Uppsala: Erik, Catarina, Nina, Per, Birgitta and Niklas for their suggestions and encouragement. Our editor at Pearson, Harriet Brinton, needs a special mention for her patience and quiet encouragement (and dinner invitations). My children Beccy and Pashmina need a mention for sharing their (extra) Dad with the world of TOK, as does my wife, Caroline, for her support, understanding and encouragement. I would like to dedicate my contribution to this book to my beloved sister Katie who has been my companion in my own knowledge adventure.
Ric Sims

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To the student

Over the years, you may have had teachers who loved their subject and taught with great enthusiasm. You might have wanted to share in their delight, to feel the same way about a formula, a cell, a colour, or a poem instead of just writing something in your notebook to use in the next exam. To be in their presence was an inspiration.

The co-authors of this book, three teachers of Theory of knowledge (TOK), love their subject in the same way. The word 'love' is used intentionally. They have a passion for this course, which is original to the International Baccalaureate, and feel blessed that they can teach TOK to hundreds of students. This emotion – which all good teachers possess along with their expertise – is called passion and should be courted in your own life as you go forward into college and university, and then out into the world to take up your professional responsibilities. Work that touches both your heart and your mind is the right kind of work for you, and will help you fulfil your nature.

Not meeting you face-to-face, it is unlikely that we can make a difference in your life in the way that the right teacher in the right classroom on the right day can, even though it is our hope and our ideal. Yet, we are speaking to you on these pages out of our deep commitment to TOK and the value of thinking about what we know and what we mean when we say that we do, and the different ways of putting this understanding to work in the world. In doing so, we understand once again why we chose teaching as our life's work and how special it is to have young people in our charge.

When we see your natural ability to think take a sharper edge, we all draw closer to the ideal of a liberal education – 'liberal' reflects something like its root meaning which pertains to freedom. Without sorting out all the ambiguities of the word, two of its meanings 'freedom *from*' and 'freedom *to*' can be mentioned: the freedom *from* total reliance on knowledge by authority and second-hand ideas, and the freedom *to* draw on the magnificent edifice of knowledge that has been built and shaped by countless others throughout the history of the human species. The delicate and sometimes elusive balance between these freedoms offers the prospect of thinking things through for yourself through a process of reaffirming, revising, refining, or even rejecting knowledge from diverse origins – everything you've learned, everything you've been told, and everything you've thought up yourself – and then to express those views with clarity and thoughtfulness. Few things feel better than to be able to stand up for yourself in front of others, and sway them with your position when you know what you think and why you think it.

It is the special mission of the IB to prepare young people to live within a pluralistic community of many voices, all possibly 'chattering' at once in every kind of boundary-crossing conversation of print, voice, and social media. You, our students, look to us to get you ready – we are your teachers. You are entitled to be prepared by us to comprehend the great world beyond your street, your neighbourhood, your culture, your nation, as a result of the expanded perspectives we arouse and shape in you. Some of this we have tried to do with our chapters in this book.

Sue Bastian
Julian Kitching
Ric Sims

01 Introduction

On previous page – Dome of the Planetarium of the Bibliotheca Alexandrina, Egypt. Its predecessor, the Ancient Library of Alexandria, was one of the largest libraries in the world containing a vast collection of books and scrolls. It is believed to have burned down 2000 years ago with the irretrievable loss of its collected world knowledge, including, it is thought, Hero of Alexandria's plans of the first ever steam-powered device.

1.1 Knowledge

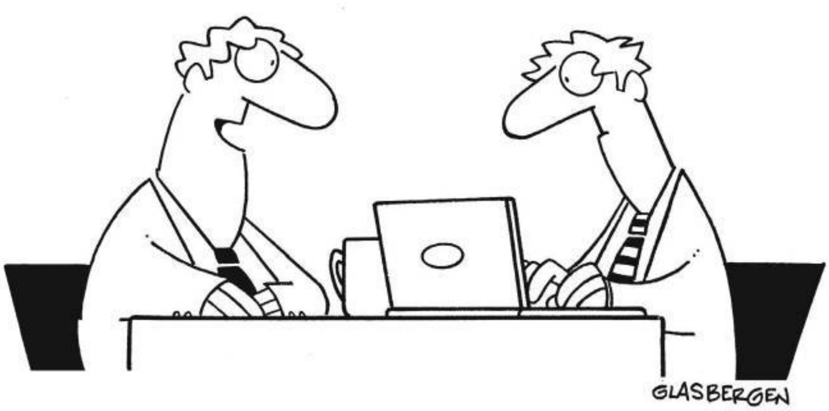
What is knowledge? It seems straightforward enough. We all know roughly what it is to know and to be correct, to be wrong, to doubt, and to be only partially right. If you've thought about knowledge at all, you may hold some view close to what can be called the 'trivial pursuit' model. That is, knowledge is seen as facts that are more or less simple, discrete, non-controversial, and displayed through recall. This model is generated and confirmed by much of your school experience and, certainly, is exploited by TV game shows. People with a lot of this kind of knowledge are often called clever and those with less of it are often called something not so complimentary.

In the world outside the classroom, the **search for knowledge** never stops. Governments appoint commissions, armies rely on intelligence, scientists conduct research, doctors constantly retrain, teachers carry on with professional development, wrestlers study their opponents, journalists check their sources, musicians look for better ways to compose and capture an audience, philosophers clarify concepts, gamblers study the odds, and so on. We speak in slogans about *lifelong learning* or *learning how to learn* as qualities more valuable than acquiring a mountain of facts that may not be relevant when the time comes to use them.

In addition, people are increasingly inclined to find out what they need to know from all kinds of places, often online, and not necessarily with deference to experts who pronounce from on high. The ubiquitous student use of the Wikipedia open-source encyclopaedia on the internet is one of the most obvious examples, especially when compared to that of the leather-bound *Encyclopaedia Britannica*, once the pride of every middle-class home in the English-speaking world and the go-to source for every student research project. While expert opinions are still sought today, especially with the aid of Google and other search engines, it is often the individuals themselves who evaluate the various authorities and come to their own conclusions with or without consultation with experts. Everyone these days seems to consider themselves **arbiters of knowledge** – just ask doctors about their web-savvy patients who come into their offices with handfuls of printouts from the internet.

> “In the Middle Ages we were told what we knew by the Church; later, after the Reformation and the printing press, by state censors, then the philosophes of the Enlightenment with their Encyclopedia, then by publishers and more recently by commercial broadcast media. In all cases it was by a small elite group of professionals. But now with the rise of the internet, all comers are invited to post their knowledge and express their opinions, and to rate the content of other people. This is the new politics of knowledge. It is decidedly egalitarian. This is where your critical thinking comes into play. How do you evaluate the tweets and texts and videos of people you don't know and have never heard of?”
>
> Sanger, 2007

So here is the modern challenge as it is often presented: attention has replaced access as the limiting factor in the pursuit of knowledge. The skill of retention is not what is needed so much as the skills of discernment and discrimination. What best supports an argument or helps solve a problem? How can I ask the right question? Where do I go for the answer? How can I tell the difference between the reliable and the slipshod? The subjective and the objective? The biased and the fair? Those skills must be valued and practised; they are not inborn. So, at the very least we should ask: What are the sources and dependability of our knowledge?



"Some men are born great, some achieve greatness, and some have greatness thrust upon them by a friend who knows how to use Wikipedia."

Is Wikipedia a double-edged sword?

Wikipedia is a challenge to traditional teaching and learning, to the authority of the professor, the textbook, the library, the publishing house, the documentary video, indeed, every form of mediated knowledge vetted by some expert, real or imagined. Until recently, these were the only voices who said: this is good to read, this is knowledge, this you should consult, this you may footnote. Just imagine the difference between the textbook you are now reading and the same contents posted on Wikipedia. In just five or ten years, the paper version will be much as it is now in contrast to the online document which will have been either improved or tampered with depending on your point of view. Both have value.

Of course, we want all of our sources of knowledge to be as reliable as possible. Ideally, we would like to read an encyclopaedia, believe what it says, and arrive at knowledge, not error. According to one leading account of knowledge called *reliabilism*, the measure of knowledge is that it has been arrived at by a 'reliable process' (for example, a result obtained through rigorous scientific procedure) or through a reliable indicator (for example, the proper use of a calculator).

But reliability is a comparative quality. Does something have to be *perfectly* reliable in order to be reliable? To say that an encyclopaedia is reliable is to say that it contains an unusually high proportion of fact rather than error, compared to other publications. But it still can contain some error, and perhaps a high enough proportion of error such that you should never use just one reference work if you want to be sure and safe about your information. Are second opinions always to be sought if there is no perfect encyclopaedia?

Exercises

1. Do you think it is possible that there will be a perfect encyclopaedia some day? Would you know it if you saw it?
2. If there were a perfect encyclopaedia, could you get knowledge just by reading, understanding, and believing it?
3. Do you ever consider getting a second opinion on your second-hand knowledge in the way people sometimes do with medical care?
4. Do you think encyclopaedias should be free (like some on the internet) or should there be a subscription or purchase fee?

CHALLENGE YOURSELF

Compare the Wikipedia encyclopaedia movement of today with that of the *philosophes* of the Enlightenment in France in terms of their motives and successes in collecting all that humankind should know.

Discuss this statement: 'Wikipedia is not egalitarian in any admirable way if the equality of its sources results in a sloppy information architecture that gives everyone equal access to creating and receiving mediocre information'.

CHALLENGE YOURSELF

Do a little research on Sugata Mitra and Nicholas Negroponte. Shifts in how knowledge is produced and validated may be mirrored by changes in how it is distributed and used – some prominent individuals have started asking provocatively, 'Is knowing obsolete?' Is there a coming age in which no one will need to become an expert on anything – when anyone can perform as, say, a doctor or accountant simply by accessing relevant knowledge as and when needed rather than by going through a process of accredited training and induction into a professional community? If not, why not? If so, what kind of society do you think would emerge and what might be the implications?

The birth of such a rapidly successful phenomenon as Wikipedia is a valuable example of how knowledge comes to be organized by, and presented to, a mass audience. But for now, most of the debate swirling around the growth and use of Wikipedia is not its reliability, which according to several studies in recent years shows its error ratio to be just a hair below that of the *Encyclopaedia Britannica*, but that it initially had no special role for experts in its content production system. In fact, Wikipedia's defenders went so far as to say that expertise is not necessary, a commitment to a position that some call *dabblerism*. This goes against the view that special knowledge or credentials should give experts special authority in contrast to the wisdom of the masses. The professors in academia are often furious.

Of course questions arise. If Wikipedia ignores the need for expert guidance, how then does it propose to establish its own reliability? Either it does so from external reports (in which case it chooses authorities to establish its credentials) or its reliability may come from Wikipedia's internal contributors who form the benchmark for what is deemed knowledge. Is it too self-serving to maintain that knowledge is in effect 'socially constructed' by crowds, anonymous or not, whose credentials are irrelevant to their entries?

In summary, Wikipedia, in its infancy, is proud of its creed of *epistemic egalitarianism* which states that we are all fundamentally equal in our authority or right to articulate what should pass for knowledge. The only grounds on which a claim can compete against other claims are to be found in the content of the claim itself, never in who makes it. In fact, Wikipedia gives quite clear instructions for anyone who wishes to post original entries or to edit those of others.

Perhaps this vision of knowledge in the 21st century is mistaken, or at least incomplete. The origins of a vast quantity of knowledge are to be found within well-established academia, in the work of communities of historians, scientists, mathematicians, and economists, to name just a few – intellectual communities that lie half-hidden to the lay person behind the institutions that distribute and interpret the output of knowledge. If we are to understand what it means to know, we will need to examine the **systematic production of knowledge** alongside the ways knowledge is commodified in society, and the human attributes we possess that are receptive to it and have the capacity to extend it in an astonishing variety of ways.

1.2 Theory of knowledge: the big picture

As you open the pages of this book, it is important to say something about the title of the course and what it is about. First, you should note that the name 'Theory of knowledge' (TOK) is not meant to imply that there is only one theory about knowledge and that you should learn it. *Theory* comes from the Greek word for *theatre* – a way of seeing something – so in this course you will be looking at and thinking about knowledge from many different angles, from many different perspectives.

All the parts of the course radiate out from these two central and related TOK questions:

- What does it mean to say that I, or we, have knowledge?
- What is the basis upon which this knowledge rests?

Nowhere in the syllabus do we consider these questions on their own, but we do so in one way or another in the following chapters. Although the fullest understanding of TOK occurs only with the experience of the required 100 hours of thoughtful discussion, it will help to give a summary as we begin.

- TOK is a course that examines the origins, nature, methods, and validity of various areas of knowledge and ways of knowing, and how they relate to one another.
- TOK is a critical reflection on what students claim to know as personal knowledge and what they and others profess from the standpoint of shared knowledge in various fields of study.
- This spirit of inquiry is meant to bring about more appreciative ways of looking at the areas of knowledge and the ways of knowing.
- TOK asks that teachers and students get a feel for how important questions are in understanding the world and what counts as a good answer. Both should help you realize that sometimes to ask a real question is to take a risk or to start a train of thought that leads to a long and winding road.
- There may not be one right answer to a TOK question, but there are standards for judgement in the expression and defence of the answers that are offered. And some answers are better than others.
- Your ability to form good TOK questions and to provide good answers to them will ultimately be assessed in an externally marked essay written on one of six prescribed titles, and in an internally assessed presentation to the class.

But more important than any definition or summary of TOK are the habits of mind and character formed in the student from the experience of reflection on how knowledge is constructed and applied to the world's problems. It is the intention of the IB that all of its Diploma Programme students acquire the intellectual honesty and powers of judgement which are characteristic of genuine thinkers, and that these defining features will be emblematic of your IB education.

Exercise

5 Based on what you have read so far, role-play with others a 30-second sound bite in which you respond to someone in a university admissions office, or a summer job interview, or your uncle asking you, 'What is TOK, anyway?'

However, to use the time-honoured method of ruling out, we also need to say what TOK is **not**.

- TOK is **not** meant to prepare you to study philosophy nor to master other people's thoughts even though you will probably hear about these thinkers from time to time.
- TOK is **not** a course in current affairs, a general studies course, or a rambling session on the meaning of life even though discussion can begin from any of these topics.
- TOK is **not** a course where a teacher needs to have qualifications in a particular subject or where teachers must be the overall experts and have the last word (even though they may prefer to be the 'sage on the stage'), so there might be a new kind of provocative exchange between teacher and student.
- TOK is **not** a course that will give you seven points, but it is foundational for every Diploma Programme student. In fact, it is the only course of study that every IB candidate must follow. You may not understand fully why this is so until several years later when you need to think and speak across subject areas, or take cultural differences into account when addressing global issues.

What is wrong with this picture?

The best TOK teachers are those who are themselves reflective or curious about knowledge claims and who admit that most of the time we live in a world with only degrees of certainty. Yet we continuously must make decisions – some trivial, some of great importance – about what to think and what to do.

More immediately, TOK will give you a capacity of mind and a skill that will soon become apparent and beneficial in your higher education as well as for years to come. Universities extol the virtues of TOK and students return to say it was the most helpful course for entering university even though they hadn't recognized it while they were sitting in their TOK classes week by week!

1.3 Theory of knowledge: the story

Imagine a group of idealistic men and women from several countries sitting around a table back in the 1960s asking, 'What should our young people know and be able to do by the time they graduate?' That's like asking, 'Why do we go to school?'

Now imagine yourself in a similar situation with a blank slate where you could design your own academic programme the way you can (up to a point) after you leave and move on to college and university. Would you include TOK? Before you could give an intelligent answer, you would have to know what it is, and what value it holds for you and for others.

It should be no surprise that the IB was born against the backdrop of the tumultuous decade of the 1960s, in which revolutionary ideas flourished and many societies underwent significant changes. And even though educational debates might lack the drama of the other movements of that era, there were radical notions at play in those early IB meetings. After all, those visionary pioneers were turning their backs on their own country's school systems in favour of an idealistic programme linked to world peace through international awareness, even compassion, and the highest academic rigour all of which was meant to be recognized by the best institutions of higher learning around the world (Figure 1.1).

But first the reformers needed a curriculum and an examination system independent of any particular culture or nation. The initial choices went smoothly. Because a mother tongue and a second language were obvious for an international diploma,

Pragmatic value ⟷ **Idealistic value**

the best education for a mobile student population | the best education for a better world

Figure 1.1 An idealistic programme of education

that was an easy decision. Next they quickly agreed on the need for science and mathematics; then at least one of several humanities or social science courses; and, finally, the arts was the finishing touch of a broad and balanced curriculum. And to make the IB a distinctive programme, rather than just a collection of courses – as was the case with the British A and O levels and the American Advanced Placements courses – the extended essay and CAS were added. Yet, to bring it all together, it was also crucial that there should be one academic course, a keystone course of study that unified the IB Diploma. But what should it be? History, poetry, music, global studies?

Exercises

6 Many students find it hard to realize that they can gain the IB Diploma without taking history over their two years of study. Why do you think this is so? What problems would be involved in mandating history as the central course for the IB? What does this say about the status of history as a subject?

7 But think again. History is singled out in the IB as one of the eight areas of knowledge and not folded into the human sciences. What does this say about the status of history? These are important TOK questions.

International agreements are not easy to reach. This reality emerged with the French insisting that every student should take philosophy and the British strongly vetoing the idea. The dispute was protracted but both sides at last seized on the idea that every diploma candidate should follow a course, not in philosophy as such, but in critical thinking based on the student's education to date. Thus, typical TOK questions include the following.

- What is distinctive about the knowledge produced by the sciences?
- On what bases can judgements about art be agreed?
- How are historical reports reliable?
- What is good evidence?
- Is there such a thing as an ethical fact?
- When do your feelings count as knowledge?

So, finally, TOK became the great compromise, and the basic design of the IB Diploma was complete. The last, as it were, became first, since today TOK is hailed as a unique feature of the IB programme and widely emulated by national schools for the quality of thought that it generates about the purpose, methodology, and findings of each discipline or field of study.

With TOK it was hoped that IB Diploma holders would not only gain a thoughtful awareness of the shared knowledge that the various disciplines codified about the world – to which students are exposed through their various courses – but also the way knowledge 'works in the world' and how it contributes to the perspectives held by individuals and groups.

Alec Peterson, pioneer of TOK, one of the founding fathers of the IB, its first Director General, and TOK teacher, saw three of the key aims of the course as counteracting specific weaknesses of many upper secondary schools.

1 **The failure to make explicit in the minds of students the different forms which academic learning and knowledge take.** TOK heightens the awareness of the various disciplines and fields of study by organizing the course around what are called areas of knowledge and ways of knowing.
2 **The tendency for students to study their different subjects in watertight compartments**. TOK reveals how multiple perspectives may be brought to bear on a single problem by relating science or history to art, or to make connections between literature and the human sciences.
3 **The opportunity to understand the virtues and limitations of their education to date and to relate it to ordinary experience.** TOK asks that student bring their learning both in and outside the classroom to critical light as a way to make integrated sense of their school life.

What mattered to Peterson was not the absorption and regurgitation of facts, but the development of powers of the mind or ways of thinking that can be applied to new facts and new situations as they arise. Thus, the definition of an educated person is someone who knows how to apply knowledge of many kinds to novel situations for which there are no ready-made answers.

Exercise

8 Suppose you were head of an international committee searching for a solution to the problem of AIDS in your country. How many representatives of how many disciplines should you invite to the conference table? Would you want them to be International Baccalaureate alumni?

As is true with many historical perspectives, the early days of the IB programme look simpler from our viewpoint. There are currently dozens of courses on offer, an expansion of student response languages to include English, French, Spanish, German, and Chinese. There is Language A instruction in numerous languages, and courses ranging from well-known traditional disciplines such as physics, history, mathematics, and economics, to design technology, information technology in a global society, environmental systems and societies, world religions, and many more. But the core of the Diploma programme continues to comprise CAS, extended essay and TOK – all iconic of what has come to be seen as the finest international education in the world.

1.4 International mindedness

The IB is now nearly 50 years old. And yet in this relatively short time it has gained the respect of the best colleges and universities in the world for its academic rigour, generality, and depth – three qualities not easy to bring together.

But, as IB students and teachers, we have an additional challenge. We must pay as much attention to the *international* part of our name as to the *baccalaureate,* the academic. This responsibility is paramount despite the fact that most schools and most students, it must be admitted, are concerned primarily with the 'B' of the IB, its academic side, in order to gain admission to the best colleges and universities.

Yet, it is not surprising that the IB has found the task of meeting its international ideals to be a complex one, even as its membership spreads to over 3400 schools in 145 countries. First of all, there is the semantic difficulty of defining what is an international education. What makes an organization international? What makes a school international? What makes a syllabus or a classroom or an exam international? Do we know it when we see it, or do we know through intuition or analysis? This is a good TOK question in itself, and one that ought to be kept in mind as the pages of this book are turned. How many answers to this question are acceptable? Over the years, the following have been put forward as features of international education:

- a diverse student body
- a diverse faculty
- a myriad of feasts and festivals
- second and third language requirements
- a foreign exchange programme
- global studies.

All of these qualities are worthy but, on their own, they do not produce young people who have learned to see through the eyes and hearts and minds of others. Nor do such bits and pieces of education totally prepare you for a world where current geographic and political boundaries and economic assumptions are being replaced by new realities, and where values, sometimes not your own (whatever they may be), are central to all decisions of global significance.

Yet, the concept of an international or a global education is not new. Are the terms *international* and *global* synonymous? Read the passage below by Michel de Montaigne, writing in 1572:

> “Mixing with the world has a marvelously clarifying effect on judgement. We are all confined and pent up within ourselves and our sight has contracted to the length of our noses. When someone asked Socrates of what country he was, he did not reply, of Athens, but of the world. This great world … is the mirror into which we must look if we are to behold ourselves from the proper standpoint.”

Montaigne, trs. Cotton, 1580

International education did not catch on in the 16th century, and Montaigne may have been well before his time when he put his finger on the need to regard ourselves as members of groups that stretch well beyond what may be our own 'comfort zones'. But in recognition of the importance of this dimension to the IB mission, the organization has responded by drawing up a learner profile, expressed in terms of an IB community that should apply to all who are involved in the business of international education. In brief, IB learners should strive to be 'internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world'. They would do this through the adoption of the attributes in Figure 1.2 (overleaf).

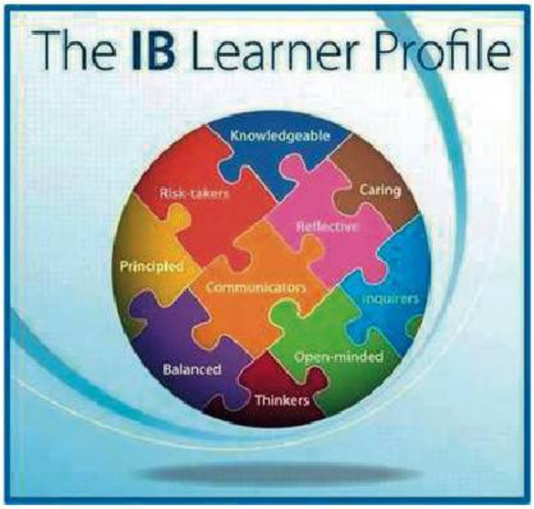
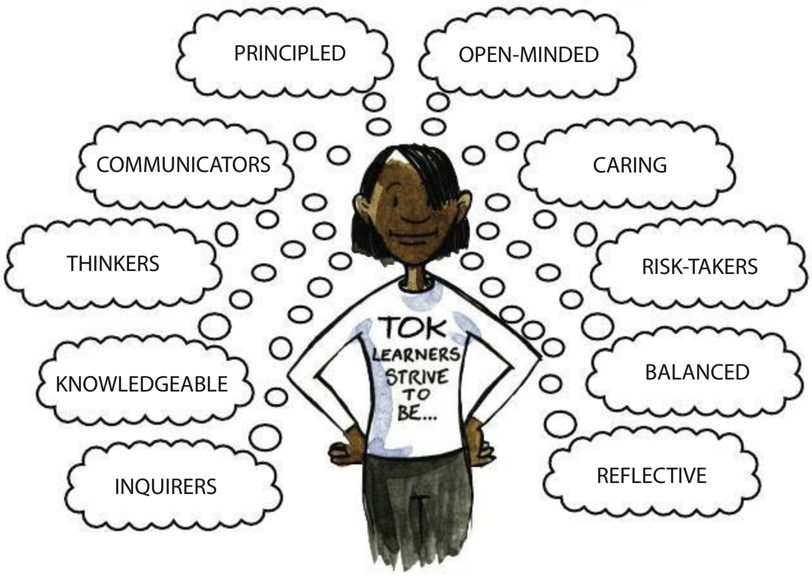


Figure 1.2 Attributes of IB learners.



What's *your* learner profile?

Are these features familiar or even clear to you? Can you identify them when you see them? Can you recognize them in yourself or in the groups to which you belong? How many have you noticed since breakfast this morning? What are their opposites? Ignorant? Closed-minded? Selfish? Apathetic? Extremist? What else?

Let's try to apply these ideals of the learner profile to the TOK student.

- **Inquirers** – We as TOK knowers seek to be learners who can work both independently and with others. Inquiry is the flame that lights our intellectual journey as we explore the various ways of finding out about the world.
- **Knowledgeable** – We as TOK knowers acquire an understanding of knowledge at a conceptual level across disciplines. We connect this knowledge with issues and ideas that have local and global significance.
- **Thinkers** – We as TOK knowers seek to reach reasoned and ethical decisions using critical and creative thinking skills. We are receptive to the knowledge of the disciplines, yet we maintain a healthy scepticism about absolute truths.
- **Communicators** – We as TOK knowers often take a collaborative approach to knowledge. We are able to use the vocabulary of the TOK programme to make comparisons and contrasts across areas of knowledge and ways of knowing.

- **Principled** – We as TOK knowers demonstrate a respect for the perspectives of diverse individuals and groups on the basis of integrity and honesty. We uphold fairness and justice as important concepts in decision-making.
- **Open-minded** – We as TOK knowers develop the habits of mind that come from an appreciation of the perspectives and values of groups other than our own. Yet we retain a critical appreciation of our personal and cultural traditions and values.
- **Caring** – We as TOK knowers seek the habits of heart and mind that nurture a sense of compassion and empathy towards others and towards the environment. We understand that knowledge can have an emotional component.
- **Risk-takers (or courageous)** – We as TOK knowers approach uncertainty with confidence. We engage courageously in the challenge of unfamiliar academic territory with a readiness to learn new ideas and strategies.
- **Balanced** – We as TOK knowers understand the importance of balancing the intellectual aspect of our lives with the physical, spiritual, and emotional in order to achieve well-being for ourselves and others.
- **Reflective** – We as TOK knowers are aware of ourselves as possessors of knowledge. We are conscious of the power of self-evaluation in measuring the strengths and limitations of what we know and how it should be used.

Exercises

9 How does the prospect of upholding these attributes and values strike you at the beginning of your TOK journey?

10 Could you identify your own TOK learner profile and create a bar chart of your prominent attributes?

11 You may think that the learner profile is only about students, but it was fairly clear that the framers of the learner profile meant teachers too. They are also meant to exhibit such qualities. Can you find your teacher in this list?

But even more astounding – to the degree that we have these qualities, we are *ipso facto* internationally minded. That bears some thinking about. It doesn't just say if you have a multicultural faculty or classroom, or if you teach this and that in your programme, or if everyone knows two or three languages, or if you celebrate Taco Tuesday, that you have achieved international mindedness. But by logical extension, it *does* say that schools in Denver, Colorado; Copenhagen, Denmark; Santiago, Chile; Jakarta, Indonesia; or Abu Dhabi, United Arab Emirates with largely local populations can be *internationally minded* as much as a United World College with 80 different nationalities. How can this be?

Exercise

12 What would be your opinion about this breakaway definition of internationalism if challenged? Could you defend a view about the value of international mindedness to the more parochial or xenophobic groups you encounter?

Is international mindedness as a way of being in the world impossible? Not at all. Idealistic? Certainly. But we need our ideals in this young organization whose future is brighter than its history is long. (Fifty may seem old to you, but think about it on a history timeline and you can see that it is still new and still innovative.) We have to keep saying over and over what we are about – to remind ourselves of our ideals. In a way, an educational programme is a movement suffused with ideals and values. You have joined this movement consciously or not. And any movement needs many voices. The IB needs your voices for a better world.

Exercise

13 Have you any notion of the philosophy or mission of the IB or have you signed up only for your own purposes? Does the notion of an educational movement seem strange to you? How is the idealism of the IB in its pioneer days still vibrant?

The IB mission statement

"The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.

These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right."

But in order to become part of a working international community and to be glad of it – not just words on the school bulletin board – an IB education, and by implication the TOK course, must include activities and ideas that encourage awareness of and commitment to the solutions to global problems of a cast and character possibly widely different from what we can now imagine as our own.

In a real sense, then, you have the whole world in your hands. We are asked to think today and tomorrow and on and on about how our teaching and learning can be relevant to issues of global significance that you face now, and others that we and you can see only dimly, if at all. You know the list – war, environment, poverty, terror, energy, global warming, and so on. It's a long list. It touches us all. But it is you who can dispel indifference and ignorance; it is you who can broaden horizons. It is you who can find unity in diversity, hear its message, and sound its echo. We teach. We make a difference. You learn. You can make that difference happen. TOK will go far to prepare you. This book is one of the steps in this hopefulness.

1.5 How to use this book

In this book, authored by experienced TOK teachers, we have set out several organizing principles and metaphors to illuminate the construction of knowledge and to help you understand and appreciate what a rich, complex, variable, and difficult process it is to separate the best we can know from the dross all around us. As a start, we list here the fundamental TOK themes and concepts in an introductory way. The chapters to follow are dedicated to their expansion.

Concepts of shared and personal knowledge

We live in a world overflowing with knowledge, a great deal of which is organized into academic disciplines. Much of this knowledge is, at least in principle, available to us if only we had the time and the inclination to explore and acquire it. The many demands in our lives and the brute fact of our mortality dictate that we will come into contact with only a small fraction of this shared knowledge, although even that fraction will exert a profound influence on each of us. What we do succeed in extracting from this reservoir, together with much of what we know about ourselves and what we know how to do constitute our personal knowledge. Each day in your life is an adventure in interaction between these two domains, and the arc of the book to some extent takes us from personal to shared and back to personal again (Figure 1.3).

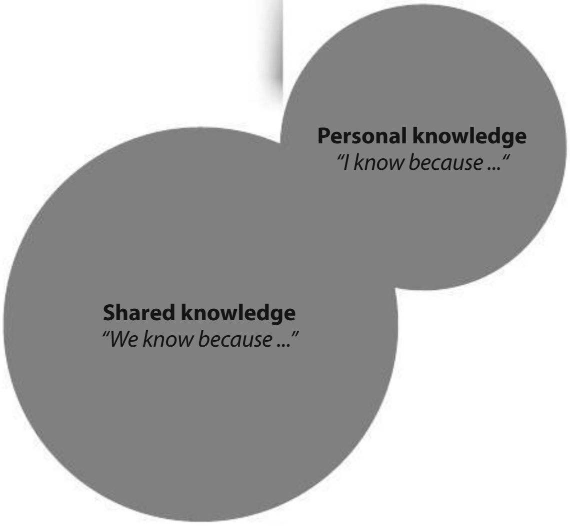


Figure 1.3 Shared and personal knowledge.

Areas of knowledge

For the purposes of TOK, the academic disciplines are organized according to relationships between them. Sometimes the similarities prevail and we get a group of disciplines; sometimes the differences dominate and the discipline retains its independence. The overall result is eight areas of knowledge: the natural sciences, the human sciences, mathematics, history, the arts, ethics, religious knowledge systems, and indigenous knowledge systems. These areas are explored in depth in eight consecutive chapters of this book – Chapters 4 to 11. In your TOK course, it is expected that you will study six of these areas.

A knowledge framework

A primary concern of TOK is the comparison of different areas of knowledge so as to explore such aspects of them as their scope and applications, the key concepts and methods that they use, how their development might have influenced their nature, and the roles of individuals and communities in how they produce knowledge. To make this task clearer and more rigorous, this book uses a tool called the knowledge framework. This is introduced in Chapter 3, and provides the structure for the subsequent chapters on specific areas of knowledge.

Ways of knowing

Underlying the methodology of the areas of knowledge and also providing a basis for personal knowledge, eight ways of knowing are presented in TOK. These can be regarded as tools for the acquisition of knowledge, or perhaps attributes that define to some extent the nature of being human. They are:

- sense perception
- reason
- language
- emotion
- imagination
- intuition
- memory
- faith.

Your course will probably focus on four of these eight in depth, although it is likely that all of them will get a mention at some point. This is partly because these ways of knowing work together rather than in glorious isolation. All of the ways of knowing are introduced in Chapter 2, and they will make appearances throughout the rest of the book – particularly in the return to the relationship between shared and personal knowledge in Chapter 12.

Metaphors

Also, running throughout the chapters are a couple of metaphors:

- knowledge as a map
- disciplines as cultures.

These are discussed in greater length in Chapter 3 and thereafter.

Knowledge as a map

As maps usually have practical purposes, the idea of knowledge as a map representing some aspect of reality helps us to think of knowledge as the attempted solution to some problem, or the answer to some question. The fact that a map cannot ever be exactly the same as the territory it represents, and may be modified according to the purpose for which it is to be used, also encourages us to think of knowledge in terms of whether it is 'fit for purpose'.

Disciplines as cultures

Outside the classroom and the university halls and laboratories, men and women on TV news and talk shows, in criminal and civil trials, in popular and professional publications, often identify themselves as belonging to a particular field of study or research. They have spent years gaining credentials within their disciplines to mark them as specialists from whom the public can learn. As individuals they have contributed to these shared knowledge fields, and, in turn, they learn from the others in their community of knowers. This reciprocity is part of what makes these disciplines dynamic.

It is crucial to your success in TOK that you understand what a discipline means, since the course is organized, in large part, around the areas of knowledge. In order to get a feel for what a discipline is in reality, it may help to think of it metaphorically as a culture. That is, a discipline is constituted by its practitioners as well as its shared norms and body of knowledge. And if we think of a discipline as a social group, there will be leaders and followers and cliques all performing their scholarly work according to well understood written and unwritten rules, acquiring knowledge, explaining it, and defending it (disputes within a discipline are endless). While there is always a body of core knowledge that is accepted within any discipline, there are also people working at the cutting edge of research, thinking new thoughts, debating the issues of the day, and publishing their work in the magazines or periodicals associated with each field of study.

Knowledge questions

The key activities of TOK are the formulation and answering of questions about knowledge. For example, we might ask the following questions.

- To what extent is disagreement a vital part of scientific methods?
- How important is the role of imagination in the production of knowledge?

- What counts as evidence, and to what extent does this vary across areas of knowledge?
- Is artistic knowledge a form of knowledge that cannot be expressed in any other way?
- What knowledge is completely independent of ethical responsibilities?

What is important to remember about knowledge questions is that they ask directly about the nature of knowledge, are open to the extent that different answers could plausibly be offered, and are framed using the kind of vocabulary and concepts that relate directly to the TOK course. They are also general enough to permit a variety of examples to be employed in responding to them (Figure 1.4).

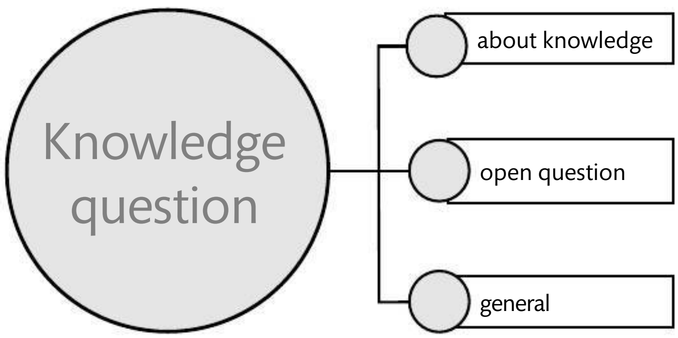


Figure 1.4 Structure of a knowledge question.

Such questions may seem mind-boggling when encountered in the abstract, but the themes and concepts presented above are designed to 'domesticate' them, and the chapters that follow will provide reassurance by offering examples of them in context and, in some cases, setting out responses.

Assessment

Chapter 13 discusses assessment and is of immense importance for both student and teacher in coming to understand how to achieve the highest standing for the highest quality of effort on the part of everyone involved.

This book represents a both a journey and a narrative arc for you to follow (Figure 1.5)

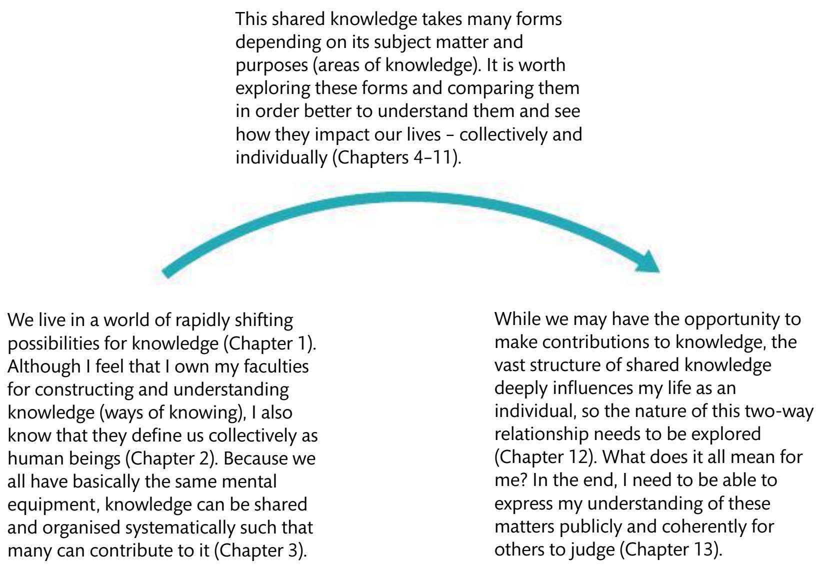


Figure 1.5 The TOK journey.

Printed, online, and electronic materials

This book is available in print and eText. The eText version can be accessed by going to the Pearson eText homepage and using your login details. The print version does not contain the bibliography, but this is available on the eText. Answers to some of the mathematics questions in Chapter 6 are also available on the eText.

Throughout this book are scattered a number of margin boxes with suggestions for internet research and advising weblinks to get you started.

You will also find many in-text exercises and a number of Prescribed Essay titles and practice essay titles. It is intended that you should attempt the exercises as you come to them in the book, and that you carefully consider your responses to essay titles also as and when you come to them in your reading.

A note about dates

Within this book, we use the common era / before common era (CE / BCE) system of dating. However, some dates in quotations use the AD / BC system. Don't let this confuse you, simply substitute CE for AD, or BCE for BC.

1.6 The TOK ideal knower

Students come to us at the beginning of the year having studied something of great human significance in art, literature, the sciences, maths, and history – a range of subjects. Experience is then deepened with the exposure to new, challenging, and relevant ideas from other disciplines, other groups, or a voice not previously heard. They internalize a feeling for more than one way of seeing the world. They find their voices in discussion with others. They know the limitations of any single voice. They are immersed in a community of intercultural and interdisciplinary thought. They have begun to master the skills of integrating these diverse perspectives because they know what counts as a good question and the beginning of a good answer. And they know that a question can be asked with admiration and awe as well as from challenge and confrontation. They are comfortable with ambiguity and prepared to live in a world of uncertainty. They sense when action or restraint in judgement is called for. They are comfortable in disagreement and poised in conflict.

This is our splendid instance, a portrait of a young person with empathy, with openness to growth, glad for the stimulation of new ideas, and with an appreciation of differences. All of this has become part of their instinctive response to novel situations. They are ready to take the next step. They are ready to graduate.

02 Ways of knowing

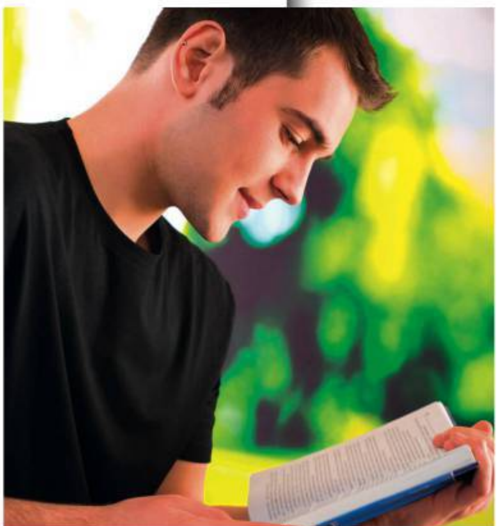
On previous page – How do we decide which path to take when faced with several options? Do we resort to intuition or reason?

2.1 Introduction to ways of knowing

What do we mean by 'ways of knowing'?

Think for a few moments about what is going on as you open this page. As you've done so many times before, you perform the act of reading with eye movements following marks on the paper in a conventional sequence. Light reflected from the marks enters your eyes, is then converted (transduced) into signals that reach your brain. You generate meaning from the encoded electrochemical trace of the marks, using learned associations between the marks and corresponding thoughts (and sounds). You trust that these sequences of meanings bear some similarity to those intended by the authors. The speed with which all of this takes place, and the depth of concentration which you bring to it, may be affected by what has happened to you in the recent past and your feelings about those events, including what is going on around you right now.

Reading is not a simple matter.



Presented in this form, your success in reading and understanding this page seems an astonishing achievement – almost miraculous. And this task is just one of many that we perform every day – think about listening to music or cooking a dinner. In order just to begin to understand what is going on, it is tempting to break this complexity down into elements, which in the TOK course we call 'ways of knowing' (WOKs). Let's see how helpful it might be to try to work out which aspects of the description in the previous paragraph could be matched with the WOKs in Table 2.1.

Identifying ways of knowing

Exercise

1 Try completing Table 2.1.

Table 2.1 Reading and WOKs.

WOKs	Aspects of reading
Language	
Sense perception	
Reason	
Emotion	
Intuition	
Memory	
Imagination	
Faith	

- How many of the WOKs did you manage to trace back into the account of reading the book?
- What difficulties emerged with this task?

One problem that you probably identified was that in some cases it is difficult to see where one WOK stops and another starts. For example, the act of *sense perception* is closely bound up with previous experiences stored in *memory*. *Reason* has a role in the construction and comprehension of *language*, which often relies on the *imagination* of the reader to 'fill in the blanks.' Completing Exercise 1 might have been facilitated by a recognition of its value (*emotion*) and underneath it all, perhaps, was an act of *faith* that you were doing it all in the right way. Was *intuition* left out? Maybe yes, maybe no: it is not easy to sort out the WOKs into individual elements because they work seamlessly together most of the time in real life.

It's not too difficult to see from this example how the WOKs whirr away in our minds – simultaneously, interdependently, often working together, sometimes in tension or opposition with one another. How hard-pressed we would be to turn them off!

CHALLENGE YOURSELF

Most TOK students are on the cusp of driving a car on their own, thinking about it or taking instruction. Make a list of the WOKs going on (perhaps sub-consciously) as you drive your family car for the first time to the airport to pick up your mother.

Ways of knowing as tools

Broadly speaking, WOKs are mental faculties that play a role in our coming to know all that we as individuals know or think we know on the personal level (Figure 2.1).

> "We know ourselves as individuals, but we also know that what goes on inside ourselves is almost exactly what goes on inside everyone else. We recognize the whole of the human race within ourselves."
>
> Bronowski, 1979

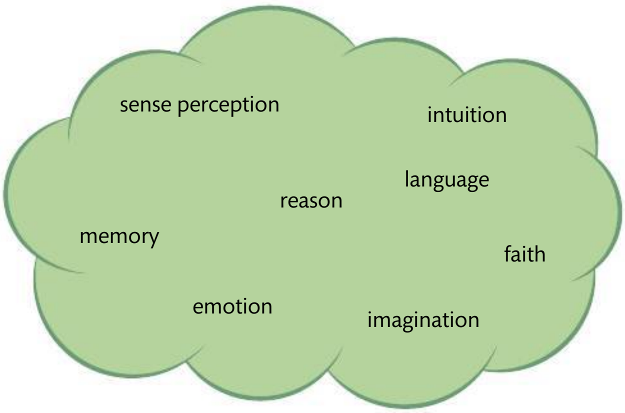


Figure 2.1 Eight WOKs.

In another sense, WOKs are part of our identity as humans – members of a species that constructs shared knowledge. The similarity of what goes on inside us all greatly enhances the prospects for shared knowledge. Knowledge of a propositional nature can be shared through the same language community, while an even wider pool of knowledge results from the common ways in which we as seekers of knowledge approach the processes of finding it out and sharing it with others. Figure 2.2 is intended to promote a consideration

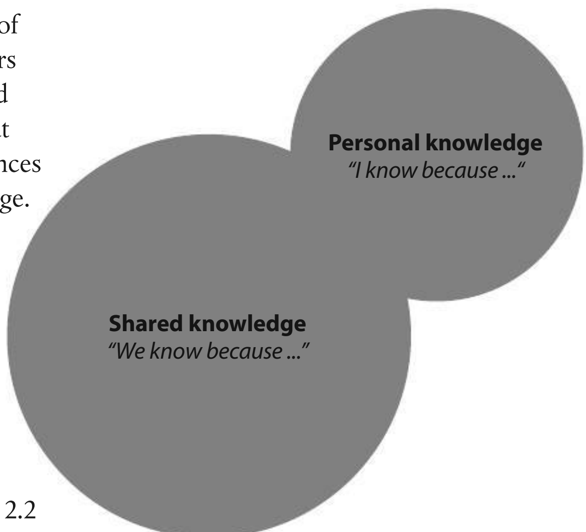


Figure 2.2 Personal and shared knowledge.

of 'what I know as an individual' and 'what we know in groups' that may be as wide as humanity itself.

As most knowledge is shared – often in highly organized and systematic ways – so in this book there are many chapters in which consideration is given to how WOKs contribute to the knowledge of the disciplines. In addition, the knowledge framework discussed in Chapter 3 features methods as one of its organizing principles. For instance, despite the fact that many WOKs work together in any discipline, perception is fundamental to the empirical sciences, reasoning to mathematics, language to literature, and imagination to visual representation in painting, and so on. Shared and personal knowledge is discussed in more detail in Chapter 12.

So, recalling the car-driving example in 'Challenge Yourself' from the previous page, and thinking in terms of the way shared and personal knowledge are interwoven, we can see that the WOKs function together dynamically. A dynamic that, for instance, led to the invention of the car, then to the automobile industry and continues today in the search for new fuels and new designs: personal to shared, shared to personal. In fact, it seems almost impossible to make sense of this kaleidoscope of skills and shared methods and knowledge that might build an enterprise, such as Toyota or a monumental Gothic cathedral, without the simplicity of a Venn-like diagram such as Figure 2.2 to help us conceive of how the areas of knowledge and the WOKs merge with one another.

What are the ways of knowing?

For our purposes in this book, we can list the WOKs as:

- language
- sense perception
- reason
- emotion
- intuition
- memory
- imagination
- faith.

Without getting into whether babies are born with these WOKs (innate) or acquire them from experience (blank slate), we will use this chapter to look at the WOKs individually, just as we will look at the areas of knowledge separately, even though we know that there is more and more overlap among the disciplines.

2.2 Language as a way of knowing

It is not easy to stand back from something so tightly woven into our lives as language, or to use language to talk about language. In more general terms, *how do we use the WOKs to understand WOKs?*

The power of language

Not too many years ago, IB students were asked to write an essay on Jean Paul Sartre's quotation, *Words are more treacherous and powerful than we think*. It was a popular topic and touched a nerve for many who remembered being called names in derision or, more happily, swooning over sweet talk; or watching charismatic leaders sway the public; or confusing the word with the thing in advertising (and elsewhere), thereby giving

spurious validity to things that have no real meaning but plenty of emotional heat. Examples and anecdotes abounded in those essays, but the weaker students stopped there without giving attention to the final clause 'than we think'. Yet we need to give attention to language as a WOK that communicates our thoughts to others *and* that itself shapes those thoughts that are part of the knowledge-making activity of each person.

But language isn't everything. Let's pick up again our thoughts about driving a car.

It is almost impossible for you to tell someone how to navigate safely at high speed. That skill – itself learned only partially through language – is a form of **tacit** knowledge that is shown rather than said. We will talk more about knowledge that escapes formal description in later chapters, but for now it is enough to say that tacit knowledge can be found in something as simple as a hunch, an intuition, a creative or religious thought, or any number of performative acts that give meaning to Michael Polyani's famous dictum, *I know more than I can say*.

Yet if we are to use language as a WOK, then at the very least language must be accurate.

This virtue was recognized as long ago as 500 BCE by Confucius in the *Rectification of names* where he lamented the careless way the ancient Chinese spoke about important matters. Here is a modern version of his views from the poem *Mokusatsu* by Heathcote Williams. In the poem, it is alleged that the ambiguity of the Japanese term, *mokusatsu*, meaning either 'no comment' or 'treat with silent contempt', was a contributing factor to the bombing of Hiroshima where thousands of people 'stood about in helpless confusion' and were burned to death in the atomic explosion.

> “Asked what he would undertake first,
> Were he called upon to rule a nation,
> Confucius replied: 'To correct language …
> If language is not correct,
> Then what is said is not what is meant,
> Then what ought to be done remains undone;
> If this remains undone, morals and art will deteriorate;
> If morals and art deteriorate, justice will go astray;
> If justice goes astray,
> The people will stand about in helpless confusion.
> Hence there must be no arbitrariness in what is said.
> This matters above everything.'”

Williams, 1988

This may be a far cry from the casualness with which most of us conduct our conversations, but the accuracy of terms and their context in conveying reality certainly bears thinking about.

Exercise

2 What steps would you suggest to move towards Confucius's goal 'to correct language'? Is 'accuracy' of language a virtue for you?

If language is as potent as the poem suggests, then there is surely no surprise in the grandness of the claims that language:

- forms our sense of self-awareness and of time and place
- develops our memory and imagination
- shapes our culture and influences our perceptions
- reveals our identities as persons and members of a community.

Only some of these claims are examined here, but they are good material for TOK presentations.

Knowledge question

1 Do you believe the maxim 'you are as you speak'? Does this mean the same thing as 'ye shall know him by his word?'

Helen Keller (1880–1968).

Language and thought

One of the open questions about language is the link between language and thought. We have only to think of the amazing life story of Helen Keller, a deaf and blind girl in Georgia, USA, to begin to realize the difference language can make. For nearly 12 years Keller lived in a frightening world of darkness, silence, and chaotic emotions until her governess, Ann Sullivan, gave her the power of naming her world by tapping on her hand. Tap, tap, tap = water = the thing you feel pouring over your skin. And on and on from there.

While we are taught today that the word is not the thing and the map is not the territory, for Helen Keller it was finding an identity between word and object that broke open the floodgates to a reality not previously comprehended. Words and things became connected for her. Can we even imagine this breakthrough when we have picked up language so effortlessly from our first moments of infancy?

An interesting analogy is given to us by Jiddu Krishnamurti (1895–1986), the Indian philosopher, in conversation with Dr Allen W Anderson in San Diego, California:

> “… the description is not the described … it is like a man who is hungry. Any amount of description of the right kind of food will never satisfy him. He is hungry, he wants food.”
>
> Krishnamurti, 1974

There are numerous well-documented stories of those without language from infancy to middle age who nevertheless have sophisticated mental lives dealing with abstract notions of time, space, number and causality as set out in Steven Pinker's book, *The Language Instinct: How the Mind Creates Language*. So it is an open question as to whether or not we would have thoughts if we had no language.

Exercise

3 Would you accept, as some people claim, that the limits of your language are the limits of your world? Try to rephrase this proposition in different ways, then figure out its implications. For example, if the limits of my language are the limits of the world, does that mean that if I had no language, I would have no sense of self? That if I had no language, I would have no memory?

Does this exercise imply that you would not know pain, fear, beauty or love if you did not have those words?

What do you think of this poem, *Stefan*, by PK Page?

"Stefan
Aged eleven
Looked at the baby and said
When he thinks it must be pure thought
Because he hasn't any words yet
And we
Proud parents
Admiring friends
Who had looked at the baby
Looked at the baby again."

What's in a name?

How much better we feel when we can name something. Some people will not eat a food, no matter how appealing, if they cannot name it. In medicine, we want names for our illnesses as well as names for our treatments. In schools we name the constellations, the continents, the countries, and the cities. Little children name the parts of their bodies: the nose, the eyes, the head, and hands often in nursery rhymes. Adults name stamps, rocks, antiques, and cars, then collect them into categories and name those classifications. In life, we run after names sometimes frantically wanting a label such as beautiful, smart or rich, or wanting to avoid the stigma of stupid, ugly or poor. Words can never hurt you? Think again. They are saturated with meaning.

Here are several answers to the question, what is a language?

1 Words and their combinations used in a conventional system to convey thoughts and feelings.
2 The use of signs and symbols in a structured and conventional way to convey a variety of meanings over time and space.
3 A set of social conventions developed to share life experiences and move others to action.

Do any of them click with you? Is one better than another? Using any one of them, could a dog communicate with you? Could a house? Could the ocean? Could you communicate with them?

Communication and language as social

Communication, in contrast to expression, is always social, and is an event that must involve at least three elements: two people (perhaps you and someone else) and language. With only you in the picture, you are expressing something but not communicating. Yet with the appearance of another person, you are trying to communicate your ideas or feelings, to reach a meeting of minds, so to speak. Whenever two people are gathered together … they talk.

Chapter 3 discusses the idea of a knowledge framework and refers to the language and concepts related to each discipline (mathematics, natural science, human science, ethics, art, history). Part of what you will find there is a vocabulary for talking about art; another for history, and so on. This is because a common language connects the members of a single community into an information-sharing network. It is scarcely possible to imagine professional life without this shared vocabulary and the shared understanding of concepts central to any area of knowledge.

If you have a condition called aphasia, you can no longer speak, read or write. You have lost your identity and your family feels like they have lost you.

Language shapes and preserves cultural values as well as professional ones through habitual forms of speech. Consider the example of endearments or honorifics between people, in particular the way an elder brother in the Philippines is addressed as 'kuya' in place of his given name. This usage reminds both the user and the brother of his special place together with his responsibilities to his younger siblings, and the respect he deserves from them. Conversely, in the 1960s in the UK and the USA (and possibly elsewhere) some parents urged their children to call them by their first names rather than Mum or Dad, as a sign of rejection of bourgeois values linked to forms of discourse. Perhaps language embeds values as much as it communicates ideas.

Although it is not part of our TOK list of WOKs, one of the most obvious, and one that depends heavily on language is authority. Most of what we know comes from other people and resources: family, teachers, friends, experts, TV, books, and so on. The Internet as a resource perhaps now outweighs all other sources combined. We simply do not have time to gain all of what we need to know directly for ourselves. And as students we are susceptible to a teacher's influence by tone, selection, and emphasis. Many subjects are taught with an aura of gospel and infallibility. This kind of influence continues into adulthood as we select our reading material, our TV political broadcasts, our educational programmes, and websites for our information. These offerings are called 'mediated' knowledge because others have vetted them and they are not experienced directly (or immediately) by ourselves. *How do you know that?* someone might ask. *They said so*, you reply. How many *theys* are there in your world?

Exercise

4 Take one of the pieces of common knowledge listed below and explore the extent to which it is based on what others have told you. Is there any personal knowledge you have that is not influenced by the shared knowledge of a community of knowers?

- Everything consists of atoms.
- The burial place of King Tutankhamen is in the Valley of the Kings in Egypt.
- JK Rowling wrote the 'Harry Potter' books.
- The Earth is round.
- Indonesia has more Muslims than any other country in the world.
- Eating too much fat is unhealthy.
- In the middle of Australia is a large outcrop called Uluru (once known as Ayer's Rock).
- Bees do a little dance to give directions to the best flowers.

To stand on the shoulders of authorities is a great convenience; indeed, it is a blessing, since how much could we learn or prove all on our own? So it follows that we all become knowers by being nurtured within a community of people who tell us things, which is part of what is meant by shared knowledge.

2.3 Sense perception as a way of knowing

> “A popular and understandable notion about perception goes something like this: you open your eyes and – presto! – you enjoy a richly detailed picture-like experience of the world, one that represents people and things in sharp focus, uniform detail and high resolution from the center out to the periphery. Let us call this the snapshot idea of sense experience.”
>
> Noë, 2004

People who study perception, whether in the arts, in psychology or in philosophy, usually take their start from the snapshot model. But then the puzzle we all face is, how do we enjoy such a visual experience when our direct contact with the world is in the form of limited information on the retina? The limitations are sometimes set out this way: there are two retinal images, one in each eye; the images are distorted, tiny and upside-down; the resolving power of the eye is weak; the retina is nearly colour-blind and its powers of discrimination are few.

There's more to seeing than meets the eye.

Have you ever watched a jittery video made with a hand-held camera that made you almost dizzy? With our eyes constantly darting back and forth, and our body hardly ever holding still, that is exactly what our brain is faced with in the process of perception. Yet despite the alternating snapshots and grey-outs, we usually perceive our environment as perfectly stable. This is the problem faced by visual theory: how do we see so much on the basis of so little? There are knowledge issues and implications for daily life attached to this question, which we will explore in the following pages.

Five senses or more?

Traditionally, we think about our perception as being linked to the five senses of sight, hearing, taste, smell, and touch, with sight being privileged among the five. After all, well over half of the input to our brains concerns this one sense. But who is this *we*? Clifford Gertz, the late anthropologist, reports that the Javanese classify their five senses as seeing, hearing, smelling, feeling, and **talking.** Yet a fuller picture even of the first description shows us that the **sensorium** of most people includes the kinaesthetic

CHALLENGE YOURSELF

Sensorium? Does anyone know what this means? One student thought this previously unheard-of word sounded almost musical, and created a tone-poem to describe the multitude of ways that we sense the world. She started with the top five – sight, sound, touch, taste, and smell – and moved on to a full ‘panoply’ (her word) of senses including some that were fantasies shared only with exotic animals.

sense of movement (we can find our hand with our eyes closed), the vestibular sense of balance, and various senses of hunger and thirst, and more.

Sight as privileged

Students often say they would give up any other sense before sight, but consider that without touch we couldn't move at all. Indeed touch must surely have been our primary sense, as our skin rubbed along the birth canal and we were brought into the world by the hands of whoever delivered us. The sense of smell is also lower on the hierarchical pole according to informal polls, with few metaphorical words beyond 'I smell danger' to indicate its wider value beyond sorting out the odours of the world. Yet the olfactory sensors have a shorter, straighter route to the brain where, in the cortex, they are linked to emotional responses we describe as pleasure or disgust, as well as to the sense of taste and our memory centres. So while we cherish and protect our astonishing powers of sight, it could be argued that the less-prized senses of touch, taste, and smell have greater survival value.

Also of interest is the astonishing variety of sensory apparatus in the animal world, the consequences of which are huge. Consider how much escapes our human detection (we cannot see certain things without the aid of ultra-violet or infrared light) despite our satisfying visual snapshots.

Proxies for the senses

While, unlike the bees, we do not have bellies that detect the magnetic field, nor, like pigeons, are we able to see 340 degrees with lateral eyes, our experimental minds have come up with technology that captures much of the world that otherwise would be beyond our reach. The microscope, the telescope, sonar imaging, and robotics are just a few of the long list of perception proxies.

For example, we learned from multiple news sources in March 2013 that data from the Planck satellite was used to create a map showing the distribution of the earliest light in the universe. The map is thought to confirm the Big Bang theory and puts the age of the universe now at approximately 13.8 billion years. But the new data raises as many questions as it answers.

Yet, by definition, whatever we cannot sense we cannot perceive. Despite the marvels of the Hubble telescope and the Planck satellite, we are often reminded of the partial nature of our human perspective compared to what we can imagine. So there are clear biological limitations to perception as a WOK. Would you have any idea of space if you could not see? Would you have any sense of objects if you could not feel? Would you have any idea of causation? There is certainly more to seeing than meets the eye!

Related questions include the following:

- Why do we have differing perceptions?
- Why do we see or perceive what cannot be?
- Why do we not see or perceive what is in front of us?
- How do context and culture affect our perceptions?
- How do we ever think or see or perceive 'outside the box'?

Prescribed essay title 1: We have eyes to see with, ears to hear with – why then do we err?

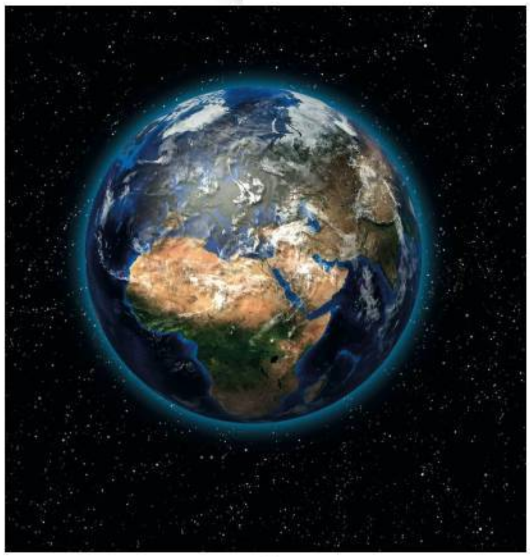
What in the world?

It's a safe bet that nearly every country in the world that promotes professional or amateur sports uses some form of technology that allows us to look again at the recording and seems to capture 'what really happened': the pitch that went wild, the foot over the line, or how the matador speared the bull.

Like so much else in the world, sports is an interesting combination of concealment and revelation. Let us have this generalization stand in for the almost irresistible thought: that a real world exists outside ourselves and we can know it. Even though we admit that the water is not really hot or cold – put a cold hand in, it is hot; put a hot hand in, it is cold – and that the sky is not really blue to all sentient creatures, it remains true that for many psychological and other reasons we need to feel at home in a world where things 'really happen' and where we can know or think we can know what 'really happened.'

On seeing or perceiving things as they (really) are

Looking at the Moon.



Looking at Earth.

Consider these puzzles and questions from *Thinking: The Journal of Philosophy for Children*, Institute for the Advancement of Philosophy for Children, Montclair State University.

1 Which person would you say is more likely to see the Moon 'as it really is'? A person looking at the Moon from Earth, or an astronaut looking at the Moon while standing on the Moon?

2 Which person would you say is more likely to see the planet Earth as it really is? A person standing on the surface of the Earth, or an astronaut looking at Earth from the Moon? Are your answers to 1 and 2 consistent?

3 Is there an exact distance that you have to be from something in order to see it 'as it really is'?
4 Is it possible that some viewpoints are better than other viewpoints? If so, how?
5 Is it possible that the more you consider things from different points of view, the better you know what they are really like? What are the implications of your answer?
6 Is it possible that some things are right and some things wrong, regardless of what point of view they are observed from? If so, give examples.
7 When people tell you that you should try to be objective, does that mean you should:
   a see things more from their point of view?
   b see things from the point of view of your teacher or other adults?
   c see things more accurately?
   d consider things from as many different points of view as possible?
   e consider all of the above?
   f consider some of the above? (which?)
   g consider none of the above?

Perception as the search for meaning

While people can often live without the certainty of truth, they cannot live in a world that makes no sense. Thus, one of the axioms of perception that this book assumes is that the human mind involuntarily creates meaning from stimuli. This is an activity that goes on in spite of your will or desire. For example, as an English speaker, you cannot help but find meaning in the words of a headline from *The Times* newspaper. In contrast, as an English speaker, it is unlikely you can find meaning in the front page of the Japanese newspaper *The Mainichi Shimbun*. Of course, as a Japanese speaker, the reverse may be true. One of the easiest inferences we can draw here is that perception is both context- and culture-dependent and is directed towards making sense of the world.

The empirical way of knowing

Everything we have so far said about perception bears on something more general: the school of thought that claims that the origins, justifications, and even proofs of our knowledge come from sense experience. In short, seeing is believing; or, to put it more strongly, seeing is knowing. Perhaps there is a corollary: if you can't observe it, you can't know it. Because this philosophy is the bedrock of the scientific method and is a key way we map our knowledge onto the material world, it is important for us to think about what are called 'the laws of perception'. Some of these 'laws' or 'principles of organization' relate to our species; others to the culture or group to which we belong. Or even, as with personal knowledge, to our own unique way of interpreting the world as happens so often in the history of scientific discovery.

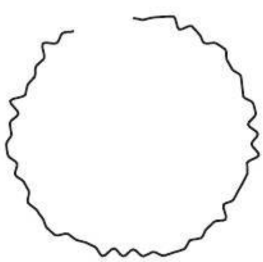


Figure 2.3 Would you call this a circle?

The organizing principles of perception

What do you make of Figure 2.3? Is it a circle? Not really. It is too irregular, a little lumpy, and not complete. In fact,

it's a funny kind of figure, yet most of us keep coming back to its circular qualities. This is an instance of the law of simplicity. A circle, a pre-existing idea, is the simplest category of meaning that your mind can come up with to fit the stimulus.

This law of simplicity was applied to the human mind by psychologists who gave us the term ***Gestalt***, a German word meaning *form*. Not only did the Gestaltists find that the mind perceives the simplest possible form, but also that it tends to see the 'best' or most 'correct' possible form. This means that we tend to see things not as they really are, but as our minds think they should be. By extension, we make mental corrections all the time, not only in irregular circles but in proofreading and any number of other instances. Your own problems with proofing your essays should give even more weight to this notion. It is interesting that, to date, most spell checkers cannot deal with the meaning of a sentence.

Nor has the computer, at the time of writing, had much success in filling in fragments (which our own minds do very swiftly). For example, imagine you see a deer in the woods – it is behind a screen of trees so that what you are actually seeing is only bits and pieces of what you, nevertheless, can identify as an intact living animal. Even though recognizing the deer as a deer is effortless for us, it is not a trivial accomplishment for the brain. Teaching robots to recognize objects in real life from fragments has proven to be a most difficult task for artificial intelligence designers.

Context

We don't see any single thing as it is, we see it in a setting where it does or does not belong. One remarkable example of the power of the context is the informal experiment reported by the US newspaper *The Washington Post* called 'Pearls Before Breakfast'. Violinist Joshua Bell agreed to perform classical solos on the platform of the underground metro system at *L'Enfant Plaze* station. The hypothetical question to be answered was, what would happen if one of the world's greatest violinists performed incognito before a rush-hour audience of over a thousand people? The answer was not surprising. Next to no one paused to listen or, seemingly, even to notice.

Optical illusions and paradoxical perceptions

Optical illusions fascinate us, challenging our default notion that what we see is really real. It is the playful child in us that makes illusions so entertaining, but problems of knowledge or knowledge issues abound if we cannot believe our eyes. Most tantalizing to study are the situations in which perception contradicts logic leading to the so-called impossible figures.

A good example is the ambiguous trident also known in some places as 'the Devil's pitchfork' (Figure 2.4). It is one of many illusions that raise profound questions about the relationship between perception and reality. What is going on here? Is the brain able to make any sense of this image? This question is important since, almost by definition, perception has to be stable at any given instant so it can help us to perform some kind of action, most especially to compute as fast as possible the answer to the question, what do I see?

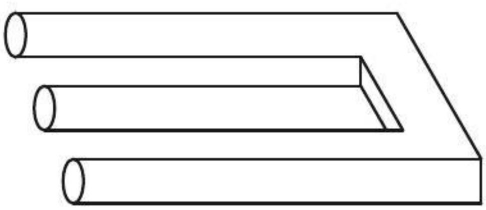


Figure 2.4 What do you see?

CHALLENGE YOURSELF

By extension, simplicity is so powerful a perceptual concept that it has been codified in science by the maxim that the best explanation is the simplest one that fits the data. A classic example is the theory proposed by Copernicus to take the Sun as the centre of the universe, and not the Earth, as was the case with Ptolemy's more complicated model. Copernicus's conception was simpler. It worked better. Can you think of another example where a complicated idea has been replaced by a simpler one?

To learn more about optical illusions, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 2.1.

Take some time to browse through the site to explore what it has to offer. Once you have surveyed the options, choose at least five illusions to focus closely on (both literally and figuratively).

Next, select weblink 2.2, which offers a 'sense challenge' of 20 tests.

The *Panchatantra* is a famous selection of stories taken from ancient Indian literature.

Practice essay title 1: What can be meant by the *Panchatantra* saying, *Knowledge is the true organ of sight, not the eyes?* Is it necessary to have clear ideas to see or perceive clearly?

2.4 Reason as a way of knowing

If you were exploring the territory of a knower, and wanted to know about their knowledge, would you choose the map of reason or the map of perception? The map of reason or the map of imagination? Reason or intuition? Reason or faith? Of course, you know it's a trick question so you might say, *'Well, it all depends on what you mean by knowledge'*, and of course it does. But still, what would you choose?

Let's be more specific and add in all the WOKs. What if you wanted to know more about what your father is thinking? Your girlfriend? Your coach? Your boss? Your rival? Your enemy? Reason or something else? What if you wanted to know more about maths, music, ice skating, or the weather, or if you are good-looking? Reason or something else?

Believe it or not, many past TOK essay questions had this kind of comparative or preferential slant. Was imagination as dominant in history as in art? Were emotion and reason equally necessary in ethics? And so on. Of course, as a good TOK student, you probably would have thought there was an appropriate response and would give credit all around. And why not, since we've gone to some length to say how the WOKs all work together.

Yet reason has held a pride of place as one of the supreme WOKs or, at the very least, as the gatekeeper. Our perceptions have to make sense, our intuitions are tested by reason, our emotions are held in check. Plus, reason is part of our identity – we are the rational animal – not only at the personal level, but in philosophy (that began with the Greeks) where the duality is labelled rational *vs* empirical.

Rational = sitting and thinking = reason = logic

Empirical = going and looking = perception = observation

A little story about big differences

Consider this story. It's about a husband and wife who are two different kinds of knower, one is **empirical** and the other is **rational**. In simpler terms, one relies on *observation* and *experience* while the other relies on *logic* and *reasoning*.

Once upon a time, there was a woman who thought she heard a burglar downstairs.

She woke up her husband …

Woman: Honey, I think someone is in the house. I think I should go and check.

Man: There's no one in the house. If someone were in the house, the alarm would have gone off. Go back to sleep.

Woman: Maybe someone cut the wires.

Man: Don't be silly. The dog would have barked.

Woman: Maybe they chloroformed the dog. I'm going to go and look.

And on and on … neither conceding to the other's way of finding out what they need to know and how to confirm it.

The point here is that for some people there is a disposition to seek knowledge exclusively by one of these two methods. Maths is thought to belong on the rational side and science on the empirical – seeing is believing. However, it's the theories of science that make sense of the facts for us and their explanatory power lies in their fitting everything together into a coherent story – the power of the rational. Maybe they are interdependent. Reason without perception? What would we be thinking about? Perception without reason? How would it make any sense?

Another comparison often made with reason as a WOK is emotion, which we will discuss in the next section, but for now we will concentrate on the power and place of reason in mapping our knowledge.

The power of reason

The status of reason as a WOK has much to do with supposing that we possess a quality of mind unmatched in nature. Few of us doubt that other creatures perceive and feel and act, but reason? In the same way? It seems doubtful. This quality of mind belongs only to *Homo sapiens*. We are prejudiced in our own favour here. Only our species argues with words to defend our opinions and reasons about our beliefs and their consequences.

Reason as meaning making

Apart from the instrumental value of reasoning – to make things cogent and clear – there seems to be an appetite, almost a craving, for sense and order. We cannot stand a mystery for too long. Like the woman in our story, if a strange noise occurs in the house, we need to tell ourselves something that makes sense, to ease the tension. Jokes need punch lines and riddles need answers. We need to know how people die and who sent us flowers. In the plot of a novel where one event leads to another, we cannot tolerate the convent schoolgirl suddenly appearing in the Tiger Den Bar without a reason. Formal consistency forms a part of artistic and dramatic truth. If Hamlet is a prince, he must behave like a prince or we become irritated or puzzled. Because we search for the point of things, logic and reason and the relation of various parts to a whole pervade our daily lives.

> Have you ever played the *Why?* game? At first, the continual asking of *Why?* results in logical answers but then delves into deeply held personal beliefs, and often into the realm of (more or less) collective universal belief. Or so say those who have stayed with it for that long.

Deductive reasoning as logic

There is a difference between deductive and inductive reasoning and university professors will assume that you know the difference. Correctly speaking, only deductive reasoning can be called logical. And to be even more precise, deductive logic is a demonstration of reasons linked to a conclusion, not necessarily a demonstration of thinking. Thinking is too mysterious and murky for us to say much about it here. How people think is a matter for psychology; studying the nature of correct reasoning is a matter of logic.

Practice essay title 2: Thinking is larger than reasoning and reasoning is larger than logic. Discuss.

Logic as form

Contemporary logicians use a variety of symbols – you may have seen truth tables and Boolean algebra in your maths books – but for our purposes we will deal mostly with the practical applications of deductive thinking as a WOK, and mostly as a way of prediction and justification. It's important to realize that the strength of deduction comes from its form (i.e. its structure or architecture), not its content. Consider the analogy of a bridge: no matter what it's made of, no matter its colour or what drives over it, it fulfils its function by not falling down. And this power comes from the way its parts are arranged, the way it is put together. The same goes for logical arguments. Take for example, 'All men are mortal': a classic example of a **syllogism**.

A	All men are mortal.	true proposition	major premise
	Socrates is a man.	true proposition	minor premise
	Socrates is mortal.	true proposition	conclusion **valid**
B	All men are mortal.	true proposition	major premise
	Socrates is mortal.	true proposition	minor premise
	Socrates is a man.	true proposition	conclusion **invalid**

What makes the difference between A and B? Clearly not what it is about since the premises are the same and they are all true. However, the arrangement of B has been changed, so you can see that it is the form, not the content (i.e. not the truth of the statements), that makes the difference as to whether an argument is valid or not. In B, the conclusion *does not necessarily follow* from the premises as they are given. It's a sharp mind that can see this difference and not fall for plausibility only. Take for example the following hypothetical syllogisms (both valid).

A	If I study, I will pass.	**B**	If he loves me, he will call me.
	And I studied,		But he didn't call me.
	So I passed.		He doesn't love me.

Both are valid according to how the premises are arranged plus the meaning of the general (hypothetical) premise, which is like a command central. You have to pay as much attention to the general premise as to the arrangement of the premises. Take one more example, this time an invalid one.

If I study, I will pass.
But I didn't study,
So, I didn't pass.

As plausible as the conclusion may be, it does not *necessarily* follow, since the general premise talks only about the times that you did study, not what happens when you didn't. The plausibility of the conclusion comes from experience not logic. Because it sounds right, it shows us how difficult it is to concentrate on the form alone when the language is emotionally loaded with talk about passing and failing, or boyfriends and girlfriends.

Another important point is this: just as the language and content can lead us astray, something in us wants to finish an argument no matter what the conclusion. Take the following example.

The moon is made of green cheese.	false proposition	major premise
My arm is part of the moon.	false proposition	minor premise
My arm is made of green cheese.	false proposition	conclusion **valid**

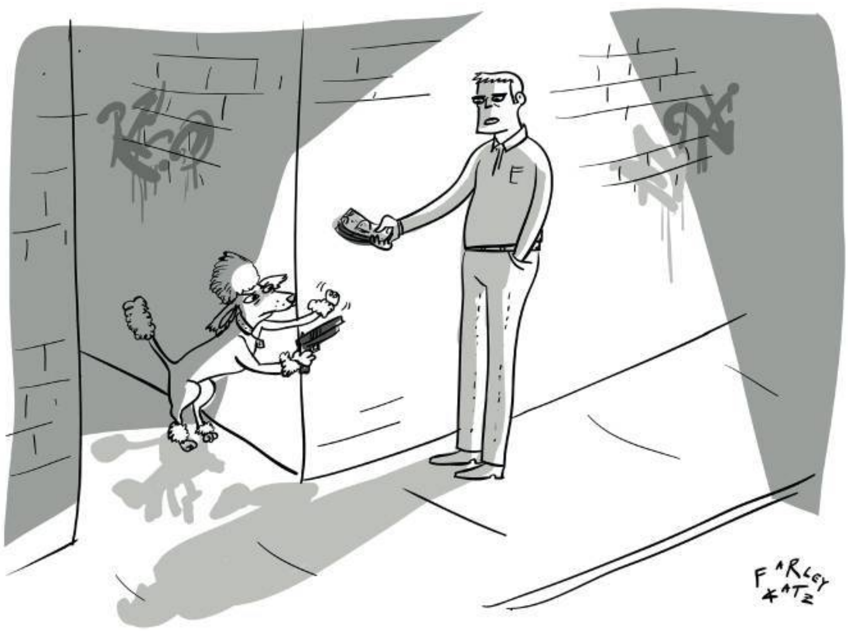
Are the premises true? Don't even ask. Is it valid? Yes, and hearing the first two premises you may feel a tug of closure in wanting to state the conclusion no matter how preposterous. Again, we cannot escape the obvious, the argument is valid by form alone. The upshot is that validity has its appeal independent of truth, which warns us to be wary of those dealing in lies but winning the day through the power of logic. Just as the Devil can quote scripture in order to confound believers, so we should recognize that there are those who stand to gain by using logic to distort truth and spread lies.

Inductive reasoning

With inductive reasoning we are in the realm of generalizations. Deduction goes from the general to the particular (from major premise to conclusion) but induction goes from the particular to the general – I saw the cars stop at the red light every single time, therefore I assume / conclude / infer that the next car will stop at the red light. But we can easily imagine exceptions to this generalization, which is why we are only entitled to say, *'In general, cars stop at red lights.'*

Betting on the horses is an interesting variety of inductive thinking with the generalized odds changing as the predictions of win, place and show shift with the circumstances or maybe just plain hope and whim.

Inductive reasoning is far less technical, far less formal and far less rule-governed – and thus it is open to exception. This is to say, our inductive inferences, our generalizations, are only probable to a degree. Yet, this kind of reasoning is what we do all day without noticing – we add up our experiences and draw generalizations from them. These generalizations, or inferences, become the mental maps of our world. They make



"Great—now I'm gonna be suspicious of every poodle I meet."

The problem with inductive reasoning.

There are some patients with mental disabilities so severe that they cannot trust any of their mental maps or models ... their ability to generalize with confidence is so impaired that they hardly move all day long and live in a mostly catatonic state.

up our expectations of what the world will be like the next minute, the next day, or forever. We predict with them, because we live by generalizations as our models of reality.

While our example of cars stopping at the red light shows the same instance repeated to the point of generalization – car 1, car 2, car 3, etc., all stopped at the red light – most of our generalizations or mental maps are shaped from a variety of circumstances from which we abstract similarities. This intellectual skill is apparent even in toddlers. For example, from dozens of images of elephants – plastic, cloth, glass or wooden ones; pictures and cartoon drawings in books; real animals in zoos; videos on TV, movies and iPads – a child abstracts a similarity sufficient to call them by one name: *elephant*. This is how we classify and organize our world.

Exceptions to the general rule

It's fairly easy to see what we are talking about when we bring up the well-known white swan example: I've seen a thousand swans in my life; they were all white – no counter-examples – so I expect that all swans are white, and if I have any swan experience in life, this model of swans is what I work with. Could I be wrong? Of course, especially if I have not been to Western Australia where swans are black, or have not heard of this example in a TOK class.

And what happens when we spot a black swan? We might dismiss it as an outlier, an inconsequential anomaly; we might put it aside as something of interest to think about in the future; or we might declare our generalization about all swans being white to be false, and think about the real truth of the matter. But what we can't do if we are honest thinkers is continue to hold on to the white swan inference as absolutely true without exception.

In fact, a generalization is only as strong as its ability to withstand exceptions. This is the basis of how scientists try to test the strength of their findings – they try to falsify them. In principle, this is the case for even the most tried and tested law-like generalizations, including 'iron rusts when exposed to oxygen' or even 'the Sun will rise tomorrow'. (But it would be a rare occasion to find a scientist trying to falsify the law about the Sun.)

Prescribed essay title 2: ***We are more likely to be mistaken in our generalizations than in our particular observations. Do you agree?***

Most students know some of the pitfalls of sloppy reasoning that lead to stereotypes and fallacies. One of the most common is jumping to a conclusion or 'hasty generalization'. There are dozens of clever online fallacy quizzes where you can train yourself to recognize and avoid the most common types of mistakes of inductive reasoning including: ***ad hominem***, ***post hoc***, **slippery slope**, **appeal to pity**, **false analogy**, and **red herring**. You can also practise by watching courtroom TV dramas and listening to politicians. Was that last statement an over-generalization?

Deduction and induction together

Do our minds shift from deduction to induction and back again? There is no sensation telling us that this is so, but we can identify the presence of both deduction and induction in one syllogism. Take the if–then hypothetical premise ‘If I study, then I will pass.’ Although it does not use the word ‘all’ (as in ‘all swans are white’), the if–then statement can still function as a general rule (built up from past behaviour) or as a hypothesis you are testing about future events.

So, in brief, you have a general (hypothetical) premise – ‘If I study, then I will pass’ – related to a fact – you do study – from which you deduce or predict that therefore you will pass. This set of steps, in miniature, is an instance of the hypo-deductive model in science that combines the deductive and inductive methods using reason, perception, and memory all intertwined.

> The major premise is a scientific law – When iron is exposed to oxygen, it rusts.
> The minor premise is observed fact – This iron was exposed to oxygen.
> The conclusion is a prediction or expectation – Therefore, it will rust.

If the iron rusts, it further confirms the general premise. If it does not, the exception must be taken into account. What would be your next step as a scientist?

There is often an unstated universal law behind examples such as ‘If I let go of this pencil, it will fall. And I do let go, and it does fall.’ Good inductive first premise and a sound little syllogism, but one that relies on unstated universal laws and the theory of gravity. Not everything is always spelled out.

Exercises

5 ‘It’s snowing, so school will be closed’. What is the missing first premise?

6 ‘When it snows, school closes. And sure enough it closed’. What is the missing premise?

7 ‘When it snows, school closes. And it snowed’. What is the missing conclusion?

In one way or another, this form of reasoning informs much of our daily activity, in the science laboratories, and even in the kind of thinking involved in ethical judgements (or at least how we explain our ethical judgements).

Ethics and logic are not so familiar a pairing as ethics and science, but some people form moral assumptions about what is right and wrong that become the principles they live by. And these principles are the same as generalizations and are used as major premises, such as (all) stealing is wrong, so that when you bump into a situation that might be stealing, you know this act to be wrong. Scale a single instance against a general rule and you can deduce the consequences.

Prescribed essay title 3: ‘Ethical axioms are found and tested not very differently from the axioms of science. Truth is what stands the test of time.’ (Einstein) Critically evaluate this claim.

An ichthyologist studies fish life.

Exercise

8 Try to find the presence of deductive and inductive reasoning in the paragraph below. You might find other ways of knowing present as well.

'Let us suppose that an ichthyologist is exploring the life of the ocean. He casts a net into the water and brings up a fishy assortment. Surveying his catch, he proceeds in the usual manner of a scientist to systematize what it reveals. He arrives at two generalizations: (i) no sea creature is less than two inches long, and (ii) all sea creatures have gills. These are both true of his catch, and he assumes tentatively that they will remain true however often he repeats it. In applying this analogy, the catch stands for the body of knowledge which constitutes physical science, and the net for the sensory and intellectual equipment which we use in obtaining it. The casting of the net corresponds to observation: for knowledge, which has not or could not be obtained by observation is not admitted into physical science. An onlooker might object that the first generalization is wrong. 'There are plenty of sea creatures under two inches long, only your net is not adapted to catch them.' The ichthyologist dismisses the objection contemptuously, 'Anything uncatchable by my net is, *ipso facto*, outside the scope of ichthyological knowledge, and is not part of the kingdom of fishes. In short, what my net can't catch is not fish.'

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2.5 Emotion as a way of knowing

The late American movie critic Roger Ebert (1942–2013) used this simple credo in judging a film's value: *Your intellect may be confused, but your emotions never lie to you*. Can you think of any clearer statement of emotion as a WOK? Yet having said that, at the beginning of a review, Ebert would then launch into 20 reasons why his creed was sound and why the film got a thumbs-up or down. So our emotions often present convincing feelings only to ourselves; for an emotion or opinion to go public, language and reason come into play.

A similar thought about emotion and reason occurs in Chapter 9, where Steven Pinker and Jonathan Haidt talk about the gut feelings that determine our moral behaviour, followed by the reasons we think of later in justifying the doing or not doing the right or wrong thing. But why do we need to justify what surely must feel right? Because this is how much of society is run. Someone will demand an explanation and you will

be obliged to give reasons. And not just any reason, but one that satisfies, since that is what explanations do – they satisfy by supplying reasons for what is in question.

A *Why did you hit your brother?*
B *Because I felt like it.*
A *Not a good reason. You can't go around hitting people just because you feel like it.*

A *Why did you hit your brother?*
B *Because he hit me.*
A *Not a good reason. Two wrongs don't make a right.*

A *Why did you hit your brother?*
B *To teach him a lesson.*
A *Not a good reason. That's no way to set an example.*

And so the discussion goes on until a good enough reason is given and accepted. 'Feeling' as an explanation is often rejected in a rational world where your emotions are not part of a first-class explanation to someone who has not felt what you do.

But there is a similar kind of dialogue where emotion seems appropriate and acceptable.

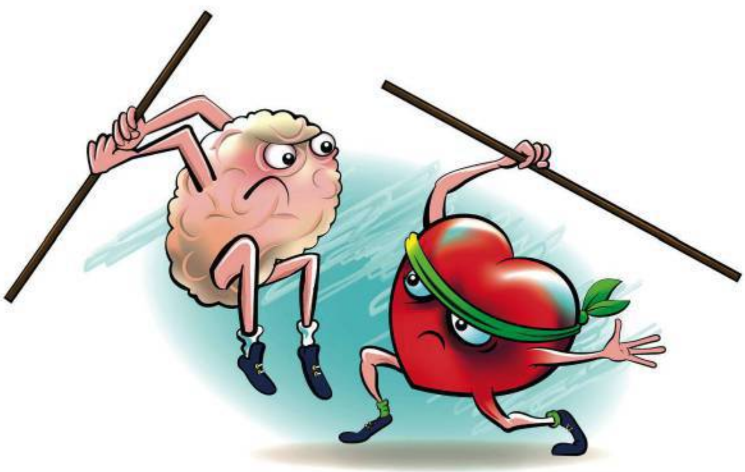
A *Why did you run away?*
B *I was afraid.*
A *What were you afraid of?*
B *I thought that shadow was a bear.*
A *Oh … good reason.*

But of course it wasn't a reason, it was an emotion that made you run – a feeling of being afraid.

These examples point to the tension between reason and emotion, where the higher status is often given to the rational (reason) over the irrational (emotion). There's also a hint about the new thinking that finds reason and emotion not only intertwined, but working together in our decision-making.

Emotion comes from the root word *motion* (to move) with the prefix *e-* meaning something like 'away from.'

Dominant human emotions include anger, love, joy, fear, desire, sadness, surprise, disgust. This is not an exhaustive list, nor does it imply that all writers and thinkers in the field agree on what the dominant human emotions are. Would you add anything? Embarrassment, guilt, shame, pride, envy, jealousy? Is curiosity an emotion? Is doubt?



Tension between the heart and the head.

Are there different ways in which these emotions can be classified? (For example, primary and secondary, positive or negative, strong or weak.)

Are the emotions listed above universal, or are they dependent on culture or some other factor? The *Bhagavad Gita* (5th century BCE) states that *emotion has the advantage of being open to all, the weak and the lowly, the illiterate and the scholar,* T'oegye, a Korean philosopher in the 16th century added hate to the list above. Darwin (19th century) supported the naturalistic view that emotions are purely physiological and experienced across all cultures. The James–Lange theory asks us to consider that the bodily state causes the feeling – smiling causes happiness or whistling banishes fear – not the other way around. The contemporary Cannon–Bard theory takes the emotions and bodily states as occurring simultaneously on a message from the brain. Antonio Damasio, the Portuguese neurobiologist, has given us his somatic marker hypothesis which proposes that emotions play a critical role in the ability to make fast, rational decisions in complex and uncertain situations.

Paul Ekman, an American psychologist, tells us that fear, anger, sadness, and enjoyment are recognizable from facial cues all over the world (Figure 2.5). Others prefer personal (guilt) and social (shame) as the main categories. The debate about how to identify and group emotions is ongoing and is an open question. A good TOK presentation might consider the value of such classifications.

Figure 2.5 Do all humans have the same facial expressions for (a) anger, (b) fear, (c) sadness, and (d) enjoyment?

Emotions as the lesser status

There are comparisons of reason and emotion throughout history (usually claiming reason to be superior): think of the war between Freud's id and ego, or Plato's two horses (one white and noble, the other black and ugly) pulling in opposite directions while the charioteer struggles to get them to work together.

The Seven Deadly Sins, a list usually attributed to Pope Gregory I (540–604), are:

- pride
- sloth
- anger or wrath
- envy
- gluttony
- lust
- greed or avarice.

Are these emotions or feelings? Can we generalize and say that all sins are emotions or feelings? Are emotions and feelings the same thing?

Many people were brought up with the dichotomy that sees reason as smart, intelligent, logical, objective, and opposed to feelings, which supposedly possesses none of those virtues. Schools are a formative example. The classroom necessarily requires self-control, delayed gratification, and reasoned expression as we go up the grade ladder. The TOK essay prizes argument, a form of logic, to ground our thinking. We are taught that we should base our decisions on evidence and a rational assessment of alternatives, which means a careful consideration of all relevant factors – a kind of cost-benefit analysis as the economists would say. In fact, most of the early 20th-century economic models have assumed that decision-makers followed this approach to some degree: the more data introduced into the process the better.

Think of the logic of buying a home (don't fall for the first thing you see), taking your first job, or even selecting a spouse. What is the difference between 'selecting a spouse' and 'falling in love'? Add in the advice to keep a clear head. If reason is the foundation of good decision-making, then emotion would seem to be its enemy.

Views from the other end of the spectrum

And yet, from the opposite end of the spectrum we are often advised to throw caution to the wind, to lead with our heart, to follow an inner voice. In other words, if something feels right, it is right. Perhaps the famous quotation from *Pensées*, a posthumously published work by French mathematician and philosopher, Blaise Pascal (1623–63), encapsulates that perspective:

> “The heart has its reasons of which reason knows nothing.”
>
> **Pascal, 1670**

Here are two other quotations you might find interesting to reflect on:

> “Reason is and ought only to be, the slave of the passions.”
>
> **Hume, 1888**

> “A novel should be an experience and convey an emotional truth rather than arguments.”
>
> **Cary**

Prescribed essay title 4: We will always learn more about human life and human personality from novels than from scientific psychology (Noam Chomsky). To what extent would you agree?

Historical *vs* contemporary outlook

> Jupiter has bestowed far more passion than reason – you could calculate the ratio as 24 to 1. He set up two raging tyrants – anger and lust – in opposition to Reason's solitary power. How far Reason can prevail against the combined forces of these two … is quite clear. Reason does the only thing she can and shouts herself hoarse repeating formulas of virtue, while the other two bid her go hang herself and are increasingly noisy and offensive, until at last their ruler is exhausted, gives up, and surrenders.'

Erasmus, Wilson, 1668

> CONTEMPORARY NEURO-REVOLUTION: Brain scans now show us that the amygdalas (emotions) act faster and often bypass the neo-cortex (rational). Not the other way around. Signals are sorted for meaning faster than the conscious mind can register.

Goleman, 1995

In short, emotions rule.

Knowledge question

2 What do you make of the statement, 'Emotions are not our enemy; they are us'?

To learn more about David Brooks's ideas, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 2.3.

A new perspective

David Brooks (2011), a respected conservative columnist in *The New York Times*, and a popularizer of the work of scholars in this area, says that such a view of a 'divided self' – reason on one side, emotion on the other – is more than just inaccurate:

> It has produced a great amputation … we're really good at talking about material things, and we're really bad at talking about emotions. We're really good at talking about skills, safety and health. We're really bad at talking about character and feelings.

Research shows, as Brooks tells us in *The Social Animal* (2011), that:

> ... the emotional, probably unconscious, parts of the mind are not primitive vestiges that need to be conquered in order to make wise decisions. They are not all dark caverns of repressed sexual urges or seething cauldrons of frustrated desires. Of course, there are shortcomings … There's a truth to the view that we all have an inner Homer Simpson, an impulsive, immature goofball (especially with the destructive, addictive, rage and anger parts), but there's an unrecognized positive side, too. The emotional mind is sensitive to context, [it] interprets and organizes data via perception, solves complex problems and helps us learn how to behave with empathy for others. And it drives the pursuit of knowledge. The conscious mind thinks it is the 'general', but in fact it is subservient to the unconscious that points our way.

Brooks says that the mistaken view of the whole person as a logic machine being an ideal form leads to huge mistakes in government:

> Over the past generations we've seen big policies yield disappointing results [in education, inequality, single-parent homes, politics, economics. The policies actually made things worse because] liberal welfare policies in the Seventies undermined families; conservative-led economic deregulation unleashed Wal-Mart and global financial markets that destroyed communities … The failures have been marked by a single feature: reliance on an overly simplistic view of human nature.

Both sides of the political spectrum focus too much on logical arguments and material incentives, and ignore factors like culture, compassion, character, and what matters in life in the long run.

Neuroscientist Professor Antonio Damasio tells us that those with certain brain injuries to the affective centres become eerily calm rather than Spock-like paragons of rationality. Their lives fall apart because they cannot make even the simplest of decisions. In order to make a decision you need to have a preference for one or another set of circumstances, but patients with these injuries no longer have such preferences. Removing emotional function from the brain doesn't make a person rational, it casts them adrift in a life without meaning. Such patients live in a world of grey neutrality. They don't even care that their lives fall apart.

Art and emotion as a way of knowing

As the emotional mind and the thinking mind ideally work so well together, does this mean that we can never tell the difference between a thought and an emotion (emotion here is not to be confused with the feeling of a cut finger)? We can now chart neural pathways by brain-imaging machinery, but that is not the point. What is the difference at the conscious level? Perhaps it doesn't matter if the goal is to have reason and emotion work in a kind of cooperative harmony. Still, the question remains for those whose curiosity will not sit still.

So what might a pure aesthetic experience of emotions be like? When there is no anticipation or no expectation? Nobody saying 'we're going to hear the best violinist in the world tonight'? Then out of the blue a lightning bolt hits you – a *coup de foudre* – that

CHALLENGE YOURSELF

What do you say to someone who is crying? Are you as adept as when you give directions or talk about a political candidate? Is it because the world of emotions is essentially private? Is it a lack of training or something else?

CHALLENGE YOURSELF

What does it mean to say *'the emotions disclose features of the world to us'*?

knocks you off your feet. It might be a counter-tenor hitting a high C, a brilliant sunset suddenly seen from the window, or a painting of such power that it stops you in your tracks. Such experiences give you, through pure emotion, through high feeling, the knowledge that you are in the presence of something marvellous.

For example, there is a frequently told little story that goes like this. An art history teacher says to her class, '*When I was fifteen, I went to see the Monet water lilies at the Museum of Modern Art. I rounded the corner and nearly fell to the floor right there in front of Picasso's* Demoiselles d'Avignon. *I had never seen it before. I had never even heard of it. My knees just buckled and I lost my breath. And now that I've told this little story, I have ruined the pure unanticipated experience for you.*'

Emotion as a way of knowing in ethics

“Anyone can become angry, that is easy. But to be angry with the right person, to the right degree, at the right time, for the right purpose, and in the right way … that is not easy.”

Aristotle

From the earliest times, thinkers have wondered about the role of emotions *vs* reason, emotions as a form of reason, emotions and the good life, meaning both the ethical good and the good life as happiness.

The quotation below is from a philosopher at the University of Chicago, who has analysed grief, compassion, love, disgust and shame among other emotions.

“Emotions shape the landscape of our mental and social lives … their urgency and heat … their tendency to take over the personality and to move it to action … their apparent adversarial relations to rationality in the sense of cool calculation … ”

Nussbaum, 2001

In the light of these features, especially urgency and heat, it might seem strange to suggest that emotions are forms of evaluation. Yet this is exactly what Martha Nussbaum asks us to consider. She suggests that emotions are *suffused with intelligence* and contain within themselves an awareness of value and importance. Furthermore, because of this kind of wisdom emotions bring us a guide to life, and cannot be side-lined in ethical judgement as has so often been the case in the past.

Exercise

9 Considering Nussbaum's remark that emotions are suffused with intelligence, discuss the recent IB question: Are reason and emotion equally necessary in justifying moral decisions?

© International Baccalaureate, November 2007, May 2008

Emotion and happiness

Is happiness an emotion? Although TOK is concerned with knowledge claims and justifications whether in the WOKs or the areas of knowledge, we seldom answer the question, *is knowledge the highest achievement for ourselves?*

What comes into your mind when you think of happiness? For some, it is everything that money can buy; for others, it is freedom from the attachment to material goods and, by extension, freedom from the emotions that come from frustrated desires.

At its highest levels, Buddhism offers to move us beyond both the rational analysis and the desires of this world to where we are free from the emotions of suffering. An exemplar of Buddhist life is Matthieu Ricard (1946–), a French biochemist who left science to pursue happiness both at a basic human level and as a subject of inquiry as a Buddhist monk. As a right-hand man for the Dalai Lama, Ricard has been the subject of intensive clinical tests at the University of Wisconsin, where he has been labelled 'the happiest man in the world'. His scientifically tinged reflections on happiness and Buddhism show up in several books, his latest being *Happiness: A Guide to Developing Life's Most Important Skill.*

CHALLENGE YOURSELF

Here are some thoughts to reflect on as we begin to think seriously about the role of emotions in our personal and collective lives. Also, you might think about the title of Matthieu Ricard's book that calls happiness a skill!

- What is freedom if it is not freeing oneself from the ego and the emotions?
- We will only succeed in changing our temperament if we are able to change our emotions.
- Is it possible that hatred can melt away, from merely not liking someone to the horror felt towards murderers?
- Happiness has more to do with inner fulfilment than with the gratification of desire for material things

2.6 Intuition as a way of knowing

The facets of intuition

Of all the WOKs, intuition is one of the most mysterious. An idea pops into your head, but you don't know where it came from. A little voice tells you to run and then suddenly the wall tumbles down just where you were standing. But wait, it's not so much a voice as a premonition. Or maybe a gut feeling, or an inkling. It's hard to put something into words when we know so little about it. Yet intuition seems to be a familiar experience even when described in so many different ways. Perhaps some of this familiarity is due to its resemblance (or overlapping) with other WOKs.

Malcolm Gladwell is an American writer who studies research in this field. He is often associated at the layman's level with intuition, although in his book *Blink, Thinking Without Thinking* (2005) he never mentions the word. Instead he describes his bestseller as:

> “a book about rapid cognition … the kind of thinking that happens in a blink of an eye when you meet someone for the first time, or walk into a house you might buy or read the first few sentences of a book … your mind takes about two seconds to jump to a series of conclusions. Well, Blink is a book about those two seconds, because I think those instant conclusions that we reach are really powerful and really important and, occasionally, really good.”
>
> Gladwell, online question and answer session

Gladwell goes on to argue:

> "Intuition strikes me as a concept we use to describe emotional reactions, gut feelings – thoughts and impressions that don't seem entirely rational. But I think that what goes on in that first two seconds is perfectly rational. It's thinking – it's just thinking that moves a little faster and operates a little more mysteriously than the kind of deliberate, conscious decision-making that we usually associate with 'thinking'. In Blink I'm trying to understand those two seconds."

Gladwell, online question and answer session

CHALLENGE YOURSELF

Booksellers tell writers that they have about five seconds to hook a buyer. That's the time a potential purchaser takes to glance at the cover, the title, and the opening sentence. The opening sentence of *A Tale of Two Cities* (Dickens) is a classic: *It was the best of times, it was the worst of times.* What is your favourite opening sentence? Can you tell in a flash if you will (probably) like a book?

Knowledge questions

3 Is intuition reason by another name?

4 Is intuition perception by another name?

5 Is intuition emotion by another name?

Intuition as snap judgements

'Snap judgements' and 'jumping to conclusions' sound like the kind of thing that usually gets us into trouble, that leads to stereotypes, hasty generalizations, and other fallacies. But a growing body of research suggests that we need to reform our opinion here. Of course, not every judgement or decision is the right one, but a fuller picture of how decision-making actually takes place puts a higher value than previously thought on intuition – a process that has sometimes been seen as no more likely than extra-sensory perception (ESP).

Gary Klein, a cognitive psychologist and the author of *Sources of Power* (1998), claims that what we call 'intuition', far from being confined mostly to women or those with 'a third eye', accounts for upwards of 90% of decisions of all kinds. Perhaps most importantly, intuition is the source of power for those in emergency rooms, battlefields, air-traffic control towers and fire-fighting squads, all of whom call on this skill in high-stakes, life-and-death situations. Klein talks about reason and intuition as being two sides of the same coin. He considers reasoning in the conventional sense of defining the problem, gathering and weighing options, choosing among competing alternatives, then implementing a solution. Although such a model is a standard of rational thought, to take that long to react in a crisis would be foolhardy. Patients would die, buildings would collapse, planes would collide, and the enemy would be victorious. But intuition comes to the rescue as the natural extension of experience, especially memory, reason, perception, and emotion.

Fire-fighting demands courage, skill, knowledge, and intuition.

When studying fire-fighting teams, Klein (1998) asked a team captain how he made decisions about where to place his men, the hoses, the ladders:

> ‘Wait, a minute’, the captain interrupted. ‘I don’t make decisions. I do what I see needs to be done. Lightning fast! That’s the only way. There’s no time for thinking about it. I’ve got a sixth sense about these things.’

Of course, if you could have a replay in slow motion of the captain’s mental process, it might well be something like the model of measured calculation we started with.

But what about less dramatic situations such as day-to-day routines?

To convince yourself of the prevalence of split-second decisions on an everyday basis, try a mental comparison of a French grocery shopper in Paris with a newly arrived Russian immigrant to the city, both going down the aisles with the same shopping list. Such ordinary situations point to the rapidity of thought (the prevalence of intuition) that comes from a broad base of experience. One knows; the other doesn’t. One sweeps through the choices, the other blunders along sorting and weighing, two steps forward, one step back. Just the same as the new cook in the restaurant, the new teacher in the classroom, the new biker on the highway, until experience and the power of intuition clicks in. What’s more, Klein believes that such intuitive powers are not only trustworthy, but are learnable skills rather than innate talents.

Intuition in mathematics and science

The Italian mathematician Enrico Bombieri tells the following story about the notion of intuition in mathematics. A senior expert in real analysis was once sent a paper that ‘proved’ a surprising theorem. The expert was immediately sceptical, but after days of combing over the paper he couldn’t find any mistakes, although his intuition continued to bother him. He looked even more carefully, and then found the problem – a typo in the paper where the words ‘closed’ and ‘open’ had been exchanged, causing a gap in the proof of the theorem and leaving the author with a faulty paper.

Multiple intelligences

Howard Gardner of Harvard has listed seven ‘intelligences’ that some say would more accurately be termed ‘gifts’ or ‘talents’. Others have suggested these ‘intelligences’ would be better described as intuitions. Then again, others find no value whatsoever in this list.

- Verbal: strong intuitions about language and meaning
- Maths: strong intuitions about numbers and logic
- Physical: strong intuitions about physical movements
- Spatial: strong intuitions about spatial arrangements
- Musical: strong intuitions about music and harmony
- Interpersonal: strong intuitions about others’ sensitivities
- Intrapersonal: strong intuitions about self-knowledge

Here are some examples. Physical intelligence is shown when Canadian star hockey player, Wayne Gretsky, says, *I skate to where the puck is going to be.* Spatial intelligence is shown by an architect who immediately sees that a door is fractionally out of line. Interpersonal intelligence is shown by the charismatic person who knows just what to say to each and every person in the room. Musical intelligence is shown by musicians like Yo-Yo Ma. These intelligences have nothing to do with IQ. Most intelligence tests rank only the verbal and the logical–mathematical.

Proving theorems requires formal manipulation and the use of intuition, the ability to see what is reasonable and what is not, and the ability to put it all together. You have to believe in that nagging little voice, and in yourself. As British writer Llewelyn Powys (1884–1939) put it:

CHALLENGE YOURSELF

To go a bit further with Klein, he describes as ‘primed’ the person who somehow has ideas in mind in preparation for a course of action. With such priming, we observe circumstances in our surroundings differently from the way we would if we were not primed. Try to put this concept of being ‘primed’ in your own words. How can you know if you are primed about anything? Does a mental rehearsal create priming or do you have to have previous experiences?

> A trembling in the bones may carry a more convincing testimony than the dry, documented deductions of the brain.

Until recently, there were few scientific theories that explained intuition, yet many great discoveries relied heavily on intuitive insights. The following view is attributed to Einstein:

> The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honours the servant and has forgotten the gift.

And John Maynard Keynes is credited with this assessment of Newton:

> Newton owed his success to his muscles of intuition. His powers of intuition were the strongest and most enduring with which a man has ever been gifted.

Exercise

10 Divide into four or five groups and search the internet for 'intuition training'. You will very quickly see dozens of organizations offering to develop this faculty to improve school performance, sports achievement, personal relationships, financial management, and overall health. Does it sound too good to be true? Use your critical judgement ... or your intuition.

CHALLENGE YOURSELF

Would you accept the instant reading of someone in speed dating, in choosing a doctor, a financial advisor, a tennis coach? Or in hiring a top executive of a Fortune 500 company? Studies show that a huge majority of CEOs in the world are much taller than average, although there is no correlation (to date) between height and capability. What do you think is going on in terms of snap judgements in such choices, and how reliable is each on a scale of 1–5 (5 being the most reliable)?

Intuition as first impressions

Do you think it's possible to tell in two seconds, two minutes, or even ten minutes if a teacher is good, great, medium, or worse? That is what some studies have tried to find out at all levels of instruction from primary to university. Consider the following instance. Rather than rely on the standard method of teacher assessment (which involves observing three classroom sessions of one hour per year), the Harvard Graduate School of Education (and others) experimented with something different. Their evaluation technique claims that viewing videos of teachers for six seconds gave the same results as a control group using the standard assessment model.

Exercise

11 Role play the different perspectives of the student, the teacher, the head of school, and any other stakeholders' positions. What is your experience based on? How many teachers have you had in your life?

Intuition and the body

In an interesting experiment conducted by Antonio Damasio at the University of Iowa, and corroborated by Barnaby Dunn of Cambridge University in the UK, subjects are asked to play a card game where they are presented with four decks of cards, two red and two blue. As they turn over their cards one at a time, they are either paid or fined a sum of money. The decks have been rigged so that the red decks pay high rewards, but also have high penalties; the only way to win is to choose blue cards which have a lower payout and penalty rate.

Once players have turned over about 50 cards, they start to suspect that something is odd and to develop a hunch about what is going on. After about 80 cards, players recognize the patterns of payouts and fines, and can begin to say why the blue decks are preferable. However, unbeknownst to them, they have been hooked up to a machine that measures stress via activity in the sweat glands of their hands. Their palms begin to sweat after turning up only 10 cards – 40 cards before their hunch that something was wrong with the red cards. At about the same time, players also changed their strategies, and started picking more cards from the blue decks and fewer from the red. Yet they were not conscious of having done so. The emotional response came first, then the changed behaviour and finally the conscious rationalization and articulation.

The hypothesis current today (in terms of intuition as a WOK) is that we become unconsciously aware of something in our environment through some kind of sensory cue. The body reacts first with a signal linked to an emotion that tags the situation as aversive or beneficial. Only afterwards can we talk about it.

Reading faces

> “Some years ago, John Yarbrough was working patrol for the Los Angeles County Sheriff's Department about two in the morning. He and his partner pulled over a sports car. 'Dark, night-time, average stop. You're hunting for guns or lots of dope, or suspects wanted for major things. You look at someone and you get an instinctive reaction. And the longer you've been working, the stronger that instinctive reaction is. … Is he a danger? Sure. He's standing there with a gun, and what person in his right mind does that facing a uniformed armed policeman? If you looked at it logically, I should have shot him. But logic had nothing to do with it. Something just didn't feel right. It was a gut reaction not to shoot – a hunch that he was not a threat to me. As it turned out, I was right. He didn't shoot.'”
>
> Adapted from Gladwell, 2002

Something in our faces gives us away. Con men and poker players know this well, which is why they look for 'tells'. Are we faking, lying, or telling the truth? Are they? Most of us aren't very good at spotting theses cues. But a handful of people are virtuosos. What do they see that we miss? All of us, a thousand times a day, read faces. There must be rules that govern the way we interpret expressions. But what are those rules? And are they the same for everyone?

Poker players try not to give anything away – hence the expression 'poker-faced'.

Reading statues

There are some classic narratives about intuition research even though the field is fairly young. Here is a widely reported story about a statue that may or may not be a fake but was bought in the mid 1980s by the Getty Museum in Los Angeles for around US$10 million.

The statue is a *kouros*, a figure of a young male nude. It is carved from marble, and is undamaged. It is larger than life at around seven feet high, with arms to the side and one leg forward. It is one of only about two hundred in existence and all but 12 are damaged. Everything pointed to this purchase being a good one for the Getty, then a young museum, looking for a fine piece of classical statuary. But is it the real thing?

Many intuitive rejections are reported as physical manifestations. For example, *It sickened me*; *I felt a wave of revulsion*; *Something made me shake*; *My stomach knotted up*. It is said about the financier George Soros that he has back spasms in the face of a bad investment.

Geologists using electron microscopes declared the *kouros* to be genuine, yet a nagging uncertainty remained. Experts were brought in from the art world. One was Thomas Hoving from the Metropolitan Museum in NYC – he shook his head, 'no, it's not real', after a single glance. The scientists had taken 14 months to declare it genuine, while the art expert took two seconds to declare it fake. Its status is still unresolved, though most experts now believe it to be a fake. *I always considered scientific opinions more objective than aesthetic judgements*, the Getty's curator of antiquities said. *Now I realize I was mistaken*.

Intuition as gut feeling

The scientific study of gut instincts in decision-making – taken literally – is led by Dr Michael Gershon of Columbia University, New York City. He published *The Second Brain* in 2012 and has become known as the leader of a recently named field of study called neurogastroenterology.

> “The idea of being centered in the belly shows up in many cultures — Incan, Maya. There is a Chinese word for belly that means 'mind palace'. Japanese culture rests on a foundation of hara, which means 'belly' and represents the seat of understanding. The Japanese have a host of expressions that use hara where we use head. We say, 'He's hotheaded.' They say, 'His belly rises easily.' We say, 'He has a good head on his shoulders.' They say, 'He has a well-developed belly.'”
>
> **Shepherd, 2013**

The enteric nervous system in the gut with its millions of nerve cells has a 'mind of its own' and expresses itself through sensations such as butterflies in the stomach and other signals of fear and distress. Its metaphorical identity with the brain as a carrier of emotional warnings is a good subject for an extended essay in Biology.

Can a male doctor know more about childbirth than a woman who has had eight children? What kind of intuitions are taking place on both sides? Who is the expert? Who has the authority to say so? What do you do when intuitions conflict? Even though you may not have the experience to give a 'rapid cognition' answer based on expertise, most students have a ready or a snap answer. Your intuitions about this question may or may not tell you something. Pretend you are writing a TOK essay on this question and conduct a Socratic dialogue with yourself to sort out what is involved in a good response.

Prescribed essay title 5: When should we discard explanations that are intuitively appealing?

2.7 Memory as a way of knowing

'It's a poor sort of memory that only works backwards', the Queen remarks in Lewis Carroll's *Through the Looking Glass* and hardly anyone knows what this means exactly. But then memory is more of a mystery than a clearly understood concept for most of us, even though all that we know or are justified in believing at any given moment resides in that part of the mind or brain we call our memory.

Indeed, in the words of the American playwright Tennessee Williams (1963), *life is all memory, except for the one present moment that goes by you so quickly you hardly catch it going*. So technically speaking, and difficult to deny, is the fact that your reading of the previous paragraph, if not the previous word, all belongs to memory, the storehouse of past events.

Yet, until recently, memory was seldom talked about in TOK. This is because TOK has been more concerned with how we come to know or believe in something, and how to justify it, than how any particular proposition comes to sit in our memory and to be called up when needed (or not).

How did any memory come to be part of our mental inventory? How forceful or faint is the memory? How is it recalled and on what stimulation? How much of the storehouse and the recall of our ideas are within our control? How reliable are these images or ideas? Does the memory make sense with what else you know or think? Does any particular memory correspond to a state of affairs in the world; if so, how can we check on this correspondence since the memory is something filed away from the past? Or does our confidence in any idea or proposition in memory take its strength from the idea fitting in with other things in our mind, in a way akin to a coherence theory of ideas fitting together?

Memory as identity

Surely most of us know the agony of failed memory. Of trying in vain to recall what does not come to us – the answer to a test question, a French verb, a face or where we left our keys. But not to despair, Gerald Brenan says, *a bad memory is the mother of invention*. Can you think what he means by these words? Compare this with the idea of a photographic memory. Which would you prefer?

Aren't there memories you would like to forget? If you could wipe those out, do you think you would be better able to remember other things? But have you thought that without memory you would have no sense of self, no way to make sense of your life experience? Without memory you could not, as amnesiacs cannot, plan for the future. In short, you would be frozen in time as are those with advanced Alzheimer's disease. As Chuck Klusterman (2004) puts it:

> " Most people consider forgetting stuff to be a normal part of living. However, I see it as a huge problem; in a way there's nothing I fear more. The strength of your memory dictates the size of your reality.' "

CHALLENGE YOURSELF

What are the implications of believing that your memories make you who you are, and then suddenly suffering 'transient global amnesia' – a mysterious short-term memory loss usually lasting only a few hours? Would this time be a restful vacation from yourself, or a terrifying loss of identity, or something else? What (or who) do you become without your memories?

Earliest memories

One of the most puzzling things about particularly early memories is that we often see ourselves in the third person. We see the child we were sitting on the floor with our toys – we don't look out through the eyes of that child. This oddity is noted by Charles Fernyhough (2012) in *Pieces of Light*, when discussing how memory works as a reconstruction.

> “If I was really reliving an experience that I recorded in my mind, I should be looking out at that room through my own eyes — but I'm not. Something has flipped around. The perspective has changed.”

Memories as reconstruction

One of the persistent models of memory is that of possession. We *have* memorie**s** and they are stored away in a metaphorical filing cabinet or a library of mental DVDs to be retrieved as needed. Harry Potter was threatened with having his memories stolen as if they were things. In *Total Recall*, the secret agent had his memories wiped out and replaced with a chip.

Exercise

12 What does it mean to ***have*** a memory? To ***have*** anything at all? Think about the different meanings, sometimes subtle, among the various uses of ***to have***. Here are some examples.

- I have a cold.
- I have five pesos.
- I have a name.
- I have a feeling.
- I have a shoe size.
- I have an appointment.
- I have a sister.

Fernyhough claims that the metaphor of the filing cabinet or library will mislead you. Rather, we should think of memories less as records of past experience and more as reconstructions created in the present in order to meet some need. At the cognitive level, they are mixed up with thoughts, beliefs, emotions and perceptions – more like imagination when you make something new out of familiar parts that shift each time.

Another memory expert, Alison Winter (2012), in *Memory: Fragments of a Modern History*, tells us that advanced technology provides a rough analogy of memory reconstruction. We take a memory picture of an event, but then we tweak it, and crop it and fix the colour to suit ourselves. It's no longer quite the same thing.

For instance, you might have a very clear memory of sitting with your grandmother in the hospital for two hours. But you certainly don't roll out two hours of memory. What you have is an image with some details in it. More than a flashbulb memory, but not two hours like a movie. Perhaps memory needs to extract the important bits or hold just the gist of the situation in mind. Otherwise, you could never get anything done or have the time to think about anything. There's a Borges story about a man who remembered every single thing in the world and was so stuffed up, he couldn't move.

Of course the reconstruction model makes memory unreliable, as psychologist Elizabeth Loftus has testified to many times about the recollection of eye-witnessed

accounts. She and others warn us that it is difficult to separate how much of memory is drawn from the need to tell a coherent story. This is a pressing need which sometimes might be satisfied at the expense of memory's correspondence to reality, especially as we tend to add on feelings, beliefs, and even knowledge obtained after the experience.

In contrast to the reconstruction model is the commonsensical feeling that we can trust our own minds as a valid basis for action, that our entire lives are somewhere 'in there' – in our cortex or hippocampus – and the problem is with retrieval. Figure 2.6 is a model that suggests memory works in this sort of way: experience is registered and, if we are paying attention, becomes part of our short-term memory. With repeated use and rehearsal, short-term memories are committed to long-term memory from where they should be retrievable.

Figure 2.6 How memory works.

Memory and emotion

Perhaps many would agree with the emotional component of memory including David Reisman's view that people tend to remember best the things they felt most deeply. That is plausible but is not all there is to it. But it does point out the connection between emotion and memory as just one of the links among the WOKs. Not surprisingly, current research shows not only that vivid sensations can lead to vivid memories, but that retrieval of specific experiences (episodic memory) can be triggered by emotional cues that match the ones in the recollection.

Memory research offers us an interesting concept, **the reminiscent effect**, which claims that the most memorable events in life are imprinted in our late teens and early twenties and held most vividly throughout a lifetime, music and smells especially, although we rarely credit the strength of the olfactory receptors. Thus the music you respond to today will be your music forever.

> “It is easier to recall poetry than prose and still easier to recall songs. Mostly these are learned by heart which means the learner is totally involved, the heart being the place where all senses co-mingle and all memories live.”
>
> Carroll, 2003

Memory and perception

Memory is one of those mental features we can't choose to accept or avoid, even as we know memory is deceptive, that we are often mistaken, and that self-interest, confirmation bias, and wishful thinking play a huge role in what we recall. But wait a minute, are we talking about memory or perception? Same thing? Let's add on that memory is conditioned by context, including the emotions that surround the situation and the personal history of the one who is reporting the experience. Memory or perception? How astonishing (or maybe it isn't) that we are not easily able to say which is which. Again, a connection between memory and other WOKs.

Memory and language

And we shouldn't leave out language as a way of remembering when it is so central to memory research. A periodical called *The Journal of Memory and Language* published in Edinburgh, Scotland is just one source of scholarship about the links between these two WOKs. One recent article, 'If Lions Could Speak' explored whether or not people can register and recall if a sentence is hypothetically true even if what it describes can never be literally true, given the laws of the natural world. The enormous storehouse of knowledge memory rather than experiential or emotional memory is a complexity of language, imagination and reason that only begins to hint at the ways in which memory is central to so many of our WOKs.

CHALLENGE YOURSELF

Do you think you would have a better sense of self if you had a better memory? Does having a better memory make you smarter? Does knowing the dates in history guarantee that you have plumbed the meaning of the events?

The decline of memorization

Preliterate and oral cultures usually have excellent memories and societies that are sometimes called 'primitive' often have staggering capacities for remembering. Certain Polynesian communities can recite family trees that go back dozens of generations. In a similar vein, in the late Middle Ages, the Inquisition found it was not enough to burn books because so many people had learned most of their scripture by heart. Even today in India it is said that if all written and printed copies of the *Rigveda* (about as long as the *Illiad* and *Odyssey* combined) were lost, the text could be restored at once by scholars from memory. And it is not so long ago that students in India could memorize a textbook and reproduce it word-for-word in an examination room.

But it has been argued that the memories of literate peoples have been impaired by print – and in contemporary societies by the availability of information on the internet – because we know that we don't need to bother ourselves with what we can find again easily. School children are seldom asked to memorize poetry or lists of countries of the world the way they once were. What value do you place on a good memory beyond competing in mental athletic contests or passing examinations for university entrance?

Even so simple a task as subtracting 13 from 40 (procedural memory) requires holding the command in mind, remembering the given numbers and how they relate to one another, the operation of subtraction, recognizing the answer and so on. Memory-impaired patients have shown us that it is not so easy. Although memory research is now close to 100 years old, the mechanism(s) of these skills or gifts is still an open question.

CHALLENGE YOURSELF

What is the collective memory of your school? Does your collaborative remembering involve people or events? Of a happy or sad nature? Of triumph or tragedy?

Collective memories

One of the few safe things to say about memories is that *mine are mine and yours are yours*, and that each of us knows our own unique memories better than anyone else. This is true even when several people have supposedly seen the same thing: a car crash, a football game, a play, or a teacher's lecture. Surely we can count these realities as examples of personal knowledge. Yet, there exists something called 'collective memory' as well. This is not group memorization so much as a shared experience that unites people in an emotional way, even if they are not known to one another, or even if the carriers of the memory were not present at the time. To give just one example, it has been thought that the collective memory of the Jim Crow laws in the American South in the Reconstruction Era helped to propel the civil rights movement decades after the actual historical events.

Although collective memory shares some features with individual memories (visuals are more powerful than words), collective memory is a phenomenon in its own right as a meaning-making activity and is not held to the same degree of specificity or accuracy. Nearly every country has its memorials and heroes around which to rally the culture and reaffirm identity. Think of the Holocaust Museum, the Hiroshima Memorial, the rebuilding of the World Trade Towers after 9/11.

Mind reading

Two opposing concepts are dominant in memory theory – that past events are perfectly preserved in the library of our brains and that memory is unreliably conditioned by physical and cultural circumstances. As a result of neural imaging, there is currently enormous interest in the field and findings quickly move out of the laboratories and into consulting rooms or the film industry and, not surprisingly, into culture at large. Dozens of articles about 'beneficial forgetting' and the ethics of memory manipulation can be found with a simple Google search about the treatment of post-traumatic stress syndrome in the military with all that that implies for the terrors of twilight sleep and brain-washing.

'Finding the Truth About Telling the Truth' could be the title of an article about one of the cutting-edge uses of functional magnetic resonance imaging (fMRI). This technique has become the newest form of lie detection used in crime-fighting in some parts of the world. In brief, the accused is put into a scanner and listens to recorded information that only a participant in the crime would know. The brain 'lights up' in certain areas when experiences are recognised or relived. The brain images are recorded by the fMRI machine to show whether or not the suspect recognizes the information.

In most countries such scans are not admissible as evidence in court. But in India, brain scan images have been allowed as evidence for several years and in 2008, a woman accused of killing her fiancé was convicted on the basis of such evidence.

At least one company in the USA offers memory searches to establish a person's innocence or guilt centred on whatever the accusation is. Reactions range from 'fascinating' to 'unconscionable'. We are still in the early days of neuroscience explorations of the brain and there are many open questions.

2.8 Imagination as a way of knowing

One of the most famous remarks about imagination comes from Albert Einstein (1929):

> "Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."

Similar to poetry, such quotations compress meaning into a few words. Perhaps trying to interpret what Einstein meant would be a good way to begin to think about this faculty of mind that brings new knowledge to us.

CHALLENGE YOURSELF

Einstein doesn't say that one is good and the other bad, but he does say that imagination is more important, and so he implies that they are different in some way. What ways would these be? Do you think imagination and knowledge are valued differently? Which do you think is more important? Is this a false dichotomy question?

All creation is the result of imagination, but not all imagination is creative if what we mean by creative is that the imaginative act results in something original and appropriately useful. While these words – innovative, inventive, original, artistic – belong to the same family, they are not identical. However, in this section we use them more loosely..

Exercise

13 Draw a line placing imagination at one end and knowledge at the other.

Knowledge ———————————————————————— Imagination

Using rough definitions of ***knowledge*** as 'somewhat equivalent to having a lot of facts and theories that you can access' and ***imagination*** as 'the ability to put that knowledge together in new ways', where would you place the following people on the line?

An artist, a dentist, an accountant, a business executive, a tennis champion, a rock musician, the head of Apple, the head of school, the head of a country, a teacher, an assembly line worker, a cook, a chef, a baby-sitter, a historian, a mathematician, an inventor, a choreographer, an equestrian, a marathoner, a scientist, an engineer, a housewife, the lone survivor on a deserted island.

Where would you put yourself?

Personal and shared imagination

Theodule Ribot, a French psychologist says that no one knows how many acts of imagination it took to transform the plough, which started out as a simple piece of wood with a fire-sharpened end into what it became after a long series of alterations. In the same way, the dim flame from a branch of resinous wood, the first crude primitive torch, led us, through a long series of inventions, to gas and electric lighting. All the objects used in everyday life, including the simplest and most ordinary ones, are, so to speak, *crystallized imagination*.

The *Journal of Russian and Eastern European Psychology* suggests that it is clear from this that our everyday idea of creativity does not fully conform to reality. According to everyday understanding, creativity is the realm of a few selected individuals, geniuses, talented people, who produce great works of art, are responsible for major scientific discoveries or invent some marvellous technological advances. We easily recognize the role of creativity in the accomplishments of Mozart, Rumi, Edison, Darwin and Madame Curie, Maya Angelous, and Freida Kahlo, but we typically believe that such creativity is completely lacking in the life of the ordinary person.

A 20th-century plough is many, many imaginings away from its wooden precursor.

However, this view is incorrect. To use an analogy devised by a Russian scholar, just as electricity is equally present in a storm with deafening thunder and blinding lightning as well as in the operation of a pocket flashlight, in the same way, creativity is present not only when great works are born but also whenever a person imagines, combines, alters, and creates something new, no matter how small a drop in the bucket this new thing appears compared to the works of geniuses.

When we consider the phenomenon of collective creativity, which combines all these drops of individual creativity that frequently are insignificant in themselves, we readily understand what an enormous percentage of what has been created by humanity is a product of the anonymous collective creative work of unknown inventors. So, in trying to understand the world, we are compelled to consider creativity as the rule rather than the exception. Of course, the highest expressions of creativity remain accessible only to a select few human geniuses; however, in the everyday life that surrounds us, creativity is an essential condition for existence and all that goes beyond the rut of routine (Figure 2.7).

Consider examples from novels or films for each square in Figure 2.7. For example, there's the dentist from Woody Allen's story, *If the Impressionists Had Been Dentists*. The dentist here got carried away and made an inspired and marvellously original denture for a patient – but it didn't even begin to fit her mouth. Square 2. He was happy. She wasn't.

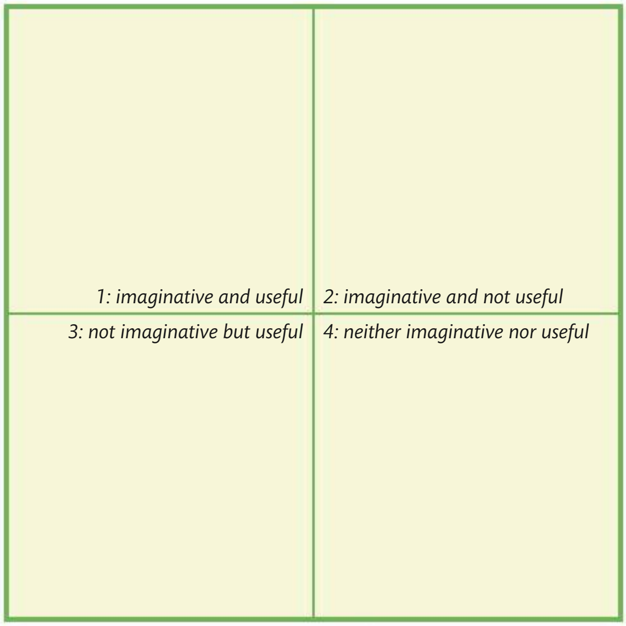


Figure 2.7 Imagination and usefulness.

Looking for imaginative thinkers

If you want to work in Silicon Valley, don't bother showing off what you know. They take that for granted. To improve your chances you should try to display what you can do with what you know: square 1 stuff. Hence the title of the book, *How Would You Move Mount Fuji*, a collection of Microsoft's often wacky interview questions used to test the applicant's attitude and skills related to creative problem-solving. As an innovative company, Google does the same with questions such as: *How many golf balls can you put in a bus*? Stanford Business School talks about two mindsets. Type 1 is fearful of making mistakes, which characterizes most individuals and corporations; making a mistake is shameful and painful. On the other hand, type 2 is fearful of losing out on an opportunity, afraid of sitting on the sidelines while someone else runs away with the new idea. Failure, if you can call it that, or being wrong for the moment, does not shut down their creative juices, but drives the imagination on to another *Aha!* moment that leads to the next innovation. A bad idea can be tossed away but a negative attitude or sulking over a mistake takes you nowhere.

There are many questionnaires designed to measure creative thinking but their validity is sometimes questioned since they seldom centre on real-life situations. But one finding is a strong relationship between metaphoric expression and flights of the imagination.

Until recently, students trying for entrance to All Souls College in Oxford, UK took a simple but devilish three-hour exam (one among many) consisting of a single word – water, miracle, harmony – discovered only on turning over the paper at the beginning of the session. Although there were no right answers, the resulting essays were thought to give the college insights into how candidates made connections and put their knowledge together in new ways.

To learn more about questionnaires and surveys that have been devised to measure what we are talking about, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 2.4 to access a PDF about the Creativity Quotient and weblink 2.5 for information on the Barron Symbolic Equivalence Test.

Look at the assumptions in this exam. The first is that everything – including every single word – provides an opportunity to leverage what you know by stretching your imagination, and that such ingenuity is prized. How would you prepare for such an exam? How do you prepare for most exams?

CHALLENGE YOURSELF

How has originality been fostered in your school? Look around at the spaces you work in. Do they inspire the imagination? Compare your upper school classrooms with those in the elementary grades. Do you look at everything in your environment as an opportunity for ingenuity? If your classroom were sensually stimulating, could you concentrate on the teacher's lesson?

Schooling for the imagination

Sir Ken Robinson, an educator and writer from the UK, made a sweeping generalization on a TED talk when he posed the rhetorical question, *are schools killing creativity?* His meaning is, are we diluting or squandering the natural capacities of children to be curious and creative, to take chances as they go along? In short, he asks are we shaping our future citizens to be afraid to be wrong, afraid to take chances, afraid to be experimental? Are we training them to put their best efforts into only finding the correct answer?

> “A teacher was strolling down the aisles of the kindergarten art class. She stopped at one little girl's table and asked her what she was drawing.
>
> 'I'm drawing God,' the budding artist said.
>
> 'But, no one knows what God looks like,' the teacher said.
>
> 'They will in a minute.' ”
>
> Adapted from Robinson

Robinson goes on to claim that all over the world there is a hierarchy of subjects in schools ranging from maths and languages at the top to the arts at the bottom. And within the arts, music is privileged while dance is at the bottom. When schools fall into trouble with their finances, the arts are the first to go. Try to answer to yourself why this is the case. Note that he says this is a *global* reality and not representative of any particular culture. Indeed, it is our schools' hidden curricula to promote 'book learning' over everything else. And attached to this agenda is the pressure to get serious and not play around. In other words, trade your imagination in for memorizing the best that has been gathered together by your teachers and textbooks, and please your parents with your efforts.

CHALLENGE YOURSELF

If imagination allows us to put together our knowledge and the things around us in new ways, how is this different from critical thinking? Can't critical thinking and analysis give new knowledge as well? Is it critical or creative thinking that will give you the answer to puzzles such as the following. There are six eggs in a basket. Six people take one of the eggs. How can it be that one egg is left in the basket?

Critical vs creative thinking

Back in the early 1970s, when the IB was in its infancy, TOK was talked about as a critical thinking course until a group of parents stepped up to say that they wanted a creative thinking curriculum, specifically centred on Edward de Bono's 'lateral thinking'. This is a problem-solving technique involving leaps of the imagination rather than step-by-step logic. Warm-up examples included the by now familiar question, how many things can you do with a brick or a piece of paper? Most people can come up with a few obvious answers – use the brick as a paperweight or a doorstop – but others generate dozens of fresh ideas through thinking 'outside the box'. de Bono thought that this kind of education, thinking with new perspectives, reframing and 'breaking the mould' could be learned with the right instructional techniques.

Alec Peterson, one of the fathers of TOK and the first IB director general believed that one mark of an educated student is what they can do in novel situations, not what they score in their exams. He and others promoted the core of the IB Diploma – creativity,

action, service, the CAS requirement – as a way to give value to the importance of life outside the world of academic studies.

Creation, imagination and memory

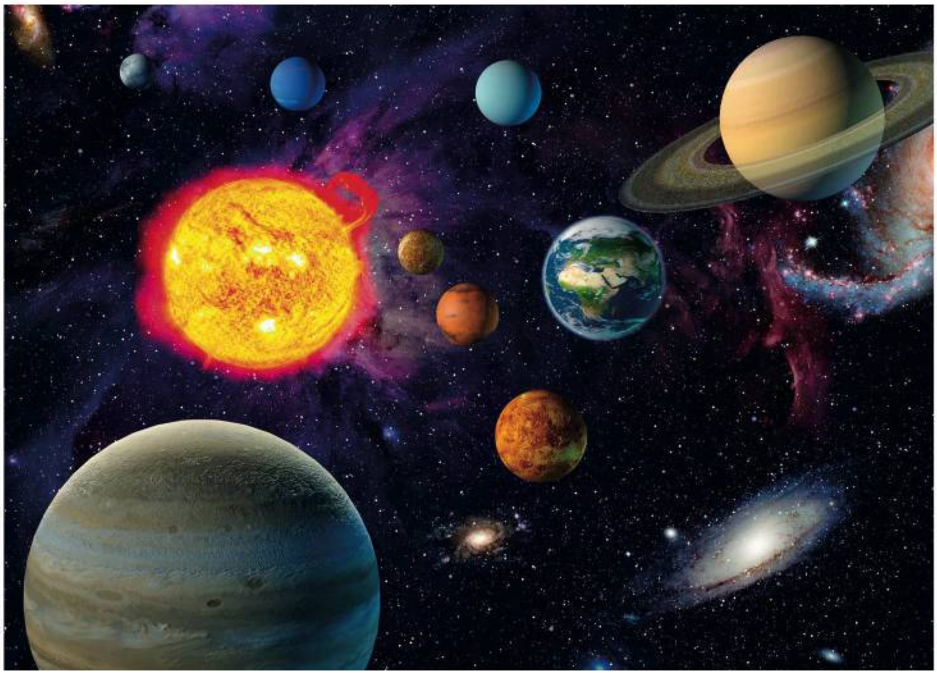
Consider these quotations linking imagination to memory.

> “Imagination selects ideas from the treasures of remembrance and produces novelty by varied combinations.”
>
> **Samuel Johnson quoted in Murray, 1837**

> “Imagination depends mainly on memory but there is a small percentage of creation of something out of nothing with it. We can invent a trifle more than can be got at by mere combination of remembered things.”
>
> **Butler quoted in Butler and Hacket, 1917**

Can you see how both ideas dip into memory for new ideas but Butler’s belief that there is a bit of something created ‘out of nothing’ is the seeming miracle of imagination?

> “The idea that things need a beginning is due to the poverty of our imagination.”
>
> **Russell, 2009**



No one has actually seen such an image as this – it has to be imagined.

The most powerful examples of imagination are those found in creation stories and myths where first there was nothing, and then there was everything. They are almost always just a bit beyond our reach since the human imagination cannot grasp nothingness. Nor can we imagine things not in space or a thing without shape. Time flies, you may say, or maybe time drags – both are metaphors of the natural world – but there is always time. The imagination cannot concoct a world otherwise. Can we imagine a world without causes? Some say we cannot think without these concepts, thus we cannot imagine their absence.

From personal to shared knowledge

In *The Marriage of Heaven and Hell*, William Blake writes, *what is now proved was once only imagined*. Without that first creative moment, our knowledge would be the poorer. Here's how it seems to go: an idea of what could be comes to mind – call it a vision or a new thought – and it belongs to no one but you. It's personal knowledge (if we can call it that at this point) and needs realization. But how many creative ideas become real? Probably a fraction of what could be. We could suppose that most such ideas fall on stony ground. A writer needs words, a musician needs notes, a cook needs ingredients and a scientist needs a lab. Others need money, encouragement, time, passion or a Muse. What do you need?

Examine Figure 2.8. How does an intuition, an idea, a hunch or a hypothesis on the left side pass from private to public knowledge, from personal to shared knowledge, from imagination into the areas of knowledge? Does shared knowledge always start as an act of imagination? Probably not. The scientist, for example, may form a hypothesis based on a careful review of existing research. Or the senior doctor leading the rounds in a hospital may challenge students to *imagine a patient* … Then the team proceeds to form a list of what might be the problem followed by a critique examining what might be the cause. The origins of knowledge are many.

While the power of imagination cannot be denied in the formation of new knowledge, it is not always the case that it is welcome by the academy or the public.

It is now easy to revere Galileo Galilei and to marvel at Ignaz Semmelweiss's discovery of childbed fever, but in their times these men were reviled. Galileo was imprisoned and Semmelweiss committed suicide. What did they do? They offered ideas that today are accepted to the point of being commonplace. Galileo asked his contemporaries to switch their perspective about the nature of celestial objects; Semmelweiss reframed 'childbirth fever' from a woman's malady to a blood infection through a change in language. These are just two examples in the history of intellectual and imaginative thought where knowledge is finally triumphant but not without a struggle and a human price to be paid.

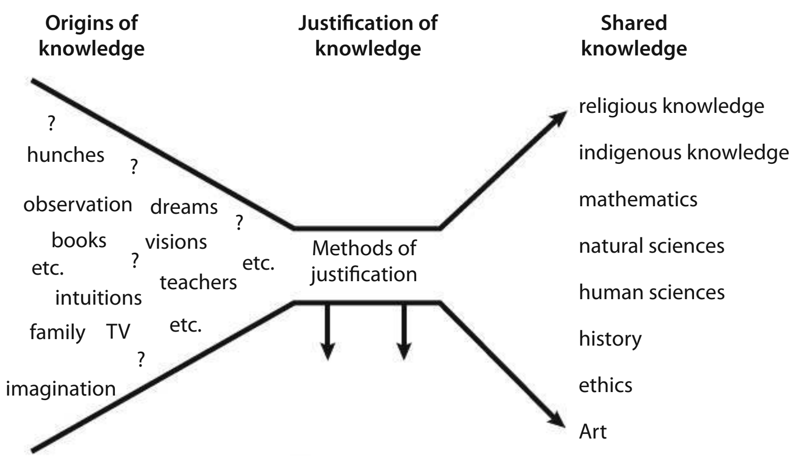


Figure 2.8 Where does knowledge come from and how does it become shared?

2.9 Faith as a way of knowing

If you had to list eight WOKs before looking at the TOK syllabus, would you have guessed that faith was one of them? You would probably say reason and perception right at the beginning. Then, maybe, imagination and intuition after a moment's thought. Perhaps even language and memory thereafter. But emotion as a WOK? And faith? Both have caused consternation behind the scenes over the years.

There were always those who doubted if emotion as a WOK could stand up to reason and perception in the realm of shared knowledge where rationality and empirical evidence had the final say about what was collective or objectively true. Such freedom is part of the liberality of a good TOK experience. In a way, the same goes for faith as a WOK. As a private matter, who is to say what someone believes or not, with or without justification? As shared knowledge, things look even less clear. A person can belong to a faith whose members number in the millions and who all assent to a common core of beliefs and values, yet in the end faith seems to belong to the personal realm of the single individual who is the architect of his or her own life. And one person's faith (or not) is seldom convincing to anyone else who is building their own set of truths to live by. One person may envy another's faith and certitude about what could be called the mysteries of life, but can it be borrowed? In the end, people have to make up their own minds (if the mind has anything to do with it.)

You are responsible for your own ideas. They are the furnishings of your mind. They are your self. Be good to your self. Do not litter your mind with rubbish.

Most of the structures of your life are set up without your choosing. Where you were born, of whom, in what circumstances, of what gender or intelligence – these are all outside your control. But what we do with 'the hand that we are dealt' seems to belong to us in some autonomous fashion. This includes the ideas we accept as true or false and how we hold them whether on trust, on faith, with logic or sense experience. To paraphrase Einstein: If you are ashamed of shabby clothes and shabby furniture, be more ashamed of shabby ideas

A story about faith

There was once a young girl of fourteen who was raised in a nice Christian family in Midwest America. She went to Sunday School, she read her Bible and she sang in the choir at church. Then one day she had a shock of such proportions that she questioned the very foundations of her belief in a watchful God of goodness and power. The next week, she went out into the Great Plains and sought to test her faith in a manner similar to Moses and the burning bush. If God shows me lightening, she thought, I will believe; if there is no lightening, I will not believe. There was no lightening. The girl went home. She stopped believing. She lost her faith. The map of her life had changed.

The girl was using reason to test her faith as in the following syllogism. If God exists, then lightening will strike. Lightening did not strike. Therefore, God does not exist.

How often does lightning strike in the Great Plains of the USA?

Because, as her mother said, she thought too much for her own good, the girl wondered about what had happened. *I want evidence*, she said. *I want to believe, but I need proof*. She talked to her older sister who said, *If you need evidence, you don't have faith. And, anyway, how do you know? Maybe the evidence was all around you and you just didn't see it. Do you think you can simply whistle up God by snapping your fingers?*

This fictional girl represents many who believe and doubt over and over again, and who may think too much about things that can't be sorted out through thought alone. What's important in this parable is the difference between knowledge, belief and faith, and how difficult it is to resolve at the personal level (and on your own), if you have been culturally conditioned to need specific kinds of evidence. No wonder some people don't want to think or talk about it.

It is a risk to put anything down on paper about faith and religion since the moment something is described a thousand exceptions come to the fore. Indeed, of the 20 major religions of the world (and hundreds of others) not all centre on faith as do the Judeo-Christian-Muslim grouping. But it is important to remember that however weak or strong the beliefs of the devoted, there is an irreducible personal character to faith and a public feature and shared understanding to religion.

The meaning of faith

Imagine taking a word association test where I say black and you say ________; I say cat and you say ________. The chances are that if I say faith, you will say something to do with religion. Yet faith can and has been used synonymously with belief and trust in secular matters as well as in religion.

A lovely translation of the Hebrew Bible retains the Greek meaning of *pisteuein* in the Old Testament when faith is defined as 'the assurance of things hoped for, the conviction of things not seen' (Hebrews 11.1). And in the Qur'an 'a living faith of the heart' attaches to a consideration of something as sure and reliable without doubting … that 'God has created the heavens and the earth with truth' (Verse 14:19 English translation).

Knowledge, belief and faith

The following is not 'gospel' in any sense of the word, but it might help to get you started on your personal reflections about the terms 'knowledge', 'belief' and 'faith'

In the history of epistemology, knowledge has often been taken as justified true belief, a legacy of Plato and others throughout the centuries. As a strict definition, it carries with it the idea of truth and evidence that often gives the knower a feeling of certainty. After all, haven't the propositions of history, the hypotheses of science, the theorems of mathematics passed some kind of demonstration in some objective way supposedly understood by all rational people? And because of these agreed demonstrations, we can share our knowledge. It is justified by methods that help us answer the central TOK question, *how do you know what you know?* Perhaps nearly all of what we claim to know comes to us in this way. Newton said he stood on the shoulders of giants; think of all the shoulders we stand on.

But note there are no claims here to infallibility. A feeling of security in our knowledge can be misleading. Theories change, paradigms shift, even facts may be correct today and wrong tomorrow, and if the accepted laws or interpretations of reality have not been falsified, they are as good as it gets in terms of confirmation. There is a pragmatic value to all this. Some say that as long as it works, who is concerned about absolutes? If the plane flies and the disease disappears, why should we worry about truth at the theoretical level? Living with a degree of uncertainty and doubt is as much a part of the search for knowledge as wonder and curiosity. Also, the definition of knowledge as justified true belief rules out much of what is important in life – art, values, morals, intuitions, emotions and all that cannot be verified in some hard and fast way.

Beliefs are a wider set of ideas. In this area, we can have our own beliefs or opinions, but others can have theirs as well and we can agree or disagree. But here is also where the belief is sometimes relative to the individual or group or culture. Just as knowledge can be held in a strong and weak sense or proven provisionally or with near certainty, the same goes with beliefs. We can believe something with only the surface of ourselves or we can believe with the totality of our being. But if you were a careful speaker, you would distinguish between *I know* and *I believe* and want others to do so also, even though the likelihood is that these expressions will often be mixed up in everyday speech.

Can we say then that beliefs may be the lesser thing in a knowledge sense, but they may be the more important thing existentially (the way you live your life)? As Sam Harris (2004), author of *The End of Faith* says, *a belief is a lever that once pulled moves almost everything else in a person's life: it shapes your world, it controls your decisions, it manages your fears, and it shapes your emotional response to others.*

Exercise

14 What difference does it make in your life to believe or not believe something? How might it make you a different person?

Note how your actions and sense of self are affected by your faith, belief or knowledge in the following realities.

- It is going to rain.
- Your father is mad at you.
- You are good looking. You are not good looking.
- You can dance. You can't dance.
- Nobody likes you. Everybody likes you.
- You are smart. You are not smart.
- God is watching you.
- The world will end tomorrow.
- The rapture is coming.

Faith is a special kind of belief. Seemingly all questions of demonstrations of fact go out the window. Faith in the religious sense is unjustified in matters of ultimate concern. The believer may find signs or hear voices or feel a presence but, deep down, faith as a species of belief is related to the invisible. Faith makes the choice to say *I believe in what I cannot see*, for it is not the physical sight that gives reality to things but the heart and the mind and intuition coming together that affirm the reality of my faith. If the evidence were the agent of conviction, then why would we need the word *faith*?

Even Aristotle, a biologically minded philosopher from Athens (350 BCE), allowed that in addition to knowing by doing, knowing by proving and knowing by reasoning, there was something similar to intuition that allowed for knowledge without demonstration. It's a short distance to expand this notion to the *numinous*, a concept of being in the presence of a spirit beyond the natural world, or at least what we take to be the natural world.

Maybe it is us. Maybe not everyone is capable of knowledge through faith similar to a radio receiver that can't bring in certain signals. Because a blind person cannot see, does that mean there is no light? Because a deaf person cannot hear, does that mean there is no sound?

CHALLENGE YOURSELF

Is it possible that we are in the grip of habits and practices that are not based on beliefs at all? At least so far as we know? Do you think that some or many or most of our beliefs are forced on us by people actually asking us questions?

CHALLENGE YOURSELF

What do you take on faith?

- That there is a physical world?
- That there is a spiritual world?
- That there is an afterlife?
- That the physical world is an illusion?
- That the physical world is an ultimate reality?
- That the axioms of mathematics are foundational and cannot be disproved?
- That there is order and law in the cosmos that reason and experience can discover?

In *Amazing Grace: A Vocabulary of Faith*, Kathleen Norris tells us that faith should be thought of as a verb, not a thing you have or don't have ... and Doris Betts writes in a *Call to Gather* that faith is not synonymous with certainty but is a decision to keep your eyes open.

The consequences of believing something on faith, depending on the context, carry positive or negative connotations. Some feel it is a virtue to be able to believe in something without evidence while others feel it is foolishness. Some believe that a higher more perfect realm eludes our language and our scientific ways of separating truth from its opposite. Perhaps one way of dividing faith-based thinking from the criticism of the sceptics is to point to what, in most logic books, is called circular reasoning.

Here is an example.

> I know God / the Prophet exists because I read it in the Bible / the Qur'an.
>
> I can trust the Bible / the Qur'an (or any other sacred text), because it is the word of God / the Prophet.

A to prove B, then B to prove A. For the faithful this makes perfect sense. For the non-believer, it is a fallacy.

Whatever can be said against religious faith by the sceptics, there is no discounting its power within the realm where it resides. People are willing to die and willing to kill on its strength. They are even willing to make the most agonizing of sacrifices. Think about this story of Abraham as it is commonly repeated from the Genesis, the first book of the Old Testament of the Bible. Abraham follows God's instruction to sacrifice his son, Isaac. Yet, when father and son reach the mountain top and Isaac is bound on the altar, an angel stops Abraham's hand that holds the knife and provides a ram as the sacrificial offering. Abraham becomes an exemplar of faith and is rewarded for his loyalty.

CHALLENGE YOURSELF

What do you say to someone who asks you about the difference between people who receive messages from God and those who believe that aliens are beaming messages to them?

The Danish existential philosopher, Soren Kierkegaard thought that a God who would make such a demand is beyond understanding by the rational mind. Such beliefs would require 'a leap to faith'.

A draft essay on whether or not faith is a legitimate way of knowing

Faith can be a belief in something for which there is little conventional evidence (reason or sense experience), such as God. Faith can also be a belief in the truth of something because no one has yet proved it wrong, but faith is not always about religion. There is a kind of everyday faith, too, such as believing your teachers and your parents, or faith in your friends when they tell you things. There are also non-personal faiths, such as that the Sun will rise tomorrow or that the floor will be solid under your feet. There is also faith in yourself, in your own instincts and your own judgements, such as having faith in the safety of crossing the street or in your hunch that someone is trying to fool you. Maybe some people would call this trust, not faith.

I have faith that the Sun will rise tomorrow because this is accepted as a given and there is evidence in support of it, even though it is possible that tomorrow will not be like today. The world could end, but no one I know is worried about it and we all have plans for next week. That kind of knowledge claim is a scientific statement and belongs to a lot of different theories; it is the way we understand our universe. Actually, we don't worry or doubt our faith in the Sun rising tomorrow, because we have faith in scientific knowledge –even though science is never 100 per cent certain or perfect.

Take a really simple example, such as: I believe the ball will fall to the floor when I drop it. And it does fall to the floor. So my belief was right. But the ball didn't fall *because of* my belief. It fell to the floor because of gravity, which I have faith is the right explanation because my teachers and the scientific community told me and I don't have any reason to doubt them. Thus, it is not just a single knowledge claim – a lot of knowledge claims fit together and a lot of people believe them. Many people believe that the ball will drop, even though they may never have heard of gravity. To me, this kind of widespread belief is what makes it a good knowledge claim.

The same is true in maths. Everything depends on everything else. For instance, if two plus two equals four is true, then two minus two is zero. All this got set up way back with some kind of beginning that made sense and people started working with it. So now, faith has nothing to do with adding and subtracting, because there are other ways that these operations are right or wrong or true or false. All of maths was accepted in elementary school because we had faith in our teachers, but our teachers didn't make maths true or false, they just taught it to us. Then, in secondary school, we found out that if we worked on another base, not base ten, then two and two would not equal four, but that didn't make it wrong in the base ten. So, depending on how you started, you give certain answers because of the rules of maths – not because of faith. So faith has no basis in knowledge claims about maths, except in the very beginning with axioms, which don't really have proofs, but on the other hand, they can't be disproved either.

Turning to real life, I know that we could not have family bonds or friendships or get married if we did not have faith in other people and in our own judgements about these people. This is where faith is trust again. But I also know that this faith is often mistaken, that families turn on one another, friends betray other friends, and husbands and wives are often wrong about one another. So that means we didn't know something about other people based on our faith. But just because we were wrong doesn't mean we have to stop using our faith, especially since I can't imagine how we would get through the day without it.

Ideal knower: the Buddha

In Buddhism, there are two kinds of faith: preliminary faith (the trust with which we begin) and verified faith (the confirmation of preliminary faith). Here are some of the words of the Buddha, who was neither a prophet, a saint nor god. He was a wise teacher and even taught his followers to doubt him.

> “Do not believe in anything simply because you have heard it. Do not believe in traditions because they have been handed down for many generations. Do not believe in anything because it is spoken and rumoured by many. Do not believe in anything simply because it is found in your religious books. Do not believe in anything merely on the authority of your teachers and elders. But after observation and analysis, when you find that anything agrees with reason, and is conducive to the good … then accept it and live up to it.”

03 Areas of knowledge

On previous page – 3D image of synapses. Synapses are connections between neurones which allow information to flow from one neurone to another. There are thought to be trillions of synapses in the human brain and it is widely accepted that they play a part in the formation of memories.

3.1 Introduction to areas of knowledge and the knowledge framework

Knowledge and the knower

All cultures around the world have developed insights into the nature of knowledge. Consider, as examples, these three proverbs from Ghana.

> “Knowledge is like a baobab tree; no one person can embrace it with both arms.”

> “Knowledge is like a garden, if it is not cultivated, it cannot be harvested.”

> “One head does not go into council.”

Before reading on, consider what they might mean.

Here are some interpretations. The first proverb asserts that the extent of knowledge is vast and the individual can know at best only a small subset of it. The second suggests that the acquisition of this knowledge demands an active approach on the part of the individual. And the third reminds us of the value of collaboration in making good decisions. But the beauty of proverbs lies in how they convey multiple shades of meaning, so how else might we read these three from Ghana? For example, we might detect in the second proverb a need for organization of knowledge if it is to be useful. We might see in the third that each individual brings a different and valuable perspective to the matter at hand.

Some of the meanings from these proverbs could be summarized as in Table 3.1.

Table 3.1 Summarizing three Ghanaian proverbs

Knowledge is	Individual knower has/is
• extensive	• limited knowledge
• organized	• active participant
• a collaborative project	• particular perspective

Insights from indigenous knowledge systems can be at least as accurate and productive as those from other areas of knowledge (AOKs), even if they cannot be traced back to their specific circumstances of origin.

Disciplines: Shared organized knowledge

When we turn to examine knowledge itself, we can start to see the accuracy of these insights. In the academic domain, knowledge is indeed *vast* and therefore divided into particular subjects, or **disciplines**, in which it is *organized* around particular types of subject matter and particular habits for addressing them. The fact that this knowledge is, in principle, distributed for you to learn means that it is in the public domain and is therefore **shared knowledge**. Also, in most of these disciplines, knowledge is produced through a *collaborative* effort from a community of individual knowers.

For a sense of perspective on the present, it is worth looking at some of the different ways in which the vastness of knowledge and the need for its organization have been managed in the past. Here are some examples.

- Two-and-a-half millennia ago, the Chinese thinker and philosopher Confucius promoted training in archery in order to develop skills of discipline and precision, and also a course in 'good manners'.
- The ancient Greeks combined arithmetic, astronomy, music, and geometry into a discipline called 'harmonics', but had no interest in foreign languages and would have considered it ridiculous to study them. Plato added a form of gym to meet the ideal of a healthy mind in a healthy body.
- In medieval Europe, university faculties were often divided into religion, jurisprudence, medicine, and the arts.
- Ultimately ill-founded subjects such as alchemy, with its single unattainable goal of transmuting base metals into gold, can die – but in the process, it gave birth to modern chemistry.
- Adam Smith of Scotland considered himself a moral philosopher, more than a century before the term 'economics' became well established.
- Modern biology emerged from 'natural philosophy', or the philosophy of nature.
- The origin of psychology as a discipline can be traced back only just over 100 years.

In modern times, rhetoric (public speaking), logic, and Latin have become neglected as subjects, in some school curricula.

There is an important distinction that needs to be made here between learning knowledge as an IB student and producing knowledge as a practitioner in a particular discipline, although the two activities may occasionally overlap. (When do you think this might happen?) Because you are much more familiar with learning rather than making knowledge, it is sometimes tempting to focus on the former when we should be exploring the latter. Both are important, but it is vital not to confuse them during your TOK journey.

You will recognize a range of familiar disciplines within your IB programme: for example, literature, economics, physics, mathematics, and music. You will also be aware that these disciplines are organized into groups around the diploma programme diagram (Figure 3.1).

You have probably been told that the manner in which these disciplines are arranged ensures that you will participate in and benefit from a balanced programme of studies. But how does this follow? We consider this in the next section.

Figure 3.1 IB Diploma programme.

Classifying the disciplines

The arrangement of the disciplines in the IB Diploma suggests that they can be classified according to similarities and differences. Because you are required to select subjects from across the groups, you gain a broad educational experience.

In TOK, we classify disciplines using a scheme that is similar in some ways to that in the IB Diploma diagram, but not quite the same. This arrangement gives rise to what we call 'AOKs'.

Some of the AOKs refer to groups of related disciplines, for example:

- natural sciences include most group 4 subjects (biology, chemistry, physics)
- human sciences include some group 3 subjects (economics, psychology)
- arts include group 6 subjects (visual arts, music, theatre arts, dance, film) and group 1 (literature).

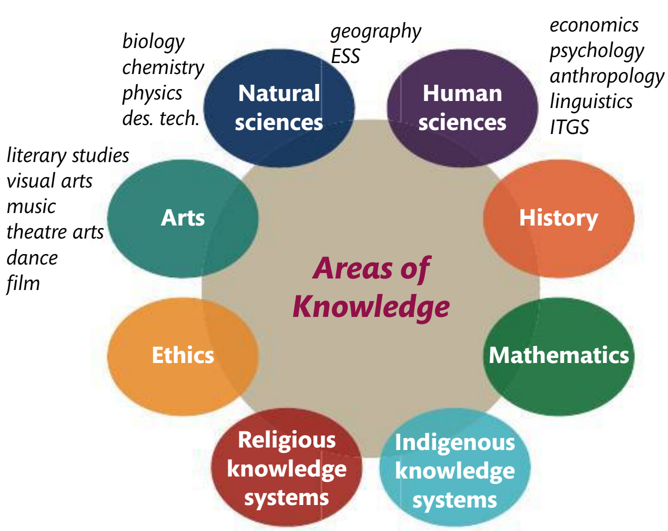


Figure 3.2 TOK areas of knowledge and some disciplines.

Other AOKs represent single disciplines:

- history (from group 3)
- mathematics (from group 5).

And yet others represent forms of knowledge not explicitly recognized as subjects in the IB Diploma:

- ethics
- religious knowledge systems
- indigenous knowledge systems.

So there are eight AOKs in the TOK programme, of which you are expected to study six in depth. Your teacher will organize your course to achieve this requirement. Figure 3.2 shows all the AOKs, with some disciplines (many of which are offered in the IB Diploma) placed tentatively around the outside.

You might ask why AOKs take precisely this form, this pattern of disciplines, as opposed to any other. This is something we will investigate in this book.

Exercises

1. On what basis would you explain the following? Could these statements be contested?
   - **a** Chemistry and biology belong together in the same AOK.
   - **b** Physics and economics belong in separate AOKs.
   - **c** Literary studies and dance belong together in the same AOK.
   - **d** History and mathematics should be considered AOKs on their own.
   - **e** Religious knowledge is an AOK.
   - **f** Geography is a human science.
   - **g** Algebra and geometry are not separate AOKs.
2. What do others in your class think?

What are the grounds for your answers? You may have mentioned the kind of subject matter of each discipline. Or possibly the ways in which they go about their business. Or even the kind of language they use. In doing this, you are starting to analyse the nature of academic disciplines and make comparisons between them.

The knowledge framework

As you identified in the previous exercise, each AOK possesses certain types of feature that can be analysed. These features also function as ways of comparing different AOKs.

We can formalize these methods of analysing and comparing AOKs by creating a **knowledge framework** (Figure 3.3). Creating a knowledge framework for each of the eight AOKs will provide a clearer picture of how they are different and how they are similar.

Knowledge framework

Knowledge framework	
Scope/ applications	• What is the area of knowledge about? • What practical problems can be solved through applying this knowledge? • What makes this area of knowledge important? • What makes the current open questions in this area – important questions that are currently unanswered? • Are there ethical considerations that limit the scope of the inquiry? If so, what are they?
Concepts/ language	• What role does language play in the accumulation of knowledge in this area? • What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area? • What metaphors are appropriate to this area of knowledge? • What is the role of convention in this area?
Methodology	• What are the methods or procedures used in this area and what is it about these methods that generates knowledge? • What are the assumptions underlying these methods? • What counts as fact in this area of knowledge? • What role do models play in this area of knowledge? • What ethical thinking constrains the methods used to gain knowledge?
Historical development	• What is the significance of the key points in the historical development of this area of knowledge? • How has the history of this area led to its current form?
Links to personal knowledge	• Why is this significant to the individual? • What is the nature of the contribution of individuals to this area? • What responsibilities rest upon the individual knower by virtue of his or her knowledge in this area? • What are the implications of this shared area of knowledge for one's own individual perspective? • What assumptions underlie the individual's own approach to the knowledge?

Figure 3.3 The knowledge framework.

Using this knowledge framework as a tool, we look at what kind of subject matter each AOK is focused on, and how the knowledge produced is useful. We examine how this knowledge is packaged and shared, and how a common understanding of it is achieved among communities of knowers. We look at how this knowledge is produced, appraise the contribution of important individuals to its development, and ask what it means to us as individuals. To help us with this goal, we use two metaphors (as discussed in Chapter 1) along the way:

- the idea that knowledge is a kind of map
- the idea that disciplines and AOKs are rather like cultures.

Let's now consider the first of these two metaphors.

3.2 Scope and applications

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

Scope

In 1931, the Polish–American philosopher Alfred Korzybski used the distinction between a map and the territory it represents as a metaphor for the relationship

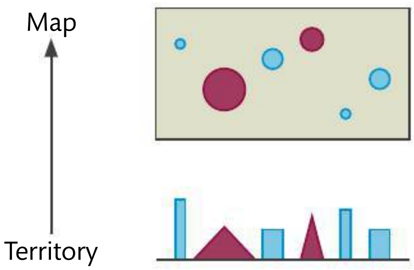


Figure 3.4 Knowledge as a map: world/territory → knowledge/map.

between some aspect of reality and the models of it that constitute our knowledge (Figure 3.4).

If the knowledge in each discipline is a map, what is the aspect of the world to which each map in Table 3.2 refers? An answer is provided for the natural sciences – what about the others?

Table 3.2 AOK maps and what they refer to

Map/AOK	World/territory
natural sciences	the physical, material world/universe
history	
human sciences	
arts	
mathematics	
ethics	
religion	
indigenous knowledge	

Is it easier to identify 'territories' for some areas than others? If so, does this tell us anything important about the AOK, or something about using the idea of a map as a metaphor for knowledge?

Exercises

3 What 'map(s)' within particular disciplines are available for each of the following 'territories'?
- **a** The inheritance of human blood groups (biology).
- **b** The fall of the Berlin Wall (history).
- **c** The shape of a molecule of methane (chemistry).
- **d** Urban land use (geography).

4 For each of the following 'maps', consider the questions below.
- **a** Demographic transition model (geography)
- **b** The Phillips curve (economics)
- **c** Fleming's left hand rule (physics)
- **d** Arrhenius theory (chemistry)

- What is the extent of the 'territory' that is mapped?
- What features of the 'territory' are shown in this 'map'?
- What features of the 'territory' are ignored by it?
- For what purpose is this 'map' intended to be used?

Are all AOKs or disciplines described well by the map metaphor? For example, the territories for the natural sciences and history seem easy to identify. But is the metaphor less apt elsewhere?

You might identify the arts as an area in which there is more freedom in map-making than the sciences, for example. Just as scientists are obliged to aim for accurate representations of the material world, artists are also often (but not always) expected to produce work that represents the psychological or social world in some way. In literature, for instance, plots usually need to be realistic, with credible characters, even if they are often larger than life. But perhaps the territory of social relations needs to be represented in ways that make sense to us as human beings – maybe our evolution has sensitized us to maps of particular kinds. For example, the Russian scholar Vladimir Propp found that folktales from different cultures tend to exhibit similar narrative structure, and the Italian writer and philosopher Umberto Eco has made a study of plot structure in James Bond novels that reveals deep resemblances between the books. It has been claimed that film plots follow only a handful of different arcs of development. In striving to provide its maps, perhaps the arts have learned to conform to preferences of mind that make those maps more effective.

With geographical maps there are different varieties. For example, we have physical or political maps. Similarly, there are different knowledge maps for the same territory. In biology, we may invoke a molecular biology model of DNA base substitution in order to explain the incidence of sickle cell anaemia; whereas in classical genetics we would probably prefer to organize the conversation in terms of dominant and recessive alleles, referring to what is called 'heterozygous advantage'. In chemistry, we can use the Brønsted-Lowry or the Lewis model for comprehending the nature and behaviour of acids. In geography, the theories of Malthus and Boserup can be used to explain the relations between populations and resources. Historians explain the Cold War using traditional and revisionist (and post-revisionist) interpretations. Can we say in each of these cases that one knowledge map is better than the other? People often differ in their answers to this question, depending on whether they have a close allegiance to one map or another. Are we just looking at two alternatives – like physical and political maps – whose value depends on what we want to do or find out (Figure 3.5)?

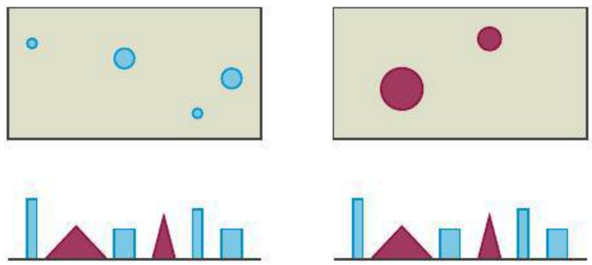


Figure 3.5 Two maps: different.

Or can we conclude that one map is clearly a more accurate representation than another of the same territory (Figure 3.6)? For example, once the process of tectonics in geology was understood, the discipline could provide much better explanations for observations of the world.

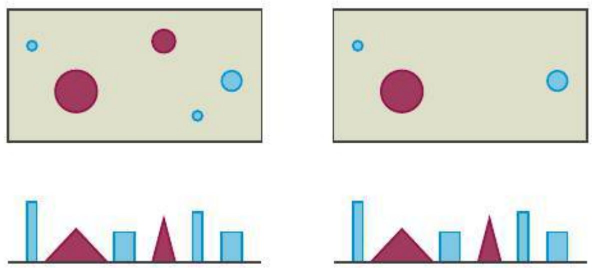


Figure 3.6 Two maps: one more accurate than the other.

Sometimes a map can be constructed that covers a larger territory than the previous one (Figure 3.7). It might explain a wider range of phenomena or it might bring together two territories that were previously thought to be completely separate. It was one of Isaac Newton's great insights to grasp that the force that caused objects to fall to the ground was the same force that kept the Moon in its orbit around us. You might also like to think about the work of other physicists such as James Clerk Maxwell and Albert Einstein, and how they demonstrated links between territories and extensions of maps.

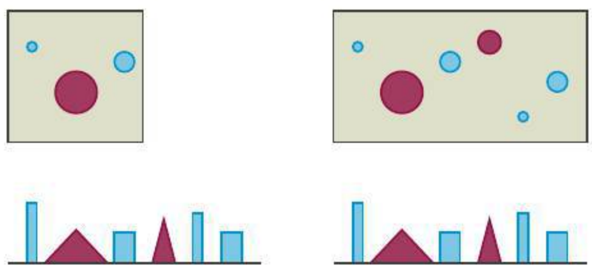


Figure 3.7 Two maps: one covers larger area.

Is it the case that maps are getting better in all disciplines? This would represent progress in knowledge. Would it be fair to measure the success of a discipline in terms of its progress?

Whatever the answer to this question, it is clear that knowledge maps and their relationships to various aspects of the world change as time goes on. Let's look at two perspectives on this process:

- knowledge maps are multiplying and fragmenting
- knowledge maps could be joined up to form one great big one.

Knowledge maps are multiplying and fragmenting

> "Every man gets a narrower and narrower field of knowledge in which he must be an expert in order to compete with other people. The specialist knows more and more about less and less and finally knows everything about nothing."
>
> **Attributed to Konrad Lorenz**

A few hundred years ago, it was possible for an educated individual (sometimes referred to as a 'Renaissance man') to keep up with developments across all disciplines, but the expansion of knowledge has made this impossible. The Austrian ethologist Konrad Lorenz might have been exaggerating, but he put his finger on a key feature of knowledge in the modern world. As knowledge expands, scholars must specialize in order to keep abreast of developments and to be able to function within the community of knowers in their field – they are obliged to focus on ever more detailed maps of ever smaller territories. Lorenz's concern was the fragmentation of knowledge and the difficulties of the connections between different fields.

A problem with specializing.

One interesting example from medicine comes from a physician who talked about his graduating class from medical school 50 years ago. Everyone was a general practitioner. Today, nearly everyone is a specialist of some kind, but patient care is no better. In fact, doctors in different areas often do not know anything outside their field and find it difficult to coordinate with other doctors when treating the same patient.

Exercise

5 **a** To what extent do you think the tendency expressed by Lorenz is real?

b Is it inevitable?

c Do the benefits outweigh the drawbacks?

Knowledge maps could be joined up to form one great big one

Despite the kind of observation made by Lorenz, or perhaps because of it, there are those who look forward to a time when it might be possible to unify all scholarly knowledge. You may have heard of the hopes of physicists to uncover a unified theory for gravity, electromagnetism, and the two forces associated with the nucleus. (Such a unification is sometimes referred to as a 'big TOE' – a Theory of Everything.) An even more ambitious goal exists under a name that might be new to you – **consilience**. This is the idea that all the sciences, humanities, and arts can be brought together in coherence because *nature is organized by simple universal laws of physics to which all other* *laws and principles can eventually be reduced*. You can read more about this in *Consilience – the Unity of Knowledge* by the famous American entomologist and writer on science, Ed Wilson. Rather than providing maps of distinct territories, in this scenario the disciplines would merge into one massive interlocking, self-reinforcing matrix.

Exercise

6 **a** Do you think consilience is a good idea?

b Will it ever be possible?

c Why or why not?

Not surprisingly, this is a contentious idea. First of all, there is the question of whether the unification of knowledge across different areas would be a good thing. Would this bring practical benefits or merely a sense of satisfaction derived from understanding the connections between seemingly independent facts? What is wrong with diversity anyway? There are those who would accuse Wilson of a kind of knowledge imperialism – as a scientist, his vision of unified knowledge seems to rest on the idea that science itself should form the basis for the whole edifice. Critics label this position 'scientism' – the view that science should occupy a privileged status as a sort of supreme form of knowledge, and that all knowledge maps should aspire to be the kinds of maps that scientists produce.

Prescribed essay title 1: If someone claims that both the division of knowledge into disciplines and the division of the world into countries on a map are artificial, what does this mean? What is the nature of the boundaries between areas of knowledge, in your view?

Are there other possibilities?

Is there a path that can be taken between fragmentation into many disciplines and the hegemony of a few? There is evidence of an increasing tendency towards collaborative projects between specialist communities of knowers, which may sometimes spawn new subjects showing differing degrees of integration. What is the point of such **inter-disciplinary** approaches? Maybe there is a fruitful distinction between **trans-disciplinary** approaches that try to unify different disciplines, and **multi-disciplinary** ones that try to achieve understanding through a combination of the insights from separate subjects.

Such initiatives are starting to be reflected in the curriculum. In the IB Diploma, there are now a number of inter-disciplinary courses available, such as Environmental Systems and Societies, and Literature and Performance, in which the subject matter and methodologies of two disciplines are to some extent dissolved in the interests of a new synthesis. If you are following one of these courses, what are your impressions? Are you aware of a synthesis of different approaches, or is there no obvious difference in style from your other subject courses?

Debate about the prospects for inter-disciplinarity might take place during your group 4 project – particularly during the planning phase. Consider the following.

- Are you being asked to work within your individual science subjects and then bring your conclusions to the multi-disciplinary table?

CHALLENGE YOURSELF

Research the publication of *Sociobiology* by Ed Wilson in 1975 and the controversy it sparked. Why do you think it elicited such strong opinions?

- Are you being asked to approach the topic simply as a science student, contributing to a common goal?
- Which do you think would be more effective?
- Is it more important to respect the diversity of disciplines or to attempt to merge them?

Multi-disciplinary approaches encourage a respect for disciplines as constructions that have stood the test of time; trans-disciplinary ones seek to transcend them. **Cross-disciplinary** studies extend the reach of one discipline by applying its concepts in another field, which may be enriched by new insights. For example, bio-politics would be concerned with introducing biological ideas about growth, homeostasis, and decay into the study of politics. We can clarify these four terms:

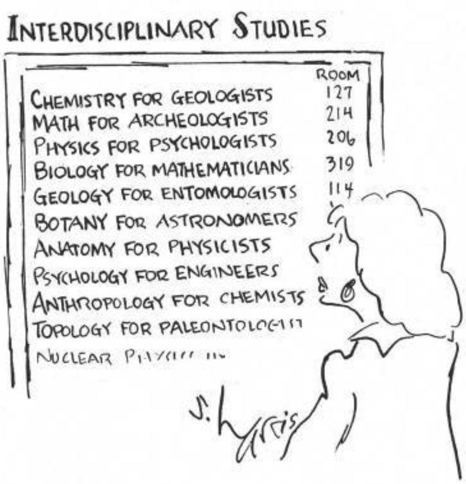
- inter-disciplinary – a blanket term covering all of the below
- multi-disciplinary – means separate disciplines working together
- trans-disciplinary – means the differences between disciplines are dissolved
- cross-disciplinary – is a way of interpreting one discipline in terms of another.

CHALLENGE YOURSELF

Research the work of VS Ramachandran and William Hirstein in using computer technology and scientific concepts in an attempt to discover 'laws of art'.

History suggests that the founding of an inter-disciplinary subject is not easy. Initially, authorities have to come from more established subjects and authors may find it difficult to get articles published in traditional journals other than those in their field. Specialist communities often feel strong loyalty to their own disciplines and are wary of the approaches made by outsiders, worrying about so-called 'mission creep' in which methods and findings established by their own communities become re-interpreted. On occasion, there are accusations that such developments are motivated more by ideology than an objective love of knowledge. Suspicion is perhaps particularly understandable in cross-disciplinary projects, such as those in recent times to apply the insights of biological evolution to literary theory, or of neuroscience to the study of aesthetics.

Inter-disciplinary study is not easy.



Exercise

7 Which categories of inter-disciplinarity do you think the cartoons above represent?

It is interesting to compare these modern developments in academia with the nature of knowledge in indigenous cultures (Chapter 11). Such knowledge tends to be broad in application within the culture but of limited use when removed from that culture. So the limitation here is not the danger of fragmentation of knowledge into disciplines that lose touch with each other, but rather the need for a particular context within which such knowledge is effective as a whole.

Knowledge question

1 On balance, do the boundaries between different disciplines or AOKs promote or hinder understanding?

Knowledge framework: *Scope and applications* – What are the current open questions in this area (important questions that are currently unanswered)?

Many, if not all, knowledge maps are incomplete. All disciplines have open questions that have not been resolved, and many of these are examined in this book.

Exercise

8 Consider some of the following topics. In which is it easiest to identify open questions? Why?

dark matter, dark energy, the origin of sexual reproduction, the origin of life on earth, the ubiquity of life in the universe, the evolution of altruism, the relation between gravity and quantum mechanics.

It is perhaps particularly tempting for IB mathematics students to think of their subject as a discipline that is fully elucidated, with nothing more than 'questions' to solve using established techniques. This is not entirely so. In 1900, the eminent German mathematician David Hilbert proposed 23 unsolved problems in pure mathematics. During the 20th century, most of these problems were resolved, while some new ones emerged. In 2000, the Clay Math Foundation offered a list of seven mathematical problems and a prize of US$1 million for a solution for each of them acceptable to the mathematical community.

CHALLENGE YOURSELF

Research the proof provided by the Russian mathematician Grigoriy Perelman for one of these problems – the Poincaré conjecture – and his refusal to take the money.

While it seems reasonable to expect that many open problems in mathematics and science will be solved sooner or later, the same might not be the case in some other AOKs. For example, it might be that we will have to live with differing interpretations of historical events, or varying views about the shape of history as a whole, without ever expecting any neat resolution. It may be that guidelines for ethical behaviour will always clash, even if they all seem to be well-grounded. In such situations, we might consider that we have at our disposal alternative maps, or perhaps a single incomplete map (Figure 3.8).

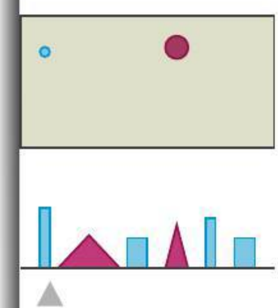


Figure 3.8 Incomplete map.

But the usefulness of such maps is not restricted to comprehension of the world; we can use them to modify the world itself. That is part of what we mean in this book when we say that our knowledge is an attempt to solve problems – of a practical as well as an intellectual nature, and why this part of the knowledge framework is entitled 'Scope *and* applications'.

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge? What makes this area of knowledge important?

Applications

There are some fairly obvious ways in which knowledge from different areas is put to use (Figure 3.9, overleaf). The application of knowledge from the natural sciences is evident wherever we look – our world is a technological one. Insights from the human

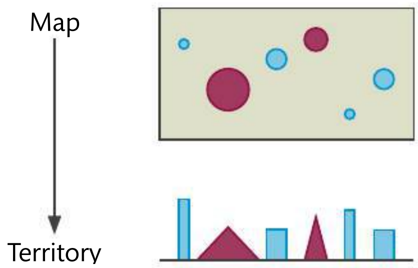


Figure 3.9 Maps can influence their territories.

sciences are engaged in the processes of setting social and political policy. This is where alternative maps may struggle for dominance – this time in the context of applying knowledge rather than acquiring it.

Consider the conflict in 20th-century economics between the views of John Maynard Keynes and Friedrich Hayek as to how to manage the business cycle. Keynes believed that judicious manipulation of aggregate demand in times of recession could stabilize output and help an economy to avoid the worst of a downturn. Hayek, by contrast, held that intervention generally distorted the efficient operation of markets and that our knowledge of economic systems was necessarily insufficient to make the outcomes of manipulation predictable.

And there has been a long-standing argument between some economists and environmentalists as to the best way to think about and value natural resources in order to maximize welfare (Table 3.3).

Table 3.3 Valuing natural resources for welfare

Ecologist/environmentalist	Economist
The economy is part of the environment.	The environment is part of the economy.
Ethical values are irreducible.	Ethical values can be reduced to economic ones.
Natural resources are irreplaceable by others.	Natural resources can be substituted by other natural resources, or by manufactured ones.
Natural resources are capital.	Natural resources are income.
We can't afford to wait for more evidence of environmental damage, as the consequences of it would be so severe.	We should wait for harder evidence before concluding there is serious environmental damage, in order to avoid misplaced priorities.
Ecosystems are fragile.	Ecosystems are robust.
Links with the political left.	Links with the political right.
We are correct!	We are correct!

This kind of dispute can easily escalate – and can perhaps be better understood as a clash of cultures rather than a choice of maps, as we shall see in the next section.

CHALLENGE YOURSELF

Open questions in pure mathematics might seem to be of mainly theoretical interest, but this is not always the case. Do some research on the Riemann hypothesis and how a proof of it could have far-reaching ramifications for internet security. (The Riemann hypothesis is the only problem on Hilbert's list from 1900 that was still outstanding in 2000, and therefore also on the Clay list.)

Exercise

9 **a** Think of some further ways in which knowledge from other areas is put to use in the world.
b To what extent are the maps from different areas 'user-friendly'?
c What about historical knowledge and mathematical knowledge?

Knowledge framework: *Scope and applications* – Are there ethical considerations that limit the scope of inquiry? If so, what are they?

Dispute is common and disagreements can be conducted on the assumption that everyone has the best of intentions for the development of knowledge and its application, although this assumption is sometimes misplaced. But are there questions that are predicated on bad intentions – indeed, questions that are unethical even to ask? What about, could a microbe be developed to kill or reduce the fertility of only those people with a particular degree of skin pigmentation?

During the proceedings of the Truth and Reconciliation Commission in South Africa in the years following the end of the apartheid system of government, it was claimed that that such a question was actually put forward and, in the context of other activities by the so-called Project Coast, it seems plausible that the question was considered. Is it acceptable to ask such a question? What would be the grounds for deeming the question itself unethical, as opposed to finding an answer to it?

The story so far …

There is a popular view that communication across fields of knowledge is a desirable aim, with positive consequences for knowledge and understanding. Lorenz points to the negative side of over-specialization, and Wilson sets out a vision that might remedy it. But the outcome of any 'cross-fertilization' depends on how successful the communities involved can be in communicating with one another and applying 'foreign' vocabulary to their own fields. We have seen how disciplines can clash with one another, and how some research questions might be 'taboo'. This in turn brings us to a consideration of how disciplines or AOKs are built around key concepts and a distinctive use of language that their attendant communities have developed, and how disciplines and their practitioners might be regarded as making up a culture.

Let's now consider the second of the two metaphors introduced on page 69.

3.3 Language and concepts

In 1959, the British novelist and physicist CP Snow delivered a lecture called 'The Two Cultures' in which he lamented a yawning gulf, as he saw it, between those conversant in the sciences and those steeped in the humanities. Perhaps you recognize this dichotomy today. Is there a preference for or prejudice against one or the other in your school or college, or among groups of students? Are mathematics and sciences considered hard subjects, and literature and the humanities as interesting but soft?

Snow considered the apparent antagonism between these 'two cultures' as a major hindrance to the application of knowledge to pressing global problems, such as poverty and inequality – instances of what in TOK we sometimes call 'knowledge at work in the world', or 'real-life situations'. The culture metaphor might help us to examine the relationships between all disciplines, not just between the sciences and humanities.

Knowledge framework: *Language and concepts –* What role does language play in the accumulation of knowledge in this area?

“Intellectual disciplines are not simply different domains of knowledge. That is to say, chemistry and history (for instance) differ not just because the one comprises knowledge about matter and the other knowledge about the course of events: chemists and historians differ in many ways. Thus they may mean different things when they appear to be saying the same thing, for example that something is 'known'—they differ characteristically over epistemic matters, over the possibility of attaining a degree of certainty; they differ over practical matters, for instance over what a desirable curriculum is; and they differ even in voting behavior, social habits, and religious beliefs.

The nature and extent of these differences make it apposite to regard the various intellectual disciplines as distinct cultures: chemists and historians are not the same sorts of people working at the same sorts of tasks with only the specific objects of work being different, as collectors of coins might differ from collectors of stamps, say: rather, chemists and historians differ much as do Germans and Frenchmen, whose differences of language are part-and-parcel of different intellectual, political, religious, and social habits. ❞

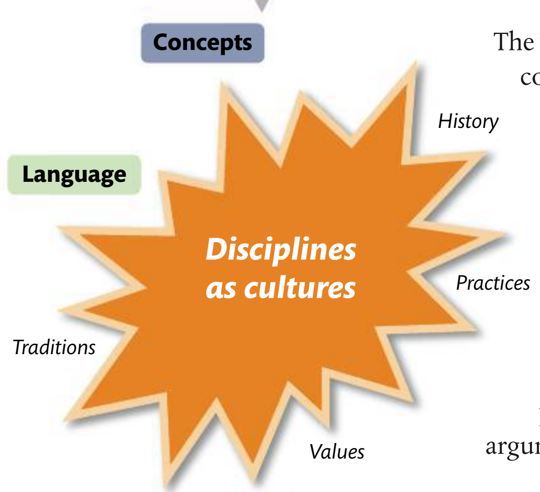
Bauer, 1990

In a follow-up to his original lecture in 1959, CP Snow suggested that he had not paid enough attention to the human sciences and their role in bridging the divide between his two cultures as a 'third culture', so we could argue that he might have agreed with Bauer in extending his vision.

As an IB student, you are frequently encouraged to think in an 'internationally minded' fashion, and this involves thinking about cultures and cultural matters. You might believe, for example, that some degree of cultural misunderstanding is inevitable in the world, but that efforts towards inter-cultural understanding are, nevertheless, worthwhile. You may well abhor xenophobic attitudes. Using culture as a metaphor, you might conclude that confusion between practitioners of different disciplines is impossible to avoid completely, but efforts toward mutual understanding should be encouraged in order to promote a broader perspective on knowledge.

The cultural metaphor is useful as we look at how disciplines develop and mature, including their core concepts and ways of communicating, and how they have methods and values that guide the practice of those involved in them. We can start by looking at the use of language and the concepts (Figure 3.10).

Figure 3.10 Concepts and language.



The ways in which words are defined have massive real-world consequences resulting in life or death outcomes for many people. In 1994, the United States prevaricated as to whether or not to call the killing that was going on in Rwanda at that time a 'genocide'. This may have played a role in the level of foreign intervention in that conflict.

In 1991, the then president of the World Bank – Lawrence Summers – wrote an internal memo that was leaked shortly afterwards, in which he defined pollution in terms of the foregone earnings from mortality and morbidity caused by that pollution. From this, it was a short step to construct the logical argument that led to the conclusion that the costs of pollution could be minimized by concentrating the pollution in countries containing people with the lowest earnings.

Exercise

10 a Can you formulate Summers's syllogism as a whole?

b What are the implications for the judicious use of formal logic?

There is often a certain language register or diction expected when scholars in a particular discipline talk or write about their work or the work of others. For example, the scientist is expected to use subject-specific vocabulary in a conventional format, using an objective tone (often in the passive voice), thus the vocabulary of a discipline can limit what we can know if we are not fully initiated members of the 'culture'. But because vocabulary is the vehicle through which concepts are shared, it is these concepts that form the bedrock on which the discipline is built and refined. So in a deeper sense, it is to vocabulary that we should look in order to discover the conceptual basis of disciplinary work.

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Prescribed essay title 2: 'The vocabulary we have does more than communicate our knowledge; it shapes what we can know.' Evaluate this claim with reference to different areas of knowledge.

The following passage was written by the famous Greek thinker Aristotle. Before you read it, think about why motion is an important concept in physics. What kinds of motion are treated in the physics curriculum? How is it defined? What prior physics knowledge is needed in order to understand motion, and what does the concept of motion itself explain? Now look at what Aristotle has to say on this matter.

> “Definition: the fulfilment of what exists potentially, in so far as it exists potentially, is motion – namely, of what is alterable qua alterable, alteration: of what can be increased and its opposite what can be decreased (there is no common name), increase and decrease: of what can come to be and can pass away, coming to be and passing away: of what can be carried along, locomotion.
>
> Examples will elucidate this definition of motion. When the buildable, in so far as it is just that, is fully real, it is being built, and this is building. Similarly, learning, doctoring, rolling, leaping, ripening, ageing. The same thing, if it is of a certain kind, can be both potential and fully real, not indeed at the same time or not in the same respect, but e.g. potentially hot and actually cold.”

Exercise

11 What can you make of this? Try to summarize what you think Aristotle is saying about motion.

If you don't find this easy, think about why not. Perhaps it is because of difficulties with translation – that sounds plausible. But it is also easy to imagine that Aristotle

Aristotle

CHALLENGE YOURSELF

Read the essay 'Smile' by the American physicist Alan Lightman, from *Dance for Two: Selected Essays*. New York: Pantheon Books, 1996.

Do you see how the vocabulary and concepts used in this essay help to explain what is going on in one way, but are impotent in another. Can you identify any implications of this?

To read the essay 'Smile', visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 3.1.

was just confused somehow. He doesn't seem to understand – he has mixed up motion (displacement of a body) with alteration in the nature of the body itself! It seems obvious to us that these are different. But for him, these are part of the same category of phenomena involving change, in space and time respectively – this inclusive concept of motion was captured in his language by the single word *kinesis*. We have different words that underline the conceptual distinction that we make.

It is easy to dismiss thinkers from the past on the basis that they now appear to have been wrong and, with the benefit of hindsight, even stupid. This is a pervasive problem in history, but try to put yourself in Aristotle's shoes. He was an accomplished biologist; he noted that living things tend towards particular states – babies become adults, acorns become oak trees. They are *moving* toward their pre-destined final states. They have the potential to become *actualized* as adults and trees. For Aristotle, this is a form of motion. From here, it is a short step to the belief that inanimate objects also have some kind of final state to which they aspire. Stones fall because they belong with the earth; smoke rises because it belongs with air and fire.

By examining Aristotle's claims, we can see that his concept of motion is deeply alien to modern physics, but nevertheless represents an attempt to connect observational data within a rational scheme. His physics is no less of a map-like construction than our own, although we now have a much better one at our disposal. His concept of motion seems puzzling to us, but it was a part of the cultural legacy of physics for a long time – in effect hindering progress to a better understanding of the behaviour of matter.

It is hard to imagine now that Aristotle and his contemporaries would have had no understanding of any of the concepts in, say, Newton's second law of motion. This law expresses a relationship that looks so simple to us today. Force, mass, and acceleration are all thoroughly modern concepts. So perhaps we can start to understand Jean Paul Sartre's meaning in the quotation that was the subject of a previously prescribed essay.

Prescribed essay title 3: 'Words are more treacherous and powerful than we think.' Evaluate the extent to which the characteristics Sartre claims for words affect negatively or positively different areas of knowledge.

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Sometimes, disciplines seem to form a hierarchy in relation to one another. In the natural sciences, a biologist might be interested in the action of an enzyme with reference to the overall conformation of the enzyme molecule caused by the sequence of amino acids that constitute it, and altered through interaction with the substrate – in other words, the induced-fit model. On the other hand, a chemist might be more concerned with the Michaelis–Menten kinetic model. A physicist might try to explain all of this at a more fundamental level still, making reference to, for example, electrostatic interactions. But, although such a physics orientated explanation of enzyme action might be accurate, it would be of limited use to the biologist whose quest is to understand the topic as it refers to concepts beyond the remit of his or her current investigation.

In the human sciences, specifically in 20th-century psychology, much effort was put into explaining behaviour solely in terms of stimulus and response. The workings of the mind itself were not considered to be suitable objects for scientific investigation.

Exercise

12 Research the meaning of the words ***jihad*** and ***crusade***. As concepts with religious origins, how far have their original meanings been preserved or overlaid with new interpretations? To what extent does this matter?

Knowledge framework: *Language and concepts –* What metaphors are appropriate to this area of knowledge?

Just as it is possible to absorb aspects of cultures different from one's own, it is also possible for disciplines to adopt language and concepts from other disciplines. We have been using metaphor to help us understand the nature of disciplines, but these disciplines themselves make abundant use of metaphor. Perhaps it is time to look at the nature of metaphor in more detail.

Remember that an analogy of the type that a metaphor promotes is not the same as a literal truth. This means there are always limits to how far we can apply the metaphor.

In order to work well, the concept in a metaphor has to travel from a context in which it is easy to understand (the **source**) to one in which illumination is required (the **target**). The source is usually better understood because it is a more concrete situation. To take a simple example, scientists may talk about a 'concentration gradient'. A gradient is a slope on a hill – easy to understand and an everyday observation – which helps us to visualize and understand how particles behave in a fluid despite the fact that there is no literal 'gradient'. They naturally move from an area of *higher* concentration to an area of *lower* concentration without the need for energy, just as an object would tend to roll down a hill without being pushed all the way. The overlap between the source and the target is called the '**ground**', and the areas in which the metaphor is not a perfect fit between source and target are called '**tension**' (Figure 3.11).

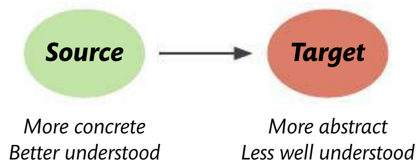
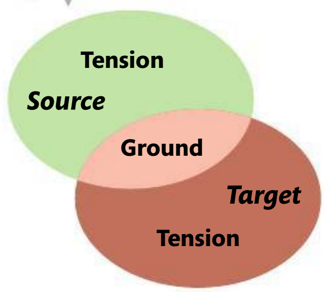


Figure 3.11 How metaphor works . . .



Exercises

13 Consider the following terms and note the subject in which each belongs. The first example is done for you.

Term	Origin of term	Subject importing term
inflation	physics	economics
dissonance		
translation		
elasticity		
resistance		
cell		
pressure		
firewall		
current		
drive		

14 Consider the terms in more detail. In each case, try to identify the source and the target. Then try to find some aspects of the ground and the tension.

In the following passage, the Norwegian economist Erik Reinert seeks to show how the choices of metaphors within his discipline lead not only to differing understandings of economic phenomena, but feed back into the policies and interventions that are made as a result. In this way, allegiance to a particular metaphor can have far-reaching practical ramifications.

“In very broad terms, we can distinguish between two main types of economic theory. One is based on metaphors from nature, generally from physics. Examples of these metaphors are ‘the invisible hand’ that keeps the Earth in orbit around the Sun (late 1700s) or the equilibrium metaphor*, based on the science of physics as it stood in the 1880s, which physicists themselves abandoned in the 1930s . . .

The other type of economic theory is based on experience, built from the ground upwards [. . .] This less abstract type of economics is normally based on biological metaphors rather than on metaphors from physics. [. . .] This type of theory is based on a qualitative and holistic understanding of the ‘body’ to be studied, and delivers a type of understanding where important elements [. . .] are not reducible to numbers and symbols.

Physics-based economics gives us an illusion of order in the chaos that surrounds us, but it is important to realize that this refuge is created at the expense of abdicating from understanding a whole range of qualitative aspects of the economic world. Forgetting that the physics-based models are not reality itself, but merely extremely simplified models of this reality, may lead to grave mistakes. One example of such a mistake is the way globalization has been introduced in the form of shock therapy. ”

Reinert, 2007

*Equilibrium in physics developed from the first law of thermodynamics to show how a system can settle down to a stable state; in economics it has been used metaphorically to promote the idea that producers and consumers will interact to produce price stability.

Exercise

15 **a** Think of some other metaphors that you have encountered in the subjects you study.

b Are there alternatives that might have been used instead?

c Is there sometimes an already developed choice of available metaphor?

d To what extent do you think that metaphor choice has the kind of far-reaching impact in different disciplines that Reinert suggests for economics?

Information from ideas

More generally, we work in a context of prior ideas and mental structures that are familiar to us. This can have a profound effect on our intellectual activities, as so well expressed in the following question from Theodore Roszak.

> "Sometimes an idea becomes so commonplace, so much a part of the cultural consensus, that it sinks out of awareness, becoming an invisible thread in the fabric of thought. Then we ask and answer questions, collecting information without reflecting upon the underlying idea that makes this possible. The idea becomes as subliminal as the grammar that governs our language each time we speak. [. . .] We live off the top of these ideas, harvesting facts from their surface."

Roszak, 1986

Knowledge framework: *Language and concepts –* What is the role of convention in this area?

By comparing the words in different languages that have the same meaning – *dog, chien, Hund*, etc. – it is immediately clear that there is no necessary connection between the object and the word we choose to refer to it. But within any language community it is obviously essential that we use the same word so that we can understand one another. Thus languages are arbitrary in the sense that there is no single 'correct' word, but conventional in that we have to 'agree' on the choice for communication purposes. Within the AOKs, there are many more specific examples of choices being made that could have been otherwise, but are stable because it is in everyone's interests to follow them. Such choices may have accidental origins, such as the decision to label conventional current as flowing from positive to negative (Chapter 4), or they may be the result of committees set up for the express purpose of defining these conventions, such as those that lay down the notation for genes and genetic crosses. In your IB studies, this can be seen in the assignation of letters to alleles in genetics or biology, and the order in which it is expected that they will be written.

The story so far …

We have seen how the map metaphor for knowledge helps us to understand that the process of constructing knowledge necessarily involves selection. And the culture metaphor has given us some insight into how communities of knowers choose to build their disciplines and AOKs guided by sets of concepts that form the basis for discourse in those areas. But cultures also endorse certain behaviours and practices, and we can extend the metaphor of the discipline as a culture by looking at how they do something similar, by examining methodology as the next aspect of the knowledge framework.

3.4 Methodology

Prescribed essay title 4: To what extent are the various areas of knowledge defined by their methodologies rather than their content?

It is a common view that the main differences between academic disciplines are their subject matters. In our map metaphor, it is the territory that counts. But what if that subject matter is accessible only through specific types of method? If this is so, we

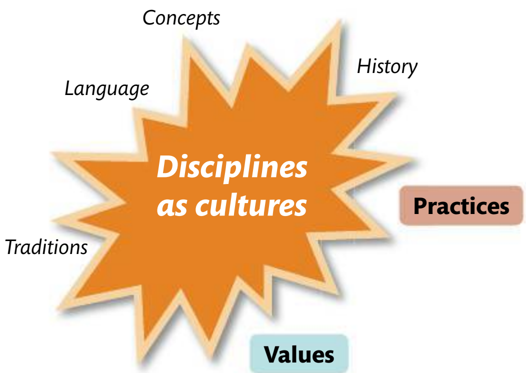


Figure 3.12 Practices and values.

could just as well couch the distinctions in those terms. And perhaps we could take this line of thinking further – perhaps those subject-specific methods place limits on the sorts of knowledge that could be obtained through their use. In terms of the culture metaphor, we are looking at the practices of the discipline, and the values of the practitioners that bind them to behaving in ways that promote those practices (Figure 3.12).

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Practices

In your extended essay work, you have a major opportunity to engage with a specific question of your own choosing. You have the chance to make a contribution to knowledge, but your work will be successful only if you adopt a suitable method of investigating the question. Even the choice of the research question itself depends on being able to see a way forward in terms of methodology.

Consider the following research questions from extended essays.

1. How did the British quest to make Asante Empire a protectorate lead to conflict between them from 1885 to 1901?
2. What physical relationship exists between the position that a ball strikes a tennis racket and the rebound distance of the ball?
3. How does Khaled Hosseini effectively portray the suffering of Afghan women in a male-dominated society from the latter half of the 20th century in the novel, *A Thousand Splendid Suns*?
4. To what extent is habit formation the dominant determinant of price elasticity of demand for Amstel and Primus beer produced by Burundian monopoly company BRARUDI in Bujumbura, Burundi?
5. What effect does pH have on the growth of *Escherichia coli* and *Staphylococcus aureus*?
6. How extensive are the socio-economic impacts of the development of enclave tourism in the Aberdeen settlement in Sierra Leone?

Consider what method would be required in order to answer the question in each of these examples. Questions 2 and 5 require similar basic approaches – change just one variable and measure the effect on another, while trying to hold everything else constant. These are the concepts of independent, dependent, and controlled variables with which you will be familiar from your activities in Group 4 of the Diploma. Question 1 needs an appraisal of various causes and effects connected with a series of events. As none of these factors can be observed first-hand, it becomes necessary to use source material and to evaluate their quality and reliability. Answers to questions 4 and 6 are dependent on the prior existence of copious data that can be analysed, possibly augmented by some first-hand data collection by questionnaire or interview. Question 3 requires close textual analysis and examination of narrative technique.

You will probably be familiar with these procedures. More formally, they would include:

- inductive method – collecting data and searching for patterns or general conclusions
- hypothetico-deductive method – empirically testing a hypothesis or prediction
- *verstehen* method – trying to reach an understanding through empathy with those involved

- source analysis – examining sources in terms of origins, purpose, value, and limitations (OPVL)
- textual analysis – examining literary devices and structure in order to extract meaning
- deductive proof – making logically valid steps from established knowledge to new findings.

An extended essay in world religions is likely to follow methods similar to those used in history or the human sciences – focusing on source material and comparisons 'from the outside'. But such methods are almost certainly different from those that the religious adherent will use. In Chapter 10, we discuss the degree to which religious knowledge is concerned with facts or practices, and it may be that the experience of religion 'from the inside' corresponds to the application of methods that rely on a suite of WOKs – such as faith, reason, imagination, and intuition. Perhaps we could add revelation as another WOK.

More broadly, methodologies across the spectrum of knowledge crucially depend on the WOKs that they engage. For example, work in the natural sciences is dependent, either directly or indirectly, on observation, in which sense perception is trained to attend to particular features of the environment. Powers of reason are employed in a variety of ways – in experimental design and in data processing, for example. It may take an imaginative insight in order to grasp the connection between phenomena, and to formulate an effective hypothesis. All of these WOKs are woven together into a web of mental activity appropriate for scientific work.

WOKs are not monolithic 'ingredients' in intellectual activity; they function in ways that are in keeping with the larger nature of the method being undertaken.

Exercise

16 Can you characterize activity in other AOKs in this sort of manner – by focusing on the interactions between WOKs? Refer back to Chapter 2 for a more extensive exploration of the nature of WOKs that will act as a foundation for this task.

Knowledge framework: *Methodology* – What are the assumptions underlying these methods? What counts as a fact in this area of knowledge?

Prescribed essay title 5: 'Tell me how you're conducting your search and I'll tell you what you're looking for.' To what extent do the methods used in different areas of knowledge determine the object or the scope of the research that is possible?

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This title reverses the usual order of thinking. Instead of starting with the object of study and then working out how to approach it, how about considering methods as indicators of the object of study? We could say that different methods produce different types of 'knowledge product'.

Exercise

17 Which methods are fit for the purpose of generating the following?

theory, interpretation, theorem, law, principle, artwork, narrative

Sometimes the desire for a particular kind of product governs the methods that are used. For example, in the 19th century, efforts to establish geology as a genuine scientific subject led to the doctrine of uniformitarianism. If geology were to be a science, it would have to be grounded in empirical data, but the only such data available is in the present. So, in order for the extrapolation of findings back to the past to be valid, the assumption is needed that the processes that we observe today are the same as those in the past, and that isolated catastrophic events (such as floods or meteor impacts) played only a very limited causal role. Hence the adherence to the principle of uniformitarianism – that the present is the key to the past. Despite all the advantages of this approach, it has been established that catastrophic events have played a significant role in the history of the Earth. It is important that the reliability of evidence in geology is not undermined by selective interpretation of evidence.

Knowledge framework: *Methodology* – What ethical thinking constrains the methods used to gain knowledge?

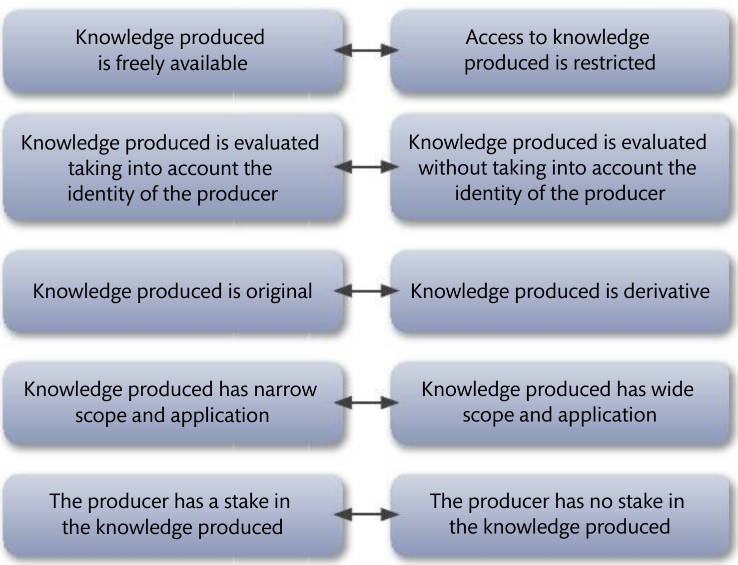
Values

CHALLENGE YOURSELF

Do some research on Milgram's 1963 experiment on obedience to authority, or Zimbardo's Stanford prison experiment of 1971.

In 1968, American school teacher Jane Elliott had an idea for a class activity. She divided her class into those students who had blue eyes and those who had brown, and told them that blue-eyed children were superior in every respect to brown-eyed children. She gave the children with blue eyes extra breaks from work, opportunities to eat more lunch, placed them at the front of the class, and a range of other privileges that were withheld from the brown-eyed students. After settling into the roles, the blue-eyed children became unpleasant and discriminatory towards the others to a remarkable extent within a short period of time. Elliott reversed the situation on the next day – eliciting similarly discriminatory behaviour from the brown-eyed. The exercise was intended as a corrective to stereotyped attitudes to ethnicity in the wake of the assassination of Martin Luther King, but Elliott's colleagues and many of the population at large who came to be aware of the event through significant media coverage were outraged. Setting aside colour prejudice, much of this discordant reaction was focused on the use of third-grade children as the principal objects of the study. Was Elliott justified in engendering the levels of psychological stress in the children that this exercise did produce? Was this an ethical 'experiment'? Elliott was not an academic researcher in any established discipline, but there are numerous instances of academic studies in the human sciences that demonstrate a similar degree of power in situational factors. Objections to these studies on ethical grounds are rife.

Figure 3.13 The norms connected to knowledge production.



While Elliott and Milgram offer examples of how an ethical dimension needs to be considered in investigation design, there are other aspects of scholarly practice that also need attention from an ethical perspective (Figure 3.13).

Exercises

18 Consider the oppositions in Figure 3.13. Choose an AOK and select which member of each pair you think more closely describes how knowledge is treated in that area.

19 Now choose another AOK and do the same. Compare your selections. Can you identify areas where the answers are very similar or very different? We will return to the questions inspired by this figure in later chapters.

In order for a community of scholars to work efficiently, there is a need for some common values concerning the treatment of knowledge and practices within the community. While these values might not be upheld in every case, practitioners become familiar with them as part of their informal induction into the community, where they sit in the background of everyone's mind as norms of acceptable practice.

In the 1940s, the American sociologist Robert Merton undertook some foundational work in this area and identified a set of norms for the natural and human sciences. After some minor modification from others, this set is as follows. Scientific findings should demonstrate:

- 'communism'* (i.e. be shared as a form of public knowledge)
- universalism (i.e. be judged independently of whoever contributed them)
- disinterestedness (i.e. be made without regard for personal gain)
- originality (i.e. offer a new contribution to established knowledge)
- scepticism (i.e. be subjected to systematic doubt by the scientific community).

*Note Merton's careful use of scare quotes here, being an American in the 1940s . . .

Compare Merton's work with your own choices in the previous exercise. To what extent do you think these norms apply equally in the natural and the human sciences? What about other AOKs? For the sciences, the answers seem to look like Figure 3.14.

Would you agree with these answers? Are there any counterclaims that could be advanced here? What do you make of Figure 3.14?

Awareness of expectations of behaviour in communities of scholars can be considered to be a kind of procedural knowledge just as much as knowledge of the actual practical methods by which each discipline tackles its subject matter.

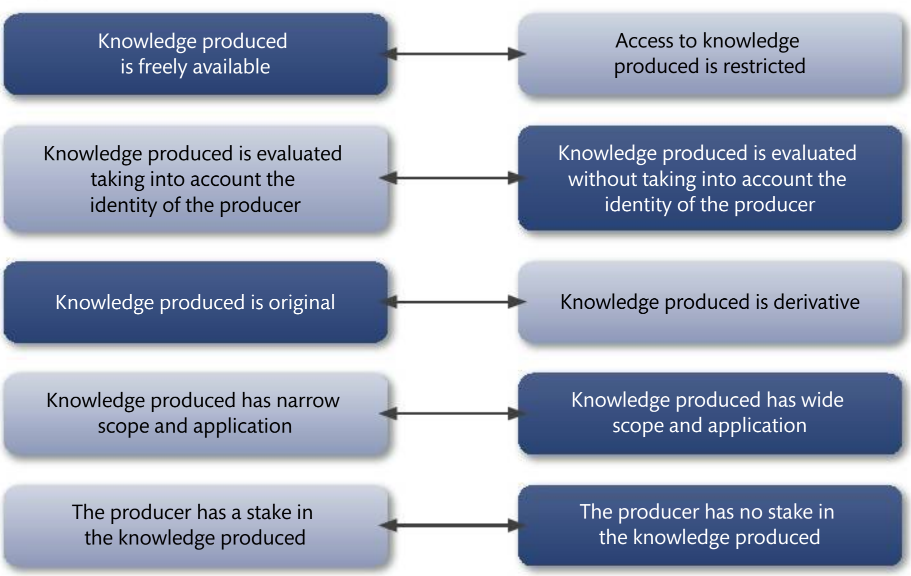
CHALLENGE YOURSELF

Henry Cavendish was a brilliant man who made many fundamental discoveries in the sciences, including the fact that water is a compound and not an element. But it took posthumous investigation into his estate (largely by James Clerk Maxwell) in order to reveal the full extent of his contribution to knowledge. Do some research on this, and try to connect it to Merton's norms.

"I'M SORRY, PROF. MINSKOV, BUT THAT ARTICLE ON MINSKOV'S THEORY... THEY WANT SOMEONE ELSE TO WRITE IT."

How many of Merton's norms are being alluded to in this cartoon?

Figure 3.14 How knowledge is treated in science (darker boxes).



3.5 Historical development

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

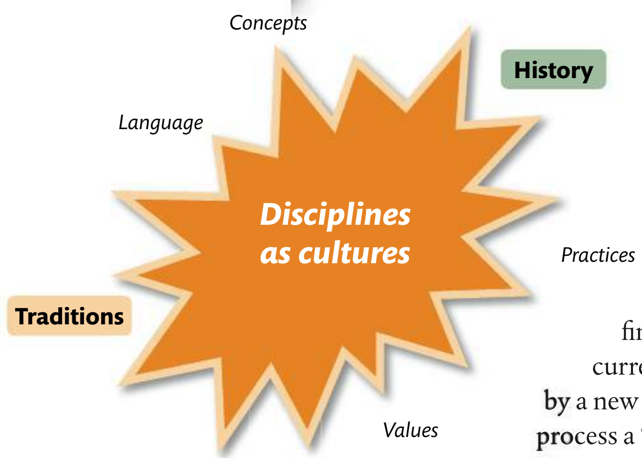


Figure 3.15 History and tradition.

In 1962, the American physicist and historian of science Thomas Kuhn proposed a model for the way science proceeds (you can refer to his book *The Structure of Scientific Revolutions*). He suggested that most of the time scientists work within a set of shared beliefs, assumptions, and practices that help to set the agenda for research and the acceptable methods for interpreting results (Figure 3.15). This kind of activity he named **normal science**, and the accepted beliefs, assumptions, and practices formed what he called a **paradigm**. As time goes on, however, findings tend to accumulate that are not consistent with the current paradigm, and eventually it is overthrown and replaced by a new paradigm that resolves the inconsistencies. He called this process a 'paradigm shift' and scientific activity during this period **revolutionary science**.

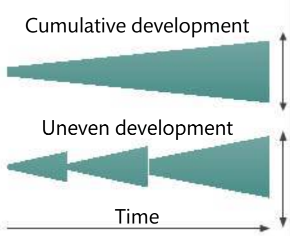


Figure 3.16 Ways of development.

Kuhn's famous concept of the paradigm helped to promote the understanding that scholarly activities take place in a shared social context. Many earlier commentators spoke about the development of science under the assumption that it was a gradual and inexorable process marked only by the contributions of individual scientists along the way (Figure 3.16). Physics, for example, had marched from the struggles of Aristotle to the state where it could be claimed that '*there is nothing new to be discovered in physics now – all that remains is more and more precise measurement*' (widely attributed to Lord Kelvin). The power of Kuhn's insight stems from a wider recognition of the nature and scope of shared knowledge, and the idea that progress in knowledge might not be so straightforward an issue.

Kuhn was talking specifically about the natural sciences, and explicitly denied the existence of paradigms in the human sciences, claiming that there was much more fundamental and everyday disagreement in these disciplines. Do you think he was right about this? What evidence do you have from your studies in groups 3 and 4?

Exercises

20 To which of the map scenarios presented in section 3.2 do the diagrams in Figure 3.16 approximate?

21 What label would you assign to the vertical dimension of these figures?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

Prescribed essay title 6: In areas of knowledge such as the arts and the sciences, do we learn more from work that follows or that breaks with accepted conventions?

A broad interpretation of this prescribed title would permit discussion on different types of conventions. These could be the adoption of certain concepts, particular methods, or facts. Let's look at some examples that will cover this range, starting with the concepts.

> “So what do we learn from all this history? Two main things, I think. First, since people are all much the same, it is our shared biology which explains humanity's great upward leaps in wealth, productivity and power across the last 10 000 years; and, second, that it is geography which explains why one part of world – the nations we conventionally call 'the West' – now dominates the rest.
>
> Geography determined that when the world warmed up at the end of the Ice Age, a band of lucky latitudes stretching across Eurasia from the Mediterranean to China developed agriculture earlier than other parts of the world and then went on to be the first to invent cities, states and empires. But as social development increased, it changed what geography meant and the centres of power and wealth shifted around within these lucky latitudes. Until about AD 500 the Western end of Eurasia hung on to its early lead, but after the fall of the Roman Empire and Han dynasty, the centre of gravity moved eastward to China, where it stayed for more than a millennium. Only around 1700 did it shift westward again, largely due to inventions – guns, compasses, ocean-going ships – which were originally pioneered in the East but which, thanks to geography, proved more useful in the West. Westerners then created an Atlantic economy which raised profound new questions about how the world worked, pushing westerners into a Scientific Revolution, an Enlightenment and the Industrial Revolution. By the mid-19th century, the West dominated the globe.”

Morris

> “It is a historical fact that the civilizations developed by various races are different. In earlier ages it was possible to establish this truth without attempting to distinguish between higher and lower civilizations. Each race, one could contend, develops a culture that conforms to its wishers, wants, and ideals. The character of a race finds its adequate expression in its achievements. But it is different in our age. The non-Caucasians [. . .] yearn for the tangible achievements of the West, for its science, technology, therapeutics, its methods of administration and of industrial management.
>
> Historical experience warrants the statement that in the past the efforts of some sub-divisions of the Caucasian race to develop a civilization have eclipsed those of the members of other races. It does not warrant any statement about the future. It does not permit us to assume that this superiority of the white stock will persist in the future. Nothing can be predicted from historical experience with a likelihood that can be compared with the probability of predictions made in the natural sciences on the basis of facts established by laboratory experiments.

A prediction about the future behaviour of those races which today are considered culturally backward could only be made by biological science. If biology were to discover some anatomical characteristics of the members of the non-Caucasian races which necessarily curb their mental faculties, one could venture such a prediction. But so far biology has not discovered any such characteristics. [. . .]

All that can be said about racial issues on the ground of historical experience boils down to two statements. First, the prevailing differences between the various biological strains of men are reflected in the civilizatory achievements of the group members. Second, in our age, the main achievements in civilization of some subdivisions of the white Caucasian race are viewed by the immense majority of the members of all other races as more desirable than characteristic features of the civilization produced by members of their respective own races. ”

Mises

Exercises

22 When do you think these passages were written? Which of them was written earlier? Why do you think this?

23 Summarize what each of them has to say about Western civilization. Is there anything on which the two authors seem to agree even if they express it differently?

Ludwig von Mises seems to reject a biological basis for the concept of race, and Ian Morris seems to concur, albeit without employing the word. The modern discovery of the degree of genetic similarity between all humans bears out this claim. But Mises continues to use the term 'race' (along with 'stock' and 'strain') in his explanations for the development of the modern world, whereas Morris not only avoids these terms but rejects the idea that genetics, or even acquired and transmitted culture, have a role to play in the modern state of affairs. The foundations of the concept of race have shifted from biology to social science – from genetics to culture. The word 'race' is often treated as contaminated with unsavoury connotations (old concept), despite the shift in its reference in recent times. Changes in accepted usage of terms and the apprehension of the concepts they convey can create difficulties in the interpretation of historical documents, and in achieving clarity of expression and meaning as work progresses.

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The Google Books Ngram Viewer allows you to track the use of specific words through time as measured in digitized books. It is interesting to see the rise and fall of particular words and to think about how these developments may or may not be accurate indicators of the popularity, and use of the underlying concepts that they convey.

The orthodoxy of a methodology can sometimes influence the development of a discipline. In the late 19th century, the German bacteriologist Robert Koch made several breakthroughs in the identification of pathogens associated with particular prevalent diseases. At the time, pathogenic disease was the major cause of death in Europe, but many believed that such conditions were miasmatic in nature – that is, they were caused by properties of the air. As an outcome of his work in promoting the alternative germ theory of disease, Koch developed postulates which set out a clear method for establishing the connection between microorganisms and disease. Koch's postulates are as follows.

1 The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms.

2 The microorganism must be isolated from a diseased organism and grown in pure culture.
3 The cultured microorganism should cause disease when introduced into a healthy organism.
4 The microorganism must be re-isolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent.

One problem that emerged from the use of these postulates was that certain pathogens can often live in healthy individuals without causing disease. Also these postulates necessitate that the pathogen is capable of being cultured in the laboratory, but it turns out that the vast majority of microorganisms cannot grow under these conditions. The emphasis on lab culturing encouraged microbiologists to focus exclusively on those microorganisms that could be cultured, and to ignore the possibility that other agents might be at work. This is a scenario in which the method seems to be determining the results and, by extension, influencing the development of the field of knowledge.

It is only in recent times that molecular biology has developed the tools (new method) through which microorganisms can be studied while circumventing the culturing challenge – now we can extract genetic information from microorganisms to positively identify them instead of trying to multiply them and observe them optically.

Scientific breakthroughs sometimes come about from the establishment of new facts. Before the German chemist Friedrich Wöhler succeeded in the pure chemical synthesis of urea – an important constituent of urine – many biologists subscribed to the doctrine of vitalism – the notion that living things possessed something in addition to their chemical constitution that rendered them alive. By demonstrating that a substance found exclusively in association with living organisms could be manufactured without contribution from them (new fact), Wöhler helped to open the avenue for life in its entirety to be investigated in terms of chemistry.

Prescribed essay title 7: 'In expanding the field of knowledge we but increase the horizon of ignorance.' (Henry Miller) Is this true?

In a different context, the former US Secretary of Defense Donald Rumsfeld once spoke about *known knowns*, as in 'what we know we know', and *known unknowns*, as in 'what we don't know but we know something about how to discover'. Applying this distinction to Miller's quotation and Figure 3.17, identify some *known unknowns* in various disciplines and AOKs. Why are they unknown? What is it that makes them *known unknowns*, as opposed to what Rumsfeld called *unknown unknowns* – the things we don't know that we don't know?

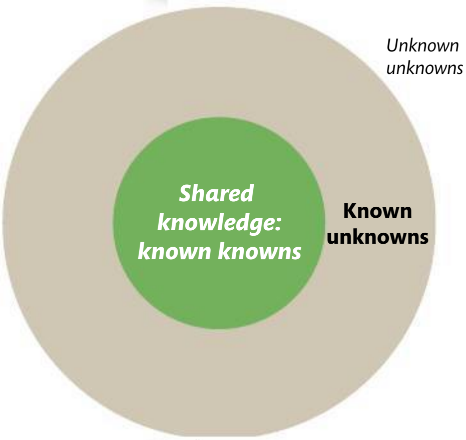


Figure 3.17 Types of unknown.

Early in this chapter, we tried to make a distinction between learning and knowledge production. But whatever facilitates both of these processes in tandem is likely to help create a better world.

CP Snow believed strongly in the power of education for change. Indeed, his primary motivation for his lecture mentioned earlier was not a dry concern with the nature of disciplines, but a commitment to harnessing their power in the service of exploited and impoverished people in the world. (He even reflected that he might better have called his lecture 'The Rich and the Poor'.) You might reflect on how academic knowledge can have a place in CAS activities. How have *you* brought (or do you intend to bring) *your* scholarly experience to bear in this part of the IB diploma?

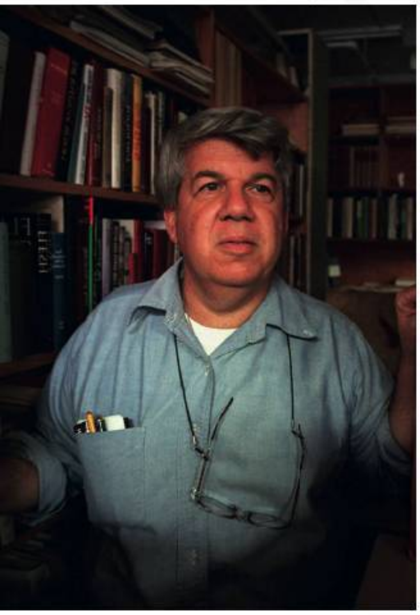
As we have seen, ideas about knowledge are a product of their time as well as their cultural origin. Snow worked at a time (1950s and 1960s) when many believed that there was only one path to a country's development, and that was through the spread of scientific knowledge. Do you think this was a correct assumption? If so, how do you explain the continued existence of massive inequality in the world? After all, scientific knowledge is shared knowledge. In order to tackle poverty in the world, which disciplines would you enlist for the challenge?

3.6 Links to personal knowledge

Knowledge framework: *Links to personal knowledge* – What is the nature of the contribution of individuals to this area?

We started this chapter by looking at some traditional, proverbial ideas about knowledge from Ghana. No one knows who first formulated these proverbs, and this is the case for much indigenous knowledge from around the world. There is a tendency – encouraged by the modern emphasis on ownership of knowledge and its accurate referencing to the individuals concerned – to undervalue that which cannot be attributed to an individual or a distinct small group. By extension, it is easy to imagine that the cultures that produce knowledge without a clear provenance are somehow lagging behind those cultures that do. While local traditions may affect the nature of the interaction between shared and personal knowledge, they only succeed in making the distinction richer and more interesting. We would do well to be familiar with some of the achievements of oral literature, knowledge of natural environmental products, and feats of memory associated with many indigenous groups around the world. Some of these are examined in Chapter 11.

Stephen Jay Gould (1941–2002)



Ideal knower: Stephen Jay Gould

> “If genius has any common denominator, I would propose breadth of interest and the ability to construct fruitful analogies between fields.”
>
> **Gould, 1980**

Born in New York, Stephen Jay Gould was an eminent figure in the discipline of palaeontology (the study of fossils). He was largely responsible for a version of the theory of evolution which claims that sudden changes in form are separated by long periods during which not much happens. This has become known as punctuated equilibrium. You may have heard of it already if you are following a biology HL course.

As a prolific writer of essays, Gould succeeded in bringing his massive scholarship to a wide audience. Although many of his writings concern his professional engagement with fossils, they show how knowledge of a variety of disciplines can enrich the understanding of all of them, and create new insights. In this sense, Gould was a brilliant multi-disciplinary champion.

Perhaps a discipline like palaeontology is likely to attract such a person – knowledge issues surrounding history (for example, those that concern missing evidence and the accidents of time) must be reconciled with the traditional methods of the natural sciences (experiments and predictions, etc.). In other words, palaeontologists must be comfortable with both maps and stories. Palaeontologists also frequently consult other disciplines. Gould saw this eclectic approach as advantageous in that practitioners in his discipline were accustomed to viewing problems through a multitude of disciplinary lenses. If one set of theoretical ideas did not yield a breakthrough, another would be to hand.

There is an interesting parallel between Gould's ideas about the evolution of living things and of academic disciplines: namely that the development of each is dependent on sudden and unforeseeable chance events. To him, the complexities of life and of human scholarship were grounds for awe and wonder – the present is precious because if we were to rewind the clock, the result would never be the same.

In contrast to many voices in recent years, Gould maintained that there was no fundamental reason for conflict between science and religion (areas of knowledge he called 'magisteria' after the Latin term for 'teacher'). While science is concerned with matters of fact and the theories that can be derived from them, religion focuses on purposes and meanings, and the values that inform them. Gould's view was that these areas of knowledge were in some sense mutually exclusive and hence both science and religion could proceed unimpeded by the other.

But the examples that Gould uses make it clear that he thinks science and religion are not so much addressing different 'territories', but the same one through different conceptual lenses and types of question. So perhaps he means that it is the tools of analysis that do not overlap rather than the direct object of inquiry. For instance, we can ask empirical questions about living organisms, but we can also ask moral questions concerning our treatment of them. These views are revisited and evaluated in Chapter 10.

On the topic of disciplines and their relation to human nature, Gould warned of the dangers of thinking in dichotomies – subjective/objective, black/white, true/false – such hard distinctions lead dangerously to demarcations of us and them, and eventually to good versus bad (sometimes called Manichean thinking). This tendency is easily extended to disciplines (e.g. science versus art) with mutual incomprehension often the result.

These views give us some insight into the answer that Gould might have given to the prescribed essay title on page 73.

Diagnosed with an unusual form of cancer in 1982, Gould discovered that the condition had an eight-month median survival period. He used this piece of catastrophic personal news as the basis for an essay on the misunderstandings often associated with the interpretation of **statistics** ('The Median isn't the Message'), and demonstrated that he had a much higher survival chance than it appeared. Having defeated the condition, he lived, wrote, and continued to shine his intellect on the disciplines until his death in 2002.

Ideal knowers: Islamic scholarship of the Golden Age

One of the key questions for the historian to ponder is why great civilizations rise and decline – a question that is unlikely to have an answer that will satisfy all that we know about individual cases, although some rough sketches have been offered that are discussed in Chapter 7. Worthwhile conjectures on this topic depend on the historian's degree of success in seeing past the assumptions and prejudices of the culture in which he or she is embedded.

For example, the Islamic Golden Age from the 8th to the 13th century has often been dismissed as a period during which ancient knowledge was merely translated into Arabic and safely stored, such that it became available to scholars of the European Renaissance. That is a deeply distorted description that diminishes and undermines the outstanding achievements of that time and place. Breakthroughs in a wide swathe of disciplines fed off one another and bore new insights and approaches to knowledge.

In this regard, the Islamic Golden Age is a good example of how shared knowledge can function to accelerate understanding. Arabs of this period can be credited with the development of medicine into an empirical discipline through alliance with a form of scientific method. For the first time, the basic nature of light and optics was understood. The fields of algebra and trigonometry are largely the product of Arabic thought. Philosophy, art, engineering, architecture, astronomy, chemistry – all of these fields were intensively developed in ways too many to outline here. In many ways, the Islamic scholars of this period constitute a community of ideal knowers.

04 Natural sciences

On previous page – There are still so many questions that we can't answer about the universe. Ordinary matter – atoms, stars and galaxies – accounts for less than 5% of the universe. Astronomers believe that dark matter and dark energy make up the other 95% but more is unknown than known about these hypotheses.

4.1 Introduction to the natural sciences

Maps and the natural sciences

Our central metaphor for knowledge in this book is a map. In this chapter, we ask what it is that is mapped by the natural sciences and for what purposes. By many measures, the map produced by the natural sciences is supremely successful. It allows us to understand the world around us, to predict what it will do in the future, and gives us technology that allows us to change it.

The success of this map raises some important questions. What is it that makes this map so powerful? Are the maps produced by other AOKs as successful in explaining and predicting the world? Is the raw material of the natural sciences particularly suited to systematic investigation? Are the methods of the natural sciences the key to their success?

In order to begin thinking about these issues, consider the statements about the natural sciences and the human sciences in Table 4.1. To what extent do you agree with them?

Table 4.1 Comparing the natural sciences and human sciences

The natural sciences	The human sciences
• are concerned with the material world	• are concerned with the world of humans
• aim to be able to make predictions	• aim to achieve understanding
• use a systematic method based on observation	• use a systematic method based on observation
• are concerned with facts that are independent of human beings	• are concerned with facts that are created by human beings
• use quantitative methods	• use qualitative methods
• are value free	• are value rich
• produce knowledge that does not change over time	• produce knowledge that changes over time
• produce the only knowledge worth knowing	• are more concerned with speculation than knowledge

Exercise

1 Compare your answers with a friend. Do you agree with all the statements? Which statements caused disagreement?

In this chapter, we investigate these claims further. We explore what problems the natural sciences can solve and what problems remain outside their scope. We investigate the language of the natural sciences and explore what special qualities are required to build the accurate map of reality to which they aspire. We examine whether or not it is true that this map does not change over time. Finally, we examine what scientific knowledge means to us as individuals.

Natural sciences and the knowledge framework

The structure for this chapter is the knowledge framework discussed in Chapter 3 (Figure 4.1). We examine each element of this framework with a view to identifying knowledge questions and illustrating them with examples and case studies.

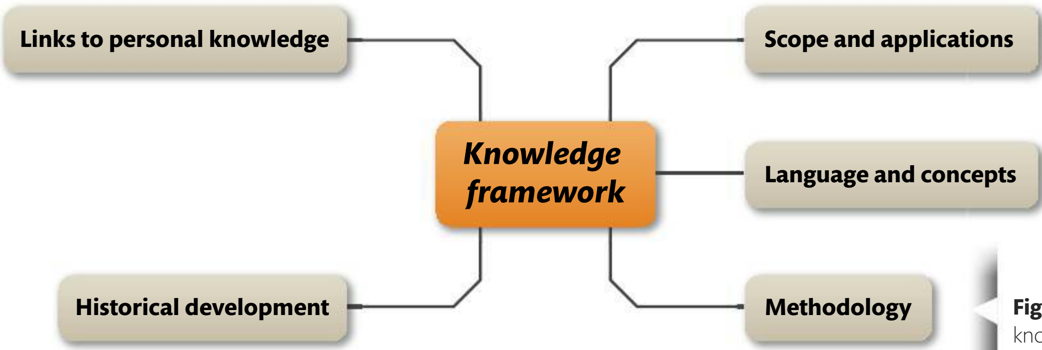


Figure 4.1 The TOK knowledge framework.

The natural sciences are good examples of shared knowledge. They are the result of a vast collaboration of people spread over great distances and over long time intervals. Individuals have learned this shared knowledge and then gone on to contribute further to it. Their contributions have been subjected to rigorous tests by others and eventually accepted as part of this shared knowledge.

In this way, these huge systems of knowledge have evolved over time. They have changed as new problems have emerged to motivate new investigations. New problems have demanded new ways of thinking, which have spawned new terminology and concepts. This in turn has led to advances in the methods used to solve problems. Sometimes, the production of new technology to help solve a problem has led to sudden advances in a field; for example, the technology of DNA sequencing led to major advances in genetics.

Changes in these AOKs influence us as individuals. Having access to shared knowledge has an impact on how we think about ourselves. Advances in the natural sciences, in particular, challenge our ideas about what it means to be a person and the degree to which we are free to make decisions over and above our biological makeup. Our significance in the universe is challenged by a cosmology that puts the age of the universe at 13.7 billion years, enough to make a human life seem like the blink of an eye. Over the last 400 years or so, the natural sciences have had an enormous effect on our view of ourselves. We have gone from living at the centre of the universe and being first among God's creations to being a speck in, to paraphrase Douglas Adams, a rather unfashionable arm of a rather ordinary galaxy which is only one of 200 billion or so and being just another animal – the result of a particular series of changes to an ancestor we might have shared with some of the other primates.

Of course, other AOKs also have a lot to contribute in terms of how we think about ourselves and may challenge or contradict the personal knowledge we take from the natural sciences. Religion in particular might be relevant here.

4.2 Scope and applications

In this section, we answer two questions: what are the natural sciences and what motivates the production of this knowledge. Before we start, try to answer the question yourself: what do the words 'natural science' mean to you?

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

The label 'natural' is a throwback to the time when all knowledge fell under the description 'philosophy'. The study of the material world independent of the intentions and desires of humans was called natural philosophy to distinguish it from moral philosophy, which was the title given to the group of disciplines devoted to the study of human beings.

Definition of the natural sciences

One way to characterize the natural sciences is through their subject matter: the objects of the natural world.

Exercises

2 This table shows some disciplines in the natural sciences. Spend a moment identifying the subject matter of each.

Map	Territory
physics	the world of matter and energy
chemistry	
biology	
astronomy	
geology	
materials science	
biochemistry	
cosmology	

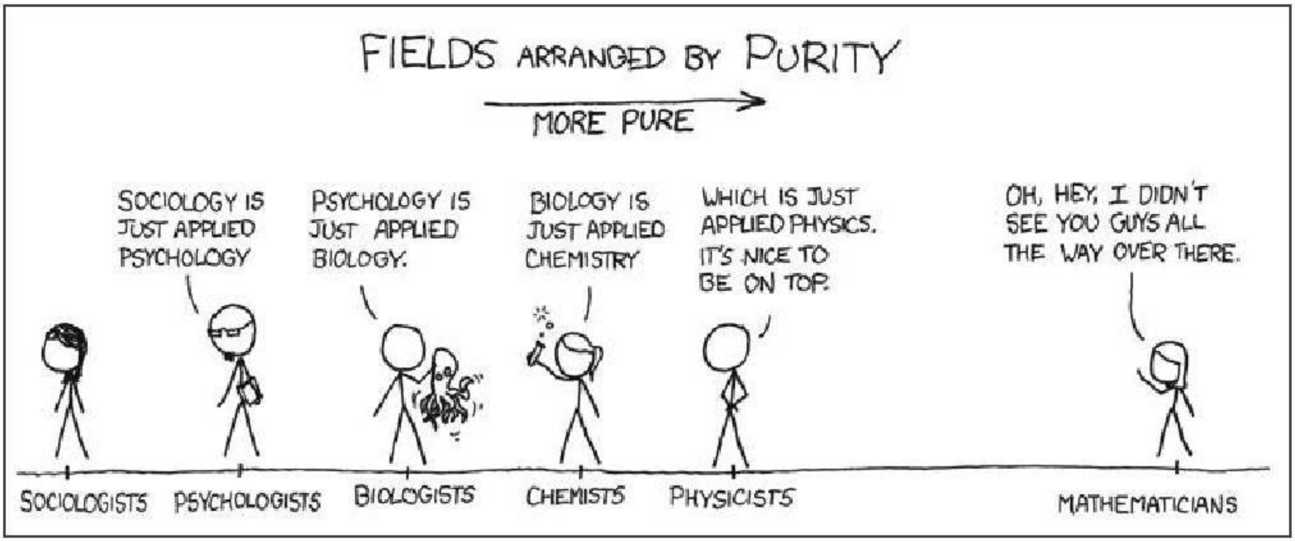
3 The first three common natural science subjects focus on rather different subject matter. How would you define each of physics, chemistry, and biology?

Physics explores the world of matter and energy in general – it is thought by some to be the foundation of the natural sciences. Chemistry is the study of how the properties of the atom and its electrons translate into the behaviour of substances at the macroscopic level. Biology studies how the physical and chemical properties of matter combine to give another material property we call 'life'. Far from the old idea that life was a special force – the *élan vital* – the modern conception of the living is purely physical. The biologist tells us that a physical system is living if it possesses a number of properties such as homeostasis, organization, metabolism, growth, adaptation, response to stimuli, and reproduction.

In some languages, for example German, Dutch, or Swedish, the word 'science' (*wissenschaft*, *wetenschap*, or *vetenskap*) simply means 'all systematic knowledge'. The term does not just apply to the natural sciences. Therefore, be careful how you use the word 'science' in TOK.

Each natural science discipline exists independently of the others but it is clear that there are deep links between them. It is tempting to suggest a hierarchy: ideas in biology require an understanding of chemical properties of matter; chemistry seems to presuppose an understanding of the underlying physics. Therefore, there is a sense in which physics is the basis for the other natural sciences.

Another way to think about the natural sciences is to look at their methods. Michael Shermer of *Skeptic* magazine claims that science is a verb – it is a way of doing things and that the natural sciences share, broadly speaking, a common method. If we accept



this idea, we might want to refer to this as the 'scientific method'. Shermer states in a TED talk that it is this method which distinguishes science from non-science.

Is there a hierarchy of natural sciences?

Exercises

4 What does Michael Shermer mean when he claims that science is a verb?
5 What reasons does Shermer give for our tendency to believe unlikely claims?
6 What two advantages did Christian Huygens have over Galileo in trying to understand observations of the rings of Saturn?
7 According to Shermer, what mistakes do pseudosciences such as astrology or parapsychology make that prevent them from gaining knowledge?
8 How would you define the natural sciences in a TOK essay?
9 Look again at the xkcd cartoon above. What do you think is meant by 'purity' in this context?

To learn more about Michel Shermer's ideas, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 4.1.

The scientific method is discussed in much more detail later in the section on methodology. For now a broad sketch is sufficient. A starting point might be that the scientific method is an attempt to link theory and observation: it is a way of systematically making and organizing our observations of the world. It often uses experiment to replicate, in an ideal manner, some aspect of the world in which we are interested. The ideal nature of the experimental environment is intended to establish precisely what causes produce what effects. It is designed to examine only one factor at a time and eliminate all others. These experimental results can be used to support theories that lead to general conclusions about how the world works (Figure 4.2).

Figure 4.2 The natural sciences balance observation and theory.

While there is some disagreement, most writers agree that something like the method suggested above is characteristic of the natural sciences. This suggests two questions for the TOK student to tackle.

- What is it about this method that produces the special reliability that is taken to be a hallmark of natural scientific knowledge?
- Other AOKs also share this method – do they, therefore, give an equally reliable map of reality?

Can you think of other AOKs that use similar methods to the natural sciences?

Prescribed essay title 1: Is it a simple matter to distinguish a scientific argument from a pseudo-scientific argument?

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

Recall our metaphor *knowledge is a map of the world*. The map is made in a particular way to solve a particular set of problems.

Purpose of the natural sciences

Exercise

10 What problems do the natural sciences solve?

Let us suppose that you came up with two answers.

- Natural sciences satisfy our curiosity about what there is in the world and how it works.
- Natural sciences help us to live our everyday lives by enabling us to control our environment and by giving us tools (technology) with which to do so.

We might call the first answer 'pure science' and the second 'applied science'. Can you think of examples of pure science that have produced useful applications? Table 4.2 has some examples to get you started.

Table 4.2 Related topics in pure and applied sciences.

Pure science	Applied science
optical qualities of materials in magnetic fields	LCD display screens
mapping the human genome	screening for genetic diseases
investigating the structure of carbon molecules	carbon fibre materials for use in aircraft

So, pure science and applied science can be closely linked. Often the application of a particular piece of pure science is not obvious at the beginning of the investigation. So even if applications were the main reason for doing science, it still makes sense to pursue pure science.

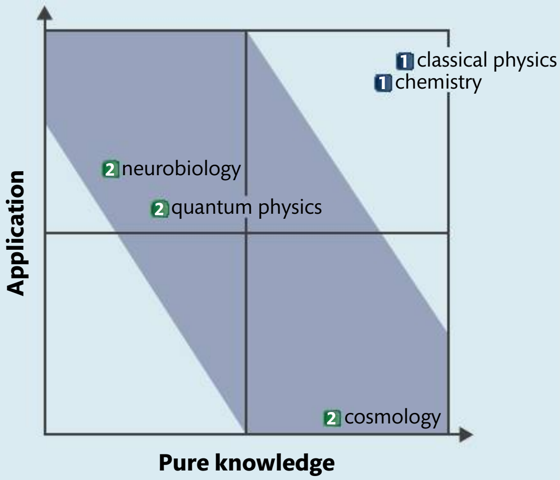
Nevertheless, much inquiry in the natural sciences belongs to the first category. It is motivated by a set of 'open questions'. These are big questions that are as yet unanswered. They act as beacons that help navigate research. One way to understand a subject is to find out what are the big unanswered questions toward which research is progressing. It might be worthwhile asking your science teachers what are the big open questions in their particular fields.

The making of predictions about the state of the world in the future is a feature both of pure science and science applied to improving our everyday life. The method of the natural sciences – the rigorous testing of theoretical models through observation and experiment – lends itself to the sort of precise prediction that we have come to associate with areas such as physics and chemistry and, to a lesser extent perhaps, biology. Predictions of this sort have obvious real-world benefits.

Does all natural scientific knowledge produce predictions? Write down a list of fields in the natural sciences that do not produce predictions. Here are two suggestions to get you started:
- seismology (the study of earthquakes)
- geology.

Exercises

11 Copy the diagram on the right and position the following fields in the natural sciences: ***astronomy, genetics, cell biology, geology, X-ray crystallography, medicine, nuclear physics, string theory, volcanology***



12 How do you interpret the different regions on the diagram (1 = top right, 2 = middle shaded band, 3 = bottom left)?

13 If you were a government minister responsible for funding research in the natural sciences, how would you decide which projects to fund? Write down a short list of the criteria you would use. What **knowledge questions** do you encounter in making this choice?

14 Write down a short description of the three most important open questions in the natural science subject you are studying in the IB Diploma Programme. What makes these questions important?

Prescribed essay title 2: 'To know is to be able to predict.' How accurate is this claim in different systems of knowledge?

Knowledge framework: *Scope and applications –* Are there ethical considerations that limit the scope of the inquiry? If so, what are they?

Ethics in the natural sciences

Ethics sets limits on what we can do. Ethical thinking might lead to a conclusion that 'I ought to do X' or 'we ought not to do Y'. Such conclusions are usually independent of our particular goals and purposes. Ethical thinking might restrict scientific knowledge in two ways:
- by limiting the sort of question we can investigate
- by limiting the sort of experiments we can carry out.

Can you think of some examples for each of these types?

Chapter 9 discusses in detail ethics as an AOK. However, it is useful here to think about a number of knowledge questions centred on ethical issues in the natural sciences. Here are some examples.

The purpose of scientific fields.

Knowledge questions

1. Could the results of an investigation justify the means used to reach them?
2. How could we anticipate the results of an investigation and the uses to which they could be put before the investigation is begun?
3. What sort of ethical principles should limit the type of experiment permitted in producing knowledge?

While these questions are general and can apply to any AOK, they are particularly relevant to some of the investigations in the natural sciences because of the powerful way in which scientific knowledge can be used to change the world.

What about the nuclear bomb?

The 'engineering' project at Los Alamos.

Here is Richard Feynman discussing how he got involved.

“I was working in my room at Princeton one day when Bob Wilson came in and said that he had been funded to do a job that was a secret, and he wasn't supposed to tell anybody, but he was going to tell me because he knew that as soon as I knew what he was going to do, I'd see that I had to go along with it. So he told me about the problem of separating the isotopes of uranium ultimately to make a bomb. He had a process for separating the isotopes of uranium (different from the one that was ultimately used) that he wanted to try to develop. He told me about it, and he said, 'There's a meeting …'

I said I didn't want to do it.

He said, 'All right, there's a meeting at three o'clock. I'll see you there.'

I said, 'It's all right that you told me the secret because I am not going to tell anybody, but I'm not going to do it.'

So I went back to work on my thesis – for about three minutes. Then I began to pace the floor and think about this thing. The Germans had Hitler and the possibility of developing an atomic bomb was obvious, and the possibility that they would develop it before we did was very much of a fright. So I decided to go to the meeting at three o'clock.

By four o'clock I already had a desk in a room and was trying to calculate whether this particular method was limited by the total amount of current that you get in an ion beam, and so on. I won't go into the details. But I had a desk, and I had paper, and I was working as hard as I could and as fast as I could, so the fellas who were building the apparatus could do the experiment right there.

It was like those moving pictures where you see a piece of equipment go bruuuup, bruuuup, bruuuup. Every time I'd look up, the thing was getting bigger. What was happening, of course, was that all the boys had decided to work on this and to stop their research in science. All science stopped during the war except the little bit that was done at Los Alamos. And that was not much science; it was mostly engineering …

… It was ultimately decided that this project was not to be the one they were going to use to separate uranium. We were told that we were going to stop, because in Los Alamos, New Mexico, they would be starting the project that would actually make the bomb. We would all go out there to make it. There would be experiments that we would have to do, and theoretical work to do. I was in the theoretical work. All the rest of the fellas were in experimental work. ”

Feynman, 1992

Knowledge questions

4 What principles should limit the sort of experiments or investigations that are permitted in producing knowledge in the natural sciences?

5 Can the results of scientific research ever justify the means used to obtain them?

6 Should we judge whether or not research should be carried out based on its possible uses in the future? If so, how can we know what these uses are?

7 Will some questions remain unanswered simply because the methods required to answer them are unethical?

Exercises

15 Find examples that illustrate each of the knowledge questions on the previous page.
16 Sketch outlines of arguments for each of the knowledge questions. Try to argue both sides.
17 Have a debate with a classmate on one of the knowledge questions. Take opposing sides to each question and present your arguments in turn. Take 4 minutes per person. Try to summarize the arguments at the end and come to a consensus.
18 Were the scientists at Los Alamos justified in the research that they were doing? How did Feynman justify his involvement in the project?
19 Are such ethical questions matters of science alone or do they involve thinking from outside science?
20 What does Feynman's account tell us about the role of theory in the search for knowledge in nuclear physics?

What about racial biology?

In 1922, the Swedish Institute for Racial Biology was established and began to examine the racial background of the 100 000 members of the Swedish population. The role of the institute changed over the decades as it moved into genetic studies and, in the 1950s, the institute was integrated into Uppsala University.

To learn more about the Swedish Institute for Racial Biology, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 4.2.

Exercises

21 What ethical problems can you identify with the work of the Swedish Institute for Racial Biology? Are there any circumstances in which such work could be morally permitted?
22 'Pure research is neutral, it can never be unethical – it is what people do with it that is the problem.' To what extent do you agree with this view? Find some good examples of your own taken from the natural sciences to illustrate your points.

4.3 Language and concepts

Scientific language is distinctive. It differs quite dramatically from everyday language. Pick up a textbook from one of your group 4 subjects and compare it with the language used in, say, a reality TV show. There is a special vocabulary and a rather formal way of using it. Spend a moment or two thinking about the reason for this.

Knowledge framework: *Language and concepts –* What role does language play in the accumulation of knowledge in this area?

Formal language

The language in your group 4 textbook is both precise and formal. There are very specific terms that are used in well-defined situations. For example, in biology, you must distinguish between the different parts of a cell. One must not confuse the mitochondria with the choloroplasts or the cytoplasm with the vacuole. Precise language with a clear well-defined meaning is required to formulate precise ideas. The ability to formulate precise ideas is important in the natural sciences. If we can define causes and effects in a precise manner, it is easier to connect them.

Exercises

23 Write down another area of human activity that requires the precise use of language. Why is precision needed in this case? How does it relate to the reasons you identified for precise language in the natural sciences?
24 Scientific terms do not just label physical objects or parts of physical objects, they also label other things. Give some examples of scientific terms that do not label objects.

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Concepts

Most specialist language in the natural sciences names concepts that are important in understanding scientific ideas. These concepts form the bricks with which the main results of the science are built – for example, scientific laws or big generalizations that hold for a large class of things or situations. A good revision tool in any AOK is to list the five big ideas in that area – that is, the five most important 'slogans', that are accepted in that AOK. These 'slogans' are statements connecting important concepts (Table 4.3).

Idea 1	The universe is expanding – this is revealed by spectroscopic analysis of distant objects (they show a so-called 'redshift').
Idea 2	The further away an object is, the faster, typically, it is receding from us (this is called Hubble's law).
Idea 3	This pattern of expansion is the typical signature of an explosion. This explosion is called the Big Bang and by playing the film of the expansion backward we can calculate that the explosion happened 13.7 billion years ago.
Idea 4	In physics, when things expand they get cooler (physics students will recognize this as adiabatic cooling); therefore. the universe is getting cooler. The temperature of the explosion that happened at the beginning of time is now only 3 Kelvin.
Idea 5	Since nothing can travel faster than the speed of light, the furthest we can see in the universe is 13.7 billion light years.

Table 4.3 The five big ideas in cosmology (the study of the whole universe and its origins).

These big ideas constitute the main branches of the tree of knowledge in this area. They connect **key concepts** and usually suggest causal relationships – that is, relations of cause and effect. A key concept is one on which other concepts depend.

Exercises

25 What are the key concepts in the cosmology example?

26 What are the causal connections in the cosmology example?

27 List five concepts from the current topic you are studying in your group 4 subject. Compare your list with a friend taking the same subject.

28 Some subjects such as biology require the student to learn a fairly long list of terms. Is the definition of a term a type of knowledge itself?

29 If you answered 'yes' to exercise 28, are the ideas which link concepts higher up in the hierarchy of types of knowledge than this 'definitional knowledge'?

30 It has been said that a good way to study a subject is to master the key concepts first. Do you agree?

So, language both labels concepts and links them in the natural sciences.

Logical language in the natural sciences

We have seen that scientific knowledge often takes the form of general statements that describe how the world works. These statements have a specific logical structure and special language is used to make this logical structure particularly clear.

Here are some of the more common types of scientific statement.
- If A happens, then it 'makes' B happen (A causes B).
- If X is true, then Y is true.
- All Zs are Ws.
- X happens because of Y, Z, W.

Causation seems, on the surface, to be the same as implication. But the two are quite different. A causing B to happen is a physical phenomenon. X implying Y is a logical one. If $x = 2$ then $x^2 = 4$ is a matter of pure logic, $x = 2$ does not *cause* x^2 to be 4. It is just built into the definition of 2. This must be true in every universe where these symbols are defined and have their standard meanings. It is called a **necessary truth**. If x^2 were not 4, then we would have a logical contradiction. It would be like saying that there is a bachelor who is married. But, to take a causal example, if we heat water to 100 °C, that causes the water to boil. That is a specific feature of our universe – pure water boils at 100 °C (at standard pressure, of course). But it is not a logical contradiction to say that water has a temperature of 100 °C and does not boil. This just contradicts the particular facts in our universe. There may be universes in which this could be true. It just isn't true in ours.

Causation is a difficult idea to express and thinkers are still divided about its nature. It does not just mean that events A and B occur together but rather A happening makes B happen. In the technical language of TOK, A is a **sufficient condition** for B. Intuitively, we expect that A and B are physically connected in some way, and that A happening somehow forces B to happen (see the discussion on causation in history in Chapter 7).

The second statement seems similar to the first but there is quite a different idea here (be aware). If X implies Y, then it is a contradiction to suppose that X is true and Y is false. In other words, the idea of Y is somehow built into X. If Fred is a bachelor, then Fred is unmarried. Being unmarried is built into the definition of being a bachelor.

The third statement makes a link between two properties. It is useful for classifying types of thing. It is useful for showing what types of property always fit together, for example, fir trees are evergreens. This helps us **characterize** fir trees – to understand their essential nature.

Explanation seems to be very similar to causation. But it is the most general type on offer here because Y, Z, W might be quite different sorts of thing to X. X might be observable (say acceleration) while Y, Z, W might be something more theoretical – they might be charge or energy – things that cannot be observed directly. So an explanation relates an observed phenomenon to some sort of general theory. We take this further in the section on methodology.

This list is not complete; there are many types of scientific statement that derive from these basic forms. Consider a simple statement that expresses the existence of something with particular properties: there is an X that has property P – there is a mammal that lays eggs, for example. This is related to the third statement, characterization. (Can you think of a mammal that *does* lay eggs? There are three.) In this example, we cannot use the absence of egg-laying to characterize being a mammal because of the counter examples (the duck-billed platypus, and the long-and short-beaked echidnas).

These statements generally do not allow exceptions. It is not the case that positively charged particles repel each other most of the time – they do it all the time and if there is an exception, it is front-page news. Scientific statements are strong and we have seen that their strength comes from the fact that language defines precise states of affairs. Deviations from these narrowly defined possibilities indicate that there is a problem with the underlying theory. We see in Chapter 5 that this is quite different from the situation in the human sciences.

Language as a means of sharing knowledge in the natural sciences

We saw previously that language names the important concepts in science and then connects them logically. Language is also important, because it is a means of collecting together scientific knowledge to make it available to everyone in the field both at the time and in the future. Until recently this was done mainly through the publishing of printed articles in scientific journals. When a group of scientists wanted to publish their contribution to knowledge in a field, they submitted an article to a journal widely read by others in the field. The article would then be read by a small team of experts in the field who would check that it was of a good enough standard to be accepted as knowledge. This process is known as **peer review**.

Most journals are now available online and many publishers have discontinued the print versions. Access is often strictly controlled by a subscription system. But peer review is still an important feature of the process by which scientific knowledge is produced.

Exercises

31 What are the advantages and disadvantages of peer review?

32 Discuss the impact of the internet in the accumulation and transmission of knowledge. What are the implications of the fact that anyone can post items on the internet in general without peer review?

33 What are the implications of moving scientific journals online? Does it matter who controls access to this information?

Knowledge framework: *Language and concepts –* What metaphors are appropriate to this area of knowledge?

Metaphor

As discussed in Chapter 3, language does more than just name and connect concepts. It allows us to picture what is going on in a particular way. One way of doing this is through metaphor.

Remind yourself how metaphors help us understand and describe complex situations. Notice in particular how metaphors can lead us towards **intuitions**.

Metaphors have their dangers too. What do you think are the dangers of using metaphors in the production of knowledge? The intuitions and understanding they yield come at a price. It is tempting to forget that a metaphor is just that: a picture. For example, students of physics have to struggle with two conflicting metaphors applied to electrons: particles and waves. The term 'wave' brings to mind the sea breaking on the shore – it seems very distant from the idea of particle or ball or planet. The pictures produced by these different metaphors are different and difficult to reconcile. At this point it is important to realize that the electron is neither a particle nor a wave. To use the terminology of Chapter 3, these are *source* concepts. We should not confuse the target with the source. But nevertheless, it is useful to think of the electron as having some wave-like and some particle-like properties. The danger is that we take the metaphor too far – we may think that because some aspects of it are helpful then all are – in the words of Chapter 3, we expand the ground to fill the whole target.

Exercises

34 Biology tends to use metaphors taken from engineering when describing organisms. Words such as ***purpose***, ***design***, and ***function*** enter the vocabulary. The popular press even go so far as to use personification as in statements such as 'evolution does not like wastefulness'. Write a short paragraph on the dangers of using such metaphors.

35 Identify metaphors in a group 4 subject that you study. What intuitions do they suggest? Are there ways in which they hinder the production of knowledge?

36 Is there a sense in which all knowledge is metaphorical?

Knowledge framework: *Language and concepts –*
What is the role of convention in this area?

Convention

Convention is an agreement that we make in order to allow certain social activities to take place smoothly. It is conventional in Sweden to drive on the right-hand side of the road. This is does not have to be so, it is just a decision that has been made, a social fact (and it was made comparatively recently).

Exercises

37 Can you think of any conventions that are used in the natural sciences?

38 What is the purpose of such conventions?

Changing convention: On 3 September 1967 at 04:50 Sweden changed the convention from driving on the left to driving on the right.

There are many conventions observed in the natural sciences in order that science can take place as a shared social activity. The units that we use are an important example of such a convention. The *Système International* designates the units metre (m), second (s), and kilogram (kg) as standard units. This means that scientists working in different parts of the world can work together because they have the same understandings of how we should measure these various aspects of the physical world. Without these conventions, we would not have standard ways of comparing and communicating the science that we do all around the world.

There are also important conventions regarding how specific experimental procedures are to be carried out. Each of these conventions ensures that scientific knowledge is sharable because we use the same units and have the same ideas about what constitutes legitimate ways of gathering data and coming to conclusions.

Convention in electrical circuits

We spoke in Chapter 3 about Benjamin Franklin and the conventional charge on the electron. In an electrical circuit the convention is that current flows out of the positive terminal, through the circuit and into the negative terminal of the source. This was the convention chosen during the discovery of electricity (Figure 4.3). Unfortunately, circuits don't work that way.

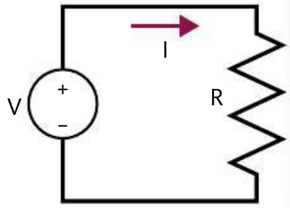


Figure 4.3 Conventional electrical circuit diagram.

Electron flow is what actually happens and electrons flow out of the negative terminal, through the circuit and into the positive terminal of the source. Both conventional current and electron flow are used by industry. Many textbooks are available in both electron flow and conventional current formats. In fact, it makes no difference which way current is flowing as long it is shown consistently. The direction of current flow does not affect what the current does.

In general, two-year technical programmes and high-school physics use electron flow. But three-year technician and university engineering programmes still use conventional current. Certain symbols (e.g. diodes and transistors) and rules (e.g. right-hand rules for electromagnets) were created using conventional current. Changing from conventional current to electron flow would cause a degree of confusion for old and new students and errors would occur, so conventional current was kept.

Exercises

39 Identify three conventions used in your group 4 subject.

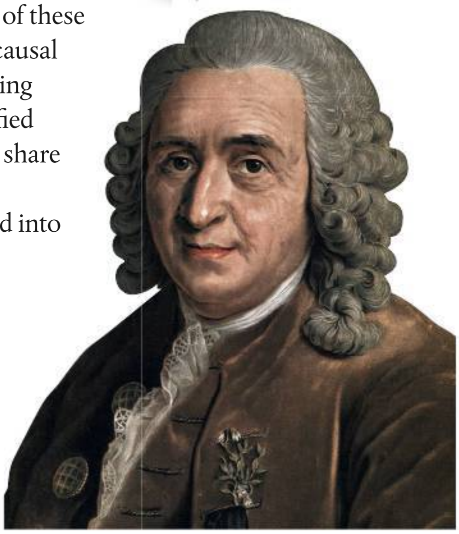
40 How do these conventions allow knowledge to be produced and shared in this subject?

41 Can you identify conventions that apply to methods or procedure rather than, say, units or terminology?

Classification systems

So far, we have discussed the use of specialist scientific terms to name important concepts from which scientific ideas can be built. We have discussed examples of these ideas such as scientific laws and generalizations. We have discussed the use of causal and logical language in the natural sciences and the use of language for explaining scientific phenomena. We have discussed metaphor to allow us to build simplified pictures of the complex world and the establishment of conventions to help us share this knowledge. But perhaps the most important use of language in the natural sciences is in the classification or sorting of the phenomena of the natural world into different types.

Carl von Linné (1707–78).



Classification systems are used extensively in nearly all the sciences. Since the natural sciences are interested in describing and explaining the natural world, it is clear that a first step might be to order natural phenomena into different types. We might want to group them together according to features that they share. Then we might want to see if there are any general statements we can make that apply to every member of a particular group. If our classification system is a good one, it can further our understanding by revealing patterns that we had not previously noticed.

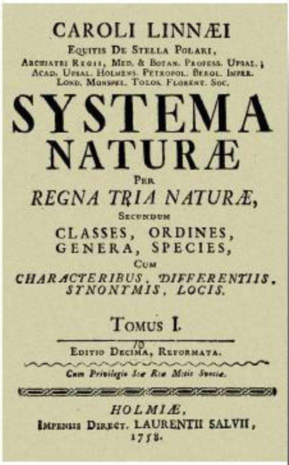
This method is used often in biology. There are different types of cell, different types of microorganism and, most striking of all, an impressive system of classification of plants and animals that group them together according to important common features.

The perennial lupin (*Lupinus perenis*).

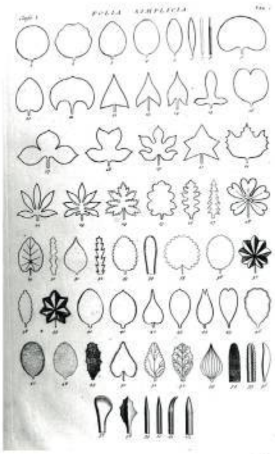
Carl von Linné

Carl von Linné is often referred to by the Latinized version of his name, Linneaus. He was a Swedish botanist who introduced the system of binomial names for plants in his *Species Plantarum* of 1753. The idea is that the name of each plant has two parts: a genus followed by a species name. For example, he named the wild perennial Lupin, *Lupinus perenis*. This system of naming is designed to aid the classification or taxonomy of plants. Botanists are quick to point out that the system of names is not the same as a classification system; the genus is intended to be a guide as to which plants should be grouped together based on certain characteristics that they have in common.

Linné's binomial system allowed botanists to adopt standard names for species. Even within a single language, there were (and still are) many different common names for the same species depending on local custom or tradition. The rigorous standardization of names made it possible for local botanical knowledge to


CAROLI LINNÆI
EQUITIS DE STELLA POLARI,
ARCHIATRI REGII, MED. & BOTAN. PROFESS. UPSAL. ; ACAD. UPSAL. HOLMENS. PETROPOL. BEROL. IMPER. LOND. MONSPEL. TOLOS. FLORENT. SOC.
SYSTEMA NATURÆ
PER
REGNA TRIA NATURÆ,
SECUNDUM
CLASSES, ORDINES, GENERA, SPECIES,
CUM
CHARACTERIBUS, DIFFERENTIIS, SYNONYMIS, LOCIS.
TOMUS I.
EDITIO DECIMA, REFORMATA.
Cum Privilegio S:æ R:æ M:tis Svecia.
HOLMIÆ,
IMPENSIS DIRECT. LAURENTII SALVII,
1758.

The front page of Linné's *Systema Natura* of 1758.



Drawings of shapes of leaves from Linné's *Hortus Cliffortianus* of 1737.

be shared globally. Moreover, the system helped scientists decide which species were related.

The genus and species are at the low end of the hierarchy of the classification. Above the genus, a plant also belongs to a tribe which belongs to a family which belongs to an order which belongs to a kingdom. So: *Lupinus perenis* belongs to the tribe Genisteae, the family Fabacae, the order Fabales and the kingdom Plantae.

The botanical taxonomist has two main problems to solve. The first is to decide which plants belong to a particular species. The second is which species belong to a particular genus. How different (and in what ways) should two plants be to belong to different species? How different (and in what ways) should two species be to belong to different genera? Indeed cladistics in modern botany is an attempt to differentiate between those characteristics that derive from a common genetic ancestor and those that result from convergence of different species.

Linné tried to solve a more basic problem in his work: how we define a plant. Although this might sound straightforward, biologists tell us that the sheer variety of life forms sharing some characteristics with plants makes such a definition problematic.

Knowledge question

8 Can a classification system itself be considered knowledge?

Exercises

42 Pick ten objects randomly from your immediate surroundings. Now try to sort these objects into four categories. None of the categories can be called 'miscellaneous'.

- **a** What criteria did you use to produce your classification system?
- **b** What difficulties did you encounter while trying to perform your classification?
- **c** Compare the system you used with that of a classmate. Can one classification system be better than another? If so, how could you decide?

43 How does a system of classification help produce knowledge?

44 What classification systems can you identify in the other natural sciences?

45 Find a classification system in the human sciences and in the arts.

Ideal knower: Brian Marsden

Brian Marsden is the astronomer who played a central role in Pluto's downgrading to dwarf-planet status.

> "The British-born astronomer Brian Marsden, Emeritus Director of the Minor Planet Centre (MPC), once famously – but wrongly – warned of an asteroid collision with Earth. He also helped demote Pluto to 'dwarf planet' status and accurately predicted the return of Comet Swift–Tuttle.
>
> Once described by the New York Times as a 'Cheery Herald of Fear,' Marsden specialised in tracking asteroids and comets and computing their orbits. He was once described as the 'sentinel protecting Earth', and his work was crucial in helping to track potentially Earth-threatening objects. Marsden was perhaps best known for his 1998 announcement that an asteroid, known as 1997 XF11, might

strike the Earth in 2028, causing catastrophic damage. Charles Alcock, Director of the Harvard-Smithsonian Centre for Astrophysics, said that 'Marsden was one of the most influential comet investigators of the 20th century and definitely one of the most colourful, with an equally pleasant demeanour.'

… Marsden … played a pivotal role in the 'demotion' of Pluto from full-planet to dwarf-planet status. He was interested in the discovery of what he called 'transneptunian objects', although colleagues referred to them as objects in the Kuiper Belt, the region extending from the orbit of Neptune to edge of the solar system.

When what seemed the first of these transneptunian objects was discovered in 1992, Marsden argued that they were not the first, because Pluto, discovered in 1930 and somewhat larger, had to be the first. More specifically, he was the first to suggest, correctly, that three further transneptunian objects discovered in 1993 were exactly like Pluto, in the sense that for every two of their solar orbits Neptune orbits the Sun three times. So he became a firm advocate of 'demoting' Pluto.

With the discovery of Eris, another object comparable to Pluto, in 2005, the 2006 International Astronomical Union (IAU) created a new category of 'dwarf planets'. This now includes both Pluto and Eris, together with two further transneptunian objects known as Makemake and Haumea, as well as the largest asteroid, Ceres. Pluto was designated minor planet 134340, though this decision remains controversial.

It was also at the IAU meeting in Prague that Marsden stepped down as MPC director after 28 years; he was entertained by the thought that both he and Pluto had been retired on the same day. He remained working at the MPC (and the CBAT, the Central Bureau for Astronomical Telegrams) in an emeritus capacity. ”

The Independent, 25 November 2010

Exercises

46 Why was Pluto reclassified as a dwarf planet?

47 Is a classification purely conventional?

48 Is there knowledge involved in reclassifying Pluto?

49 Does it matter whether Pluto is a dwarf planet or a 'regular' planet?

50 What role did prediction play in the research that Brian Marsden did on comets?

51 Marsden's work involved very careful measurements and painstaking calculations. How does this research differ from research such as Albert Einstein's work on special relativity? Is one type of research more important than the other?

Prescribed essay title 3: In areas of knowledge such as the arts and the sciences, do we learn more from work that follows or breaks with accepted conventions?

4.4 Methodology

We have argued that the key to the success of the natural sciences lies in the method they use to produce knowledge. This method is so important, so the argument goes, that it merits a special title: the *scientific method*. We examine two questions here.

- Is there just one scientific method?
- What it is about this method that guarantees the reliability of scientific knowledge?

Knowledge framework: *Methodology* –

What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Exercise

52 Try to draw a flowchart that describes the scientific method and includes the words: ***hypothesis, analysis of experimental results, observation, design experiment, modify hypothesis, carry out experiment, question, form conclusion***.

Hypothetico–deductive method

The mantra for this book is that knowledge is a map that is produced to answer a specific question. This is true as much in the natural sciences as in any other AOK. The starting point of scientific inquiry is a question. So while it is often claimed that all science rests on observation, it does not occur in a vacuum. It is not a question of innocently observing the world and writing down our observations. Observation is driven from the beginning by a question that needs to be answered. This question is often posed in the form of a **hypothesis**. We produce a statement about how we think the world works. We then devise an **experiment** to test whether the hypothesis is true. We **observe** the results of the experiment, **collect data,** and analyse it often using the methods of mathematics. We draw a **conclusion** based on this analysis and **modify the hypothesis** accordingly. Thus begins a new cycle of testing (Figure 4.4).

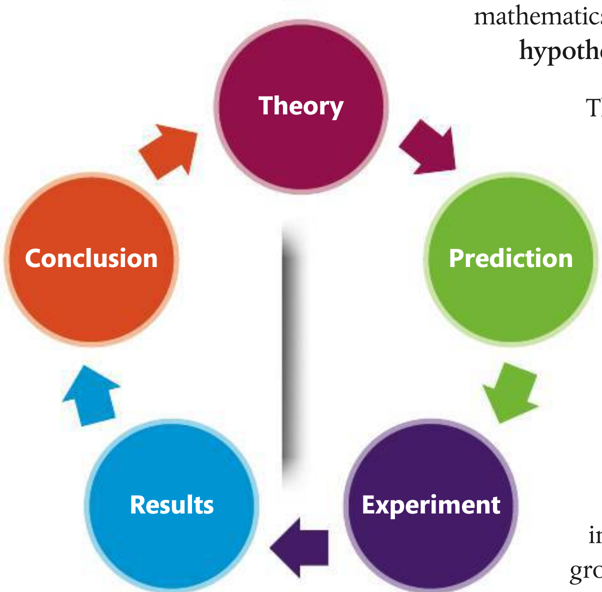


Figure 4.4 Testing a hypothesis.

The whole procedure has a number of **feedback loops** built into it. That the hypothesis is modified on the basis of the analysis of experimental results means that it can be corrected if the results deviate from what is expected.

Moreover, the natural sciences are shared knowledge. This means that an experiment done by one group of people might be repeated by another group elsewhere. The second group try to **replicate** the results of the first.

What is the point of trying to replicate scientific results? If a second group cannot replicate the results of the first, the validity of the results might be called into question. Further investigation would be needed to understand why the two groups obtained different results. Such feedback mechanisms make the natural sciences **self-correcting.**

The whole system is called the hypothetico–deductive method because the hypothesis (which is derived from theory) can be used to **deduce** a prediction which can be tested against observations.

Feedback mechanisms in the scientific method

Figure 4.5 is a flowchart for the simple task of correcting the temperature of the water in a shower. If the shower water is too hot, the regulator is moved towards 'cold'. If the water is too cold, the regulator is moved towards 'hot'. Further corrections are made until the water temperature is correct. If the corrections are small enough and the time taken for the change in temperature is short, the system should settle down to its 'steady state' fairly rapidly. This is why the system is said to be a balanced feedback system. If the corrections are large and they take a relatively long time to come into effect, the system might end up in a state where the temperature oscillates between hot and cold.

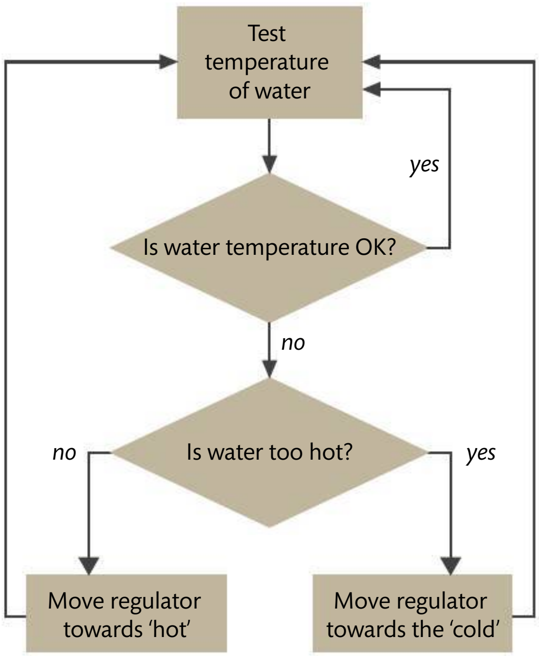


Figure 4.5 Correcting the temperature of the water in a shower.

Exercises

53 What would happen in the system in Figure 4.5 if the shower were incorrectly installed with the labels ***hot*** and ***cold*** transposed?

54 Where else can you find feedback loops in the natural sciences?

55 What is the significance of feedback loops in the production of knowledge?

56 Connect feedback loops to the idea that the natural sciences are self-correcting. What does this term mean?

57 Do other AOKs use feedback loops to for correction purposes?

Scientific results are provisional

The diagram for the hypothetico–deductive method is a circular flowchart. It never seems to end. What are the implications of this for scientific results?

One conclusion we might draw is that the results of the natural sciences are always provisional. They are always open to modification in the future. Let us go back the idea of knowledge as a map. We can always improve the map of the natural sciences. It is not even a question of truth or untruth. Newton's laws work perfectly well in most situations. Einstein proposed a modification to deal with extreme velocity or mass. It is not that Newton is plain wrong, it is just that his theory is a first approximation, Einstein's is a better approximation. Einstein's map is more accurate but we can get by with Newton's map in the majority of terrestrial situations. The Newtonian map got human beings to the Moon, after all.

Exercises

58 Write down a hypothesis you have tested in a lab in your group 4 subject. Explain the different stages of the lab test that correspond to the method above.

59 Did you follow the method strictly?

60 What feedback loops can you identify in your method?

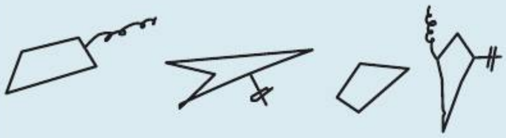
61 What is it about the method that makes it reliable?

62 Reflect on what you could have done to improve your experiment to make it more reliable.

Prescribed essay title 4: ***What separates science from all other human activities is its belief in the provisional nature of all conclusions.*** **(Michael Shermer) Critically evaluate this way of distinguishing the sciences from other areas of knowledge.**

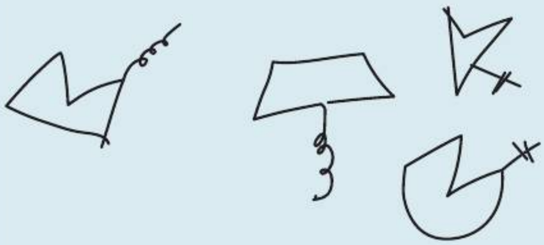
Exercises

All of these are floops:



None of these are floops:

Which of these are floops?



63 What strategies did you use for deciding what characteristics a floop has? What is the defining characteristic of a floop?

64 How does this relate to the hypothetico-deductive method discussed above?

There are two meanings for the word 'theory'.

A system of interdependent, well established scientific laws is called a theory. It is what we usually mean when we talk about scientific knowledge. For example, the theory of molecular chemistry tells us that water is H_2O. The discussions in this chapter tell us that this knowledge is not completely immune from being shown to be wrong. It could happen but in the case of the chemical constituents of water, this is very unlikely. Scientific theory is usually very well established. In this sense, theory is often taken to be the facts of science.

Unfortunately, there is another use of the word. Theory is sometimes taken to mean something for which there is little or no evidence: 'That is just theory – there is absolutely no evidence to back it up'.

Sometimes these two meanings get confused in a discussion. For example, the Theory of Evolution is a very substantially verified body of knowledge. Unfortunately, some of its detractors latch on to the word 'theory' and claim 'but it's only a theory'.

Theory in the natural sciences

The description of the scientific method raises a number of questions.

- In order to measure something in an experiment, we need to know what to measure. Let us say that we decide to measure the mass of something . How do we know that it is mass that we should measure?
- In order to measure something, we already need to have the concept of the **variable** we are measuring. So in order to measure mass, we already need to have the concept of mass. Where do these concepts come from?

The answer to both these questions is that **theory** tells us what to measure. It tells us which variables are relevant and it provides the concepts to help us do the measuring. The concept of mass does not exist outside Newton's (and later Einstein's) theory of motion. It would have been impossible to measure mass before Newton as the concept simply did not exist.

So, measurements are always made against the background of a scientific **theory** that, as we saw earlier, connects together key concepts. In the natural sciences, the core of the theory is a **law of nature** that proposes a relationship between key concepts in the theory.

Let us take an example from classical physics. We have the key concepts of mass, acceleration, and force. One of the laws of nature discovered by Newton was that force is related to mass and acceleration by the equation:

$$\text{force} = \text{mass} \times \text{acceleration}$$

We could devise an experiment to measure the force exerted by the gravitational attraction of the Earth. This is effectively what we are doing when we weigh something. The point here is that the results of an experiment *do not mean anything outside a particular theory*. We need to have a theory that ties together the relevant concepts before we can interpret experimental results. Without a theory, experimental results are just meaningless numbers – theory and its embedded concepts provide meaning. The startling implication is that a different theory might produce a different interpretation of experimental results. We say that the interpretation of experimental results is **theory laden**.

Prescribed essay title 5: What is it about theories in the human sciences and the natural sciences that makes them convincing?

Simulating methods in the natural sciences

A good illustration of the hypothetico–deductive method is the following game, which can be played in TOK class.

Group mastermind

This game is based on a popular family board game. It can be played between the teacher and the rest of the class. The teacher should choose one student to be the chairperson. Once the game is underway, the teacher communicates only with the chairperson. The game consists of six coloured dots which can be drawn on the white board or their initial letters can be used instead. The colours are: red (R), yellow (Y), green (G), purple (P), blue (B), and orange (O).

The teacher writes down a code (a list of four colours which can include repeats, and which he or she keeps secret. The aim of the game is for the class (through the chairperson) to discover the code by asking questions. Each question consists of four coloured dots (or initials) with or without repeats. The teacher responds to these questions as follows.

- For each coloured dot or initial that is the right colour in the right position, a black circle is drawn.
- For each coloured dot or initial that is the right colour in the wrong position, a white circle is drawn.

The order of the black and white circles does not correspond to the order of the correct pegs (Figure 4.6).

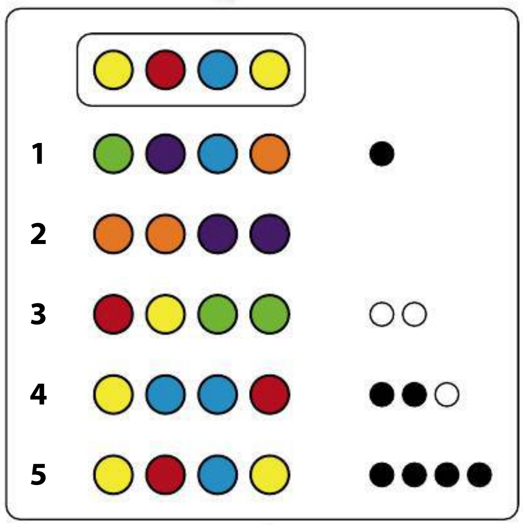


Figure 4.6 An example game.

The chairperson has the job of chairing the debate as to what colours to try. After an interval of time determined by the teacher, he or she makes a choice based on the class discussion.

Students are advised to play the game with a great deal of TOK awareness. Be aware of your own thoughts. What strategies are you using? What feelings do you have when playing? Also be aware of others. How are they behaving? How does the group respond to the challenge?

Figure 4.6 shows an example game. The hidden code is contained in the box at the top. The questions are the coloured dots on the left-hand side and the responses from the teacher are on the right-hand side.

There was much argument how to proceed. Some students wanted to try one colour at a time. There was a feeling that this gave no positional information but there was also a feeling that the first row should be random. What the class came up with was moderately successful with one colour right and in the right place. The second row appears completely unsuccessful but actually gives a lot of information. Neither orange nor purple can be in the code. This illustrates that negative results can give a lot of information in science. Since only one colour out of four was correct in the first row there must be a repeated colour in the code. The class chanced that green was that colour, hence row 3. But the response of only two white circles indicates that it is either three reds and one green, or no greens and red and yellow. The class after much argument went for the latter possibility. Row 4 involved much discussion about which colour was doubled and the class went for blue. But two black circles and one white circle means their guess was wrong. Suppose red were right in row 4. We now know blue is right, reinterpreting row 1 after row 3. So this accounts for the two black circles in row 4. But this would mean that yellow was in the wrong place. But yellow cannot be in position 2 because of row 3, so there is nowhere else for yellow to go. This leads to a contradiction, so red cannot be in the right place in row 4. So there must be two yellows (there cannot be two blues because there would be more right in row 4 and there is no position left for a second red to go) and one must be in position 1. So the only place red could be is position 2, which means that the second yellow has to be in position 4.

Exercises

65 If the teacher is 'mother nature', which group of people do the students represent in the game?

66 What does the teacher's (mother nature's) hidden code represent?

67 What does each sequence of four colours or letters represent?

68 What do the black-and-white-circle responses to each line of four colours or letters represent?

69 What is the role of hypothesis in the game?

70 What is the role of theory in the game?

71 In what sense is the meaning of the black and white circles theory-dependent?

72 What did you notice about the social interactions of the students during the game? In what sense is this realistic?

73 What WOKs were in involved in playing the game? Were you using imagination or emotion to guide your play?

74 Were there any moments when you felt you were using your intuition to guide your play?

75 In what way did the game illustrate the fact that scientific research is a group effort?

76 What aspects of the game are unrealistic? How could you make them more realistic?

Einstein's mistake

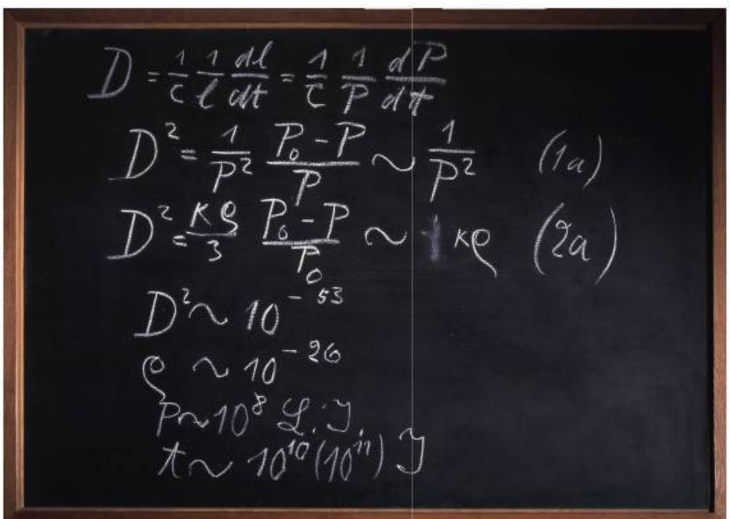
“Recently my partner and I were lucky enough to be shown pages from the actual notebook in which Einstein invented general relativity, while it was being prepared for publication by a group of historians working in Berlin. As working physicists it was clear to us right away that the man was confused and lost – very lost. But he was also a very good physicist. In that notebook we could see a very good physicist exercising the same skills and strategies, the mastery of which made Richard Feynman such a great physicist. Einstein knew what to do when he was lost: open his notebook and attempt some calculation that might shed some light on the problem.

So we turned the pages with anticipation. But still he gets nowhere. What does a good physicist do then? He talks with his friends. All of a sudden a name is scrawled on a page: 'Grossmann!!!' It seems that his friend had told Einstein something about the curvature tensor. This is the mathematical structure that Einstein had been seeking, and is now seen to be the key to relativity theory.

Actually I was rather pleased to see that Einstein had not been able to invent the curvature tensor on his own. Some of the books from which I had learned relativity had seemed to imply that any competent student should be able to derive the curvature tensor given the principles Einstein was working with. At the time I had had my doubts, and it was reassuring to see that the only person who had ever actually faced the problem without being able to look up the answer had not been able to solve it. Einstein had to ask a friend who knew the right mathematics.

The textbooks go on to say that once one understands the curvature tensor one is very close to Einstein's theory of gravity. The questions Einstein is asking should lead him to invent the theory in half a page. There are only two steps to take, and one can see from this notebook that Einstein has all the ingredients. But could he do it? Apparently not. He starts out promisingly, then he makes a mistake. To explain why his mistake is not a mistake he invents a very clever argument. With failing hearts we, reading his notebook, recognize the argument as one that was held up to us as an example of how not to think about the problem. As good students of the subject we know that the argument being used by Einstein is not only wrong but absurd, but no one told us it was Einstein himself who invented it. By the end of the notebook he has convinced himself of the truth of a theory that we, with more experience of this kind of stuff than he or anyone could have had at the time, can see is not even mathematically consistent. Still, he convinced himself and several others of its promise and for the next two years they pursued this wrong theory. Actually the right equation was written down, almost accidentally, on one page of the notebook we looked at. But Einstein failed to recognise it for what it was and only after following a false trail for two years did he find his way

This is a blackboard Einstein used during his second Rhodes Memorial Lecture in 1931, on the theory of relativity. Here he shows an equation proving the expansion of the universe, and estimates the universe to be 10 billion years old, close to the modern estimate of 15 billion. From looking at these neat workings, would you guess how difficult it was to reach these conclusions?



back to it. When he did it was questions his good friends asked him that finally made him see where he had gone wrong.

Nothing in this notebook leads us to doubt Einstein's greatness – quite the contrary, for in this notebook we can see the trail followed by a great human being whose courage and judgement are strong enough to pull him through a thicket of confusion from which few others could have emerged. Rather the lesson is that trying to invent new laws of physics is hard. Really hard. No one knew better than Einstein that it requires not only intelligence and hard work but equal helpings of insight, stubbornness, patience and character. This is why all scientists work in communities. And that makes the history of science a human story. There can be no triumph without an equal amount of foolishness. ”

Smolin, 2000

The particle game

This game is an interesting way to explore the scientific method. You can play it with a classmate. The rules are simple. The board consists of an 8 × 8 grid which represents a physics experiment. The red blobs represent atoms and the lines with arrows represent particles that are fired into the grid. Particles are repelled by atoms and behave according to the following rules (Figure 4.7).

- If a particle is fired directly towards an atom, it bounces straight back (e.g. particle X is fired in at 3 and comes out again at 3).
- A particle is deflected 90 degrees away from an atom (e.g. particle Y enters the grid at 2 and leaves the grid at C; particle Z is deflected twice, entering the grid at F and leaving at E′).
- A particle cannot enter of the grid immediately beside an atom (e.g. particle W at B′; the same would apply to a particle attempting to enter at A′ or 8 or 7).

Here is how to play the game. Make an 8 × 8 grid and place two atoms somewhere on it but do not let your partner see where they are. Your partner must try to find out where the atoms are by firing particles into the grid. So they might say: *Particle enters at F′*. You look at your grid and tell your partner at what point the particle leaves the grid. In the game shown in Figure 4.7 above you would say: *Particle leaves at 6*. Your partner might surmise that there is an atom in column G–G′ and suggest: *Particle enters at H′*. You would answer: *Particle leaves at 6′*.

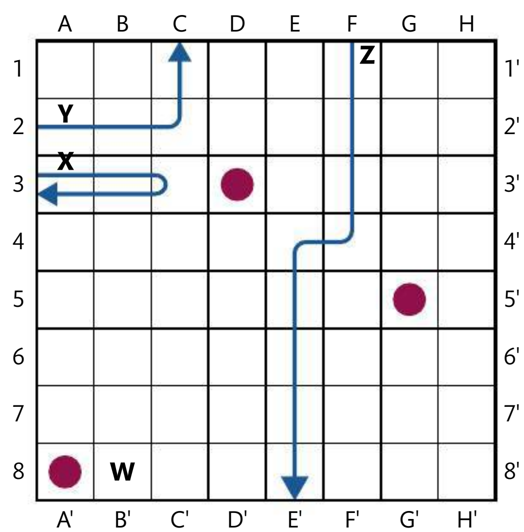


Figure 4.7 An example particle game.

Your partner keeps on bombarding the grid with particles until he or she has discovered the positions of your two atoms.

In the game shown in Figure 4.8, you could be lucky and find the atom with your first particle by observing a 90-degree deflection which locates the atom exactly. But this is only sufficient if you know there is only one atom in the grid.

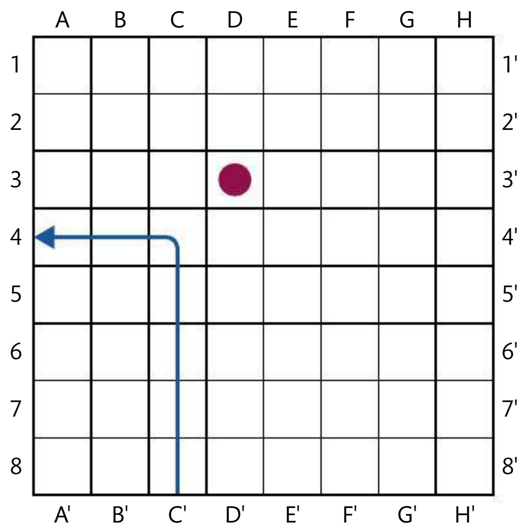


Figure 4.8 If there's only one atom ....

Exercises

77 Try the particle game with your partner using two atoms. When you get good at it, try increasing the number of atoms.

78 **a** What theory can you make about the arrangement of two atoms if you had the following experimental data:
particle enters at 4, leaves at C; particle enters at D′, leaves at D′; particle enters at G, leaves at E′; particle enters at H, leaves at H; particle enters at 6, leaves at C′; particle cannot enter at 8′.

b Is this enough information for your theory to be unique given that you know that there are only two atoms?

c What if you did not know how many atoms there were?

79 This is slightly more difficult. There are three atoms.

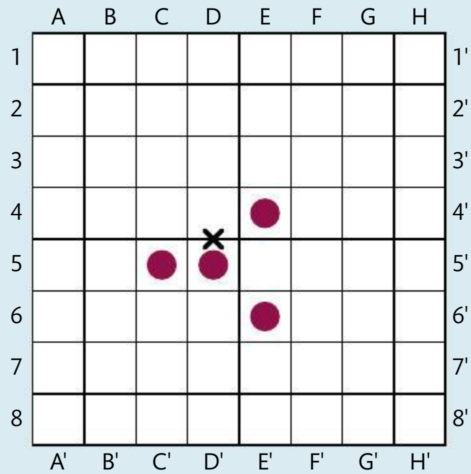
particle enters at 4, leaves at B; particle enters at E, leaves at 1; particle enters at F, leaves at F; particle enters at D, leaves at 3; particle enters at 3′, leaves at 4′; particle enters at 6, leaves at B′; particle enters at C′, leaves at C′; particle enters at D′, leaves at E′; particle enters at F′, leaves at F′; particle enters at G′, leaves at 6′.

80 Are the particle paths always symmetrical (i.e. if enter at G, leave at 6 is a path, is enter at 6, leave at G also a path? In other words, are there any laws you can derive about the observed entry and exit points of particle?

81 Is it possible for a particle to get stuck (i.e. enter and never leave)?

82 Try the game again but using slightly different deflection rules. Can your partner work out the new rules just by observing the entries and exits from the grid?

83 What can you say about the atom labelled X in the arrangement below? Is it possible to make a similar arrangement with only three atoms?



Exercises

84 a How realistic do you think the particle game is in simulating the basic methods of experimentation in particle physics?

b Which aspects do you think are realistic and which aspects are not?

c What could be added to make the game more realistic?

Ways of knowing in the natural sciences

“I believe in intuition and inspiration. … At times I feel certain I am right while not knowing the reason. When the eclipse of 1919 confirmed my intuition, I was not in the least surprised. In fact I would have been astonished had it turned out otherwise. Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly speaking, a real factor in scientific research.”

Einstein, 1931

Before we go on, you might like to think about what WOKs are employed by the hypothetico–deductive method.

Here are some of the possibilities.

- **Language** plays central role in naming key concepts in the production of theory and hypothesis as we have seen.
- **Sense perception** is important because it is the basis for observation and measurement. Many of the sensitive instruments that are employed in the natural sciences are, in some sense, extensions of the human sensory apparatus. Microscopes and telescopes improve on our vision, for example. But are all scientific instruments that make measurements just extensions of our senses?
- **Reason** seems to be at the heart of the hypothetico–deductive method. After all, we are testing deductions from the background theory. Theory gives us predictions that we test. If the predictions are wrong, something about the theory is wrong. This is straightforward classical reasoning – *modus tollens*. The form of the argument is straightforward:

  theory → prediction
  not prediction
  therefore **not** theory

- **Imagination** and creativity are involved in coming up with possible hypotheses to explain the observed experimental results (as we saw in the mastermind game). Reason on its own cannot generate hypotheses. It is tempting to speculate, as Einstein does in the above quotation, that imagination is more important to the natural scientist than pure reason.
- **Intuition** might be used by scientists to produce plausible hypotheses to test. For example, the chemist Kerkulé is said to have had a dream about a snake biting its own tail which led him to the discovering of the ring structure of the benzene molecule.
- **Emotion** might play a part in inspiring individual scientists to pursue their inquiries. Interest, fascination, and curiosity might be important in motivating

CHALLENGE YOURSELF

There are other ways in which classical logic underlies the natural sciences. We want all our theories to be consistent [that P and (not P) cannot be derivable from the statements of the theory]. This is a logical condition based on what we can accept as part of our theory. We also want current theory to be consistent with all previously accepted observations. What this means in practice is that the interpretations of all previous observations relative to the current theory are consistent with it.

them. But emotion might also form the basis for evaluation and hence be part of the reasoning process. Students are often quick to claim that emotion gets in the way of scientific research because it prevents scientists from being truly objective in the consideration of their results. Much contemporary thinking (Haidt, Damasio, Thaler, etc.) regards this view as profoundly mistaken because it rests on the assumption that emotion and reason are somehow opposites, or that emotion and objectivity are enemies. The evidence from neuroscience shows that emotions are essential for good reasoning.

- **Faith** traditionally seems far removed from the processes of scientific inquiry. Faith seems to mean belief without sufficient evidence while scientific inquiry seems to require belief only with sufficient evidence. So, at first sight, the two appear to be opposites. Nevertheless there might be a case for stating that the evidence in science is never completely sufficient for the sort of conclusions that are drawn. Consider the process called **induction**. Induction means inferring generalized statements from particular ones:

  X_1 has property P
  X_2 has property P
  X_3 has property P
  …
  X_n has property P
  Therefore all X have property P

Induction is problematic because it does not matter how many positive examples we find of an X having property P, there is still a possibility that the next X we find does *not* have property P. There is no cast-iron guarantee that all Xs have this property. But that is exactly what we are concluding. Therefore, the conclusion is not completely warranted by the evidence. Hence, we might be justified in stating that we have used faith to bridge the gap between the evidence and the conclusion when we are making scientific generalizations.

Knowledge framework: *Methodology* – What role do models play in this area of knowledge?

Models are a central idea in the natural sciences. In fact, they are also important in many other AOKs. Here, the aim is to discuss models purely in the context of the methods used by the natural sciences.

Models in the natural sciences

Let us start again with knowledge as a map. We discussed how a map is not the same as the territory it depicts and that there is much about a map that is left out. We argued that a map derives its usefulness from the fact that it is a *simplified* version of reality. Because it is simpler than the reality, it can be used to solve practical problems.

Imagine now a map that can change with time. It is **dynamic**. That is what we mean by a model in the natural sciences: a simplified representation of reality that can evolve in time.

A model is constructed to solve a particular problem in the natural sciences. Quite often, scientific models use the language of mathematics. This is because many of the measurements we make in science are numerical. It seems the physical world lends itself to description in mathematical terms.

Figure 4.9 is a simple diagram of a model in the natural sciences. The question we want to answer is, does the real-life Spitfire plane fit through the doors of the real-life hangar? We make measurements of the length and wingspan (and other necessary dimensions) of the Spitfire, and of the doors of the hangar. Then we build scale models of the aeroplane and the hangar. Now we can check whether or not the model spitfire fits through the doors of the model hangar. If it does, we can be sure that the real-life spitfire fits through the doors of the real-life hangar.

In the figure, the blue background separates the real-world situation (on the left) and the beige background represents the world of the model (on the right). More generally, the model can be represented as in Figure 4.10.

Scientific models can be used to make predictions about the future state of the real world but they can also help us to understand the mechanisms that produce changes in the real world. It is possible to use a model that is very poor at prediction to give us understanding.

Each of the arrows in Figures 4.9 and 4.10 gives rise to a specific set of knowledge questions. The first arrow concerns the extraction of information from the real world. It requires us to do some observation, experiment or measurement. This of course begs the question: what should we measure? It is clear that this decision depends on the concepts employed by the theory and the model being used. What quantities to measure seems to presuppose that we know the relevant variables already – that we already know the solution to the problem. The second arrow concerns what we should do to the model in order to manipulate it to provide a useful answer to our research question. The third arrow projects the idealised world of the model back into the real world. In most cases the model is mathematical and yields numerical results which need to be interpreted in the non-numerical real world.

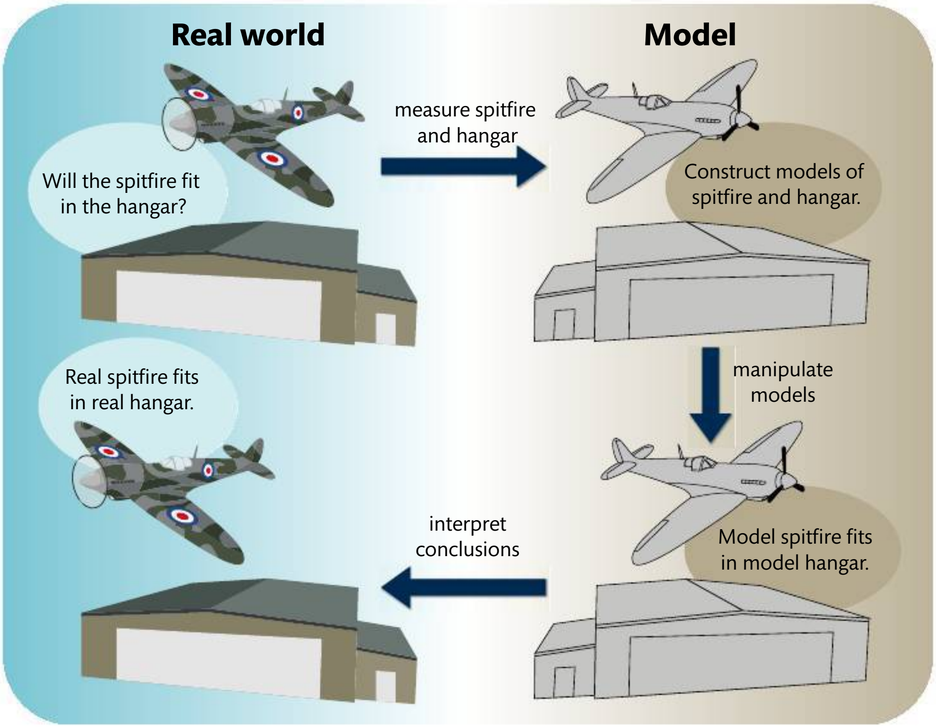


Figure 4.9 Modelling spitfire and hangar.

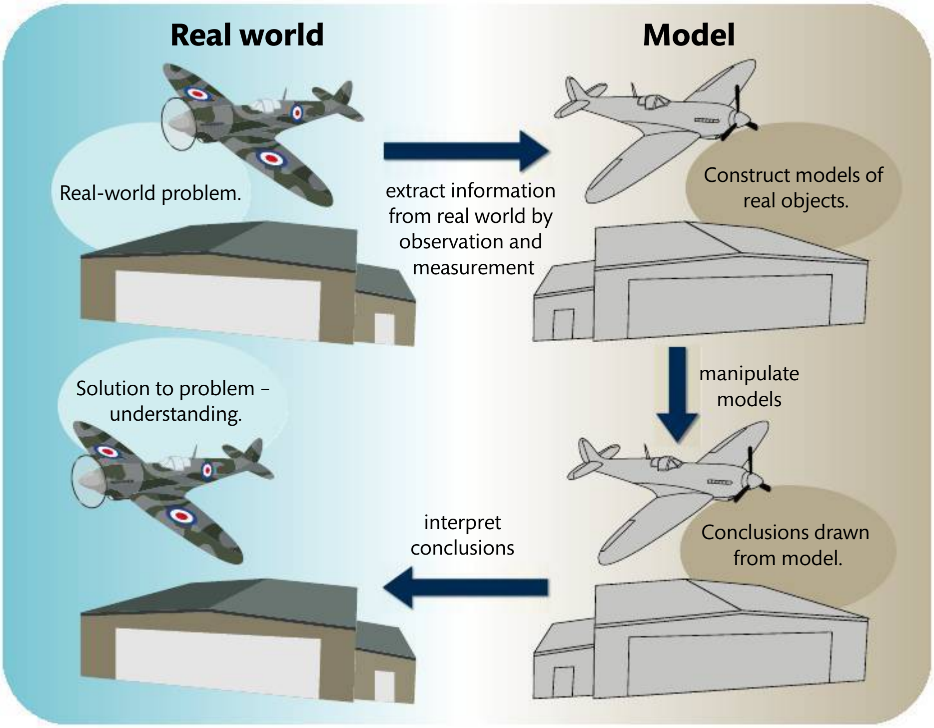


Figure 4.10 General modelling.

Knowledge questions

9 How can we know what to measure (what factors are relevant) before we know the solution to the problem?
10 How do we know which model is appropriate?
11 How do we know what assumptions to make in constructing the model?
12 If different models give different solutions to the problem, how can we decide which one is best?
13 How do we know how we should we manipulate the model to get an answer?
14 How should we interpret the model answer in the real world (often this means interpreting a number)?

Prescribed essay title 6: A model is a simplified representation of some aspect of the world. In what ways may models help or hinder the search for knowledge?

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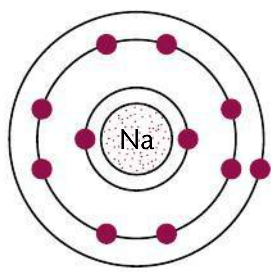
Modelling – electron shells

Figure 4.11 is one that most of us recognize from chemistry lessons in lower school. The nucleus in the centre and the electrons orbit the nucleus like planets orbiting the Sun. This metaphor helps us understand the structure of the atom. But it is more than a metaphor. By understanding this picture, we can understand how elements bond together chemically.



Na (11) 2, 8, 1

Figure 4.11 Model of a sodium atom.

Representations like this predict the chemical properties of elements. For example, the outer electron shell for the inert or noble elements He, Ne, Ar is full with electrons. This means, broadly speaking, that they have no electrons free to make bonds with other elements. But high-school chemistry classes debunk this picture completely. This is not at all how electrons are in relation to the nucleus. Electrons are smeared-out probability waves satisfying Schrödinger's equation. We need to remember that our simple picture is a model (and so is the Schrödinger equation – just a more sophisticated one). It does a good job in the limited area in which it operates. It allows us to build and understand the Periodic Table and do basic chemistry.

To watch the computer simulation of two galaxies colliding, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 4.3.

Exercises

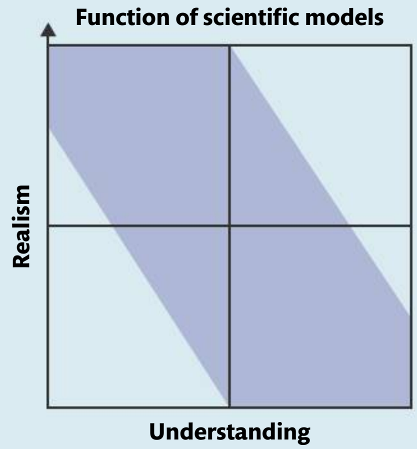
85 Why do you think astronomers have to use computer simulations when investigating phenomena such as the collision of two galaxies?

86 Is there a difference between a simulation and a model?

87 What are the strengths and weaknesses of simulations like this?

88 List three models that you have studied in your group 4 subject. What simplifying assumptions does each model make? What are the consequences of making such assumptions?

89 Place each of your models on the realism–understanding diagram below.

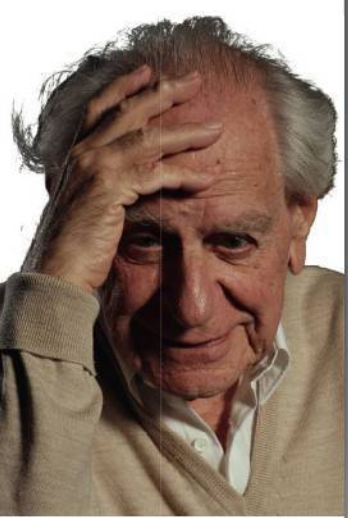


90 Does it matter that simplifying assumptions make a model inaccurate?

91 What other functions might a model have apart from accuracy or predictive power?

92 Can an inaccurate model still give us knowledge?

Sir Karl Popper



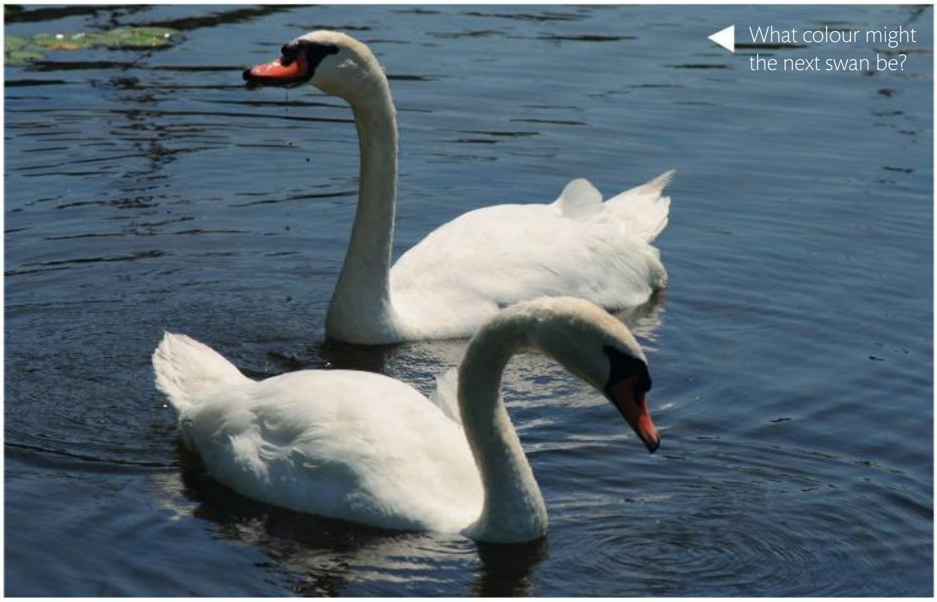
Sir Karl Popper (1902–94)

Karl Popper was born in Vienna but spent much of his professional life in London. He was one of the leading philosophers of science of his generation as well as being an influential political philosopher. His *Logic of Scientific Discovery* (published in German in 1934, translated into English in 1954) was hailed by the scientist Sir Peter Medawar as *'one of the most important documents of the twentieth century'*. In it, Popper suggests an answer to the problem of induction. Because we can never prove a universal statement like 'all swans are white', this cannot be the aim of scientific inquiry. We can disprove such universal statements by finding a counter-example, such as a black swan. Therefore, Popper says, the energies of science should be devoted to disproving universal statements rather than proving them. For Popper, science consists of statements that haven't yet been disproved. This idea is known as *falsificationism* and has influenced many working scientists in their approach to investigation. The scientist should aim to disprove his or her pet theory, rather than prove it. As long as a theory remains not disproved, it is in good health.

Popper was impressed by the fact that Einstein's theory of relativity was put to a severe test by the solar eclipse of 1919. The theory predicted that light from a star obscured by the eclipsed Sun would still be visible because it would be bent by the Sun's gravitational field. If the star were not visible, then the theory was disproved and that was that. It turned out that the star was visible, so Einstein's theory survived this test. He noted that theories in the social sciences, notably Marxism and Freud's psychoanalysis, could not be subjected to such severe testing and were therefore less 'scientific' (and in Popper's mind not really knowledge).

Exercise

93 Einstein was asked what his reaction would have been if general relativity had been disproved by the observations of Eddington and Dyson in the 1919 solar eclipse. He is supposed to have said, 'Then I would feel sorry for the dear Lord. The theory is correct anyway.' To what extent do scientists really follow Popper's principle of falsification in practice? Is there really no attempt to protect their theories from falsification?



What colour might the next swan be?

CHALLENGE YOURSELF

Carl Gustav Hempel was a distinguished German philosopher of science who spent the latter part of his academic life at Princeton University in the US. He was particularly interested in the problem of induction – the idea that a universal statement might be more secure the more positive observations support it. His example used ravens instead of swans but the idea is the same. Suppose one has only observed black ravens. One might be tempted to think that the more black ravens one observes, the more secure the statement 'all ravens are black' is – let us call this the **induction hypothesis**. But Hempel pointed out that the statement is logically equivalent to 'all non-black things are non-ravens'. But then, by the induction hypothesis, good evidence for the statement that all ravens are black would be to observe a large number of non-black objects and check that they are non-ravens. This is clearly absurd and demolishes the induction hypothesis as a basis for scientific inquiry. This is called Hempel's Raven Paradox.

Carl Gustav Hempel (1905–97).

Are all ravens black?

Knowledge framework: *Methodology* – What are the assumptions underlying these methods?

Assumptions underlying the scientific method

The scientific method as described here rests on a number of assumptions.

- Comprehensibility
  - There are laws that govern the natural world.
  - They are discoverable using methods available to human beings.
- Continuity
  - The laws that operate today will also operate tomorrow.
- Uniformity
  - The laws that operate in laboratories on Earth also operate in the far reaches of the universe.

Since the natural sciences devote their energies to discovering general principles or scientific laws, they naturally make the assumption that such laws exist. They assume there is some sort of order in the universe rather than randomness, and that every event has a cause. Up to a point, they assume that if the cause is the same, the effect produced by it will be the same. This assumption is necessary because of the way in which the scientific method attempts to isolate causes from other irrelevant factors. We say ‘up to a point’ because modern quantum physics challenges some of these fundamental assumptions about nature.

There is a further assumption acknowledged by many fields in the natural sciences that these laws of nature are simple enough for human beings to understand and are expressible relatively simply in the language of mathematics. The comprehensibility of the universe propelled pre-Socratic Greek thought along the path of trying to find out what the world was like. We did not require interventions from the Gods – human reason was sufficient for us to discover the secrets of the universe. This was a dramatic shift in thinking and ushered in the golden age of Greek thought. It was later reversed with the arrival of Christianity and a closing of the door on free inquiry. Both Newton and Einstein were impressed by the apparent simplicity of the laws of nature when expressed in mathematical form.

Correlation is not the same as causation. Popular newspapers often scare the public with headlines like ‘Drinking coffee gives you cancer’. These headlines, if they have any evidential support at all, might be based on a study showing that there is a significantly higher rate of cancer in patients who are big coffee drinkers. But concluding the two are causally linked has to be approached with extreme caution. Correlation on its own will not do. In particular, it is important to produce a mechanism to show (within existing theory) how the two phenomena are linked.

It is assumed that the laws of nature do not change from one day to the next because it is essential for us to use past observations to establish predictions about the future. Such predictions would not be possible in a universe where the laws of nature changed rapidly over time. It would be like playing a sport where the rules changed during the course of a game.

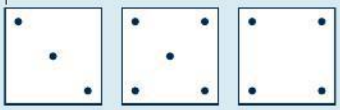
Similarly, we assume that there is nothing special about our own position in the universe – that Earth is a small planet orbiting a fairly ordinary yellow star in a typical galaxy. This assumption is necessary for us to be able to generalize the conclusions we reach about nature, as we see it from our local position, to the universe as a whole.

It is difficult to see how there can be any evidence for these assumptions since any analysis of evidence presupposes them. Take the problem of causation. It is possible to observe that whenever A happens, then B happens. But it is not possible to observe that A causes B. This has to remain an inference – an act of faith perhaps. Whether or not every event has a cause is a question that is one step further removed from observation. If the fact of A causing B has to be inferred from observations of them occurring together, what observation would we make to establish that *every* event had a cause? We have to take these assumptions on trust. They are required for the methods of the natural sciences to work. They are preconditions for doing science in the first place.

Exercise

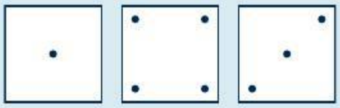
94 The polar bear and fish puzzle

One day a scientist was flying over the frozen polar wastes. He looked down and saw an extraordinary pattern in the ice. This is what he saw:



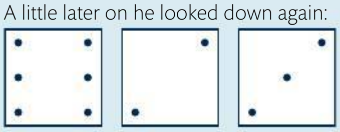
'Aha', he said to himself, 'two watering holes, ten polar bears and nine fish.'

Later on he looked out of the window again and saw a different pattern:



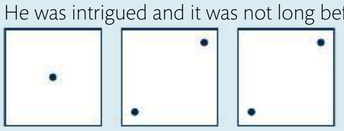
'What a strange pattern!' he cried. 'But I can see clearly that there are two watering holes, six polar bears and thirteen fish.'

A little later on he looked down again:



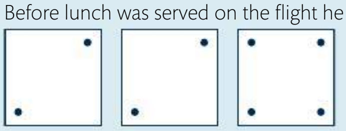
'Well that's extraordinary: one watering hole, ten polar bears and ten fish.'

He was intrigued and it was not long before he looked again:



'I can easily see that there is only one watering hole and just four bears but sixteen fish.'

Before lunch was served on the flight he looked down one more time: This was the scene:



What exactly did he see?

The watering holes and the polar bears you will find soon enough. The fish require lateral thinking. How does this puzzle relate to the work you have done in this chapter on the natural sciences?

4.5 Historical development

We might be forgiven for thinking that the natural sciences just map what is out there and that there is little room for questions about their history. After all, how much of a science textbook is devoted to the history of science? But a crucial part of the knowledge framework is concerned with how our AOKs depend on their historical development.

Knowledge framework: *Historical development –* What is the significance of the key points in the historical development of this area of knowledge?

The current form of the natural sciences depends on their historical development

There are two parts to this.

- How the current shape of a discipline depends on its past.
- How progress is made over time in the discipline.

Exercises

95 Are there any events in the history of your group 4 subject that were crucial to its development?

96 What aspects of your group 4 subject in its current form were shaped by those developments?

A good place to start is with the units we use to measure the quantities that are important in the natural sciences. It is easy to see that they depend on historical circumstances. The metre (m) has a history that goes back to the 18th century and the division of the distance between the equator and the pole into 10 million pieces. (This makes the Earth's circumference about 40 000 km). But its precise definition is a good deal more complicated than this.

Exercise

97 Why is the establishment of standard units important in the natural sciences? (Hint: see page 108).

The concepts which we employ in the natural sciences are also historically situated. Because they are strung together into more elaborate scientific theories, they are clearly very important in the formation of scientific knowledge. It is useful to trace the history of the individual scientific disciplines to establish points at which important conceptual advances took place.

There are more fundamental developments in the history of the natural sciences, however. These are points where the methodology itself changed or developed. Let us examine two major developments in the approach to scientific methodology.

- An initial attempt to answer the question: How should we conduct inquiry in the sciences in order to produce knowledge that is reliable?
- A 20th-century view of how scientific progress is made.

Francis Bacon and an early view of the scientific method

Our discussion so far has focused on the hypothetico–deductive method: the use of hypothesis and experiment to conduct scientific research. We have assumed that there is only one scientific method and that this is it. This assumption might be open to question. It is possible that there are other methods which might qualify as suitable forms of scientific inquiry. Indeed there may have been other methods that were considered the essence of science in the past. One of the first people to try to set down exactly what was required in a scientific investigation was Francis Bacon. His scientific method is quite different from the modern conception.

Francis Bacon (1561–1626).

Bacon's method, as described in his book *De Novum Organum*, starts with the making of observations – lots of them. The job of the scientist is to try to find patterns in these observations. Bacon's method is **empirical** in that it is based on observation but it differs from the hypothetico–deductive method because experiments are not conducted to test hypotheses. Instead, it relies on **induction** to justify generalizations made by science.

Exercises

98 Identify a field in the natural sciences that uses Baconian methods (collecting data first and then looking for patterns).

99 What are the strengths and weaknesses of Bacon's method?

100 What were the major historical developments in the group 4 subject that you study?

101 How did these shape the current form of the subject?

102 Is there a tension between Bacon's method and the statement earlier that all observation is theory laden?

Thomas Kuhn and how changes occur over time in the natural sciences

Now we look at a more recent development in thinking about the way scientific knowledge is produced. Thomas Kuhn was an American historian of science who argued in his book *The Structure of Scientific Revolutions* (1962) that progress in the natural sciences was not smooth but was jagged – that science advanced through a series of revolutions (Figure 3.16). Kuhn's theory sees scientific knowledge as something dynamic – something constantly changing. Kuhn is deeply indebted to the work of Michael Polyani in this respect.

Kuhn's theory is elegant and can be expressed simply. What he calls **normal science** is the everyday operation of scientific inquiry within a **paradigm**. For Kuhn, a paradigm is very much like what we call a knowledge framework in TOK. It is the system of concepts, language, assumptions, methods, values, and interests that define scientific research. It can be thought of as the whole system of scientific knowledge, expressed through scientific theory along with the underlying foundations: concepts, language, convention, assumptions, and so on. A neat summary here would be:

paradigm = theory + foundations

In Kuhn's research in the history of science, he noticed that paradigms rarely existed without being challenged. Quite often, it was new observations that challenged the current paradigm. The hypothetico–deductive method suggests that as soon as the result of an experiment challenges the hypothesis that is itself derived from a theoretical framework, the framework itself should be revised.

In practice, Kuhn noted, the science community was reluctant to relinquish its cherished paradigm. After all, it had served well up to now and was only being challenged by one result. There is always the nagging doubt that the experiment itself had not been conducted properly. If the deviant result is confirmed and other **anomalies** observed that also challenge the paradigm, there comes a time when the current paradigm – the current system of understanding – is no longer sustainable. At this point, we have what Kuhn described as **revolutionary (abnormal) science**. The old paradigm is broken and as yet there is nothing to replace it.

During this period, Kuhn believed that a number of rival explanations emerge; each, perhaps, with its own system of concepts and methods. There is, as yet, no uniform rational means of validating one or other of them because there is no overarching paradigm to which appeals can be made. These new theories must explain the new observations, but they must also explain all previous observations explained by the old paradigm. This corresponds loosely to political revolutions in history, when there is a period where there is no stable government and there are many rival groups making

To learn about homeopathy and the nature of modern clinical trials, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 4.4.

To learn more about homeopathy, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 4.5.

CHALLENGE YOURSELF

1 Describe briefly the method of **double blind** trials explained in the Goldacre article about homeopathy and clinical trials.

2 What is the point of neither the patient nor the experimenter knowing which treatment is being offered?

3 What is the placebo effect?

4 What is meant by *publication bias?*

5 What ethical issues surround the prescription of homeopathic remedies?

6 After watching the *Horizon* programme, what further tests would you perform to establish the effectiveness or otherwise of homeopathic methods?

bids for power (think of the factions in the French Revolution, for example). Eventually, one of these new theories becomes dominant (just as, after a revolution, one political group becomes dominant). What we mean by 'dominant' in this context is that the new theory is accepted by the establishment, or by enough of those with influence, to become the new orthodoxy. Eventually, this dominant theory and its underlying foundations become the new paradigm and we get back to a new period of normal science (Table 4.4).

Table 4.4 Evolution of scientific knowledge and paradigms.

Normal science	Current paradigm operates.	Anomalies are observed. Gradually the set of anomalies becomes too big or significant for the current paradigm to continue to hold.
Revolutionary science	No paradigm operates.	Many rival theories compete for acceptance – each with its own foundations. Gradually one of them becomes dominant and is accepted as the new paradigm.
Normal science	New paradigm operates.	After a while new anomalies are observed …

Thomas Kuhn (1922–96).

Kuhn's theory suggests that progress in the natural sciences is truly revolutionary and that the cycle never stops.

Exercise

103 Can you think of examples of paradigm shifts in other AOKs?

It is interesting to discuss the selection of the dominant theory in the revolutionary phase of Kuhn's cycle. There is an almost Darwinian process of natural selection where the 'fittest' theory wins the competition to become the new paradigm. Kuhn mentions five characteristics that might contribute to 'fitness' of a theory (Table 4.5).

Table 4.5 Characteristics that can help a theory become a paradigm.

Accuracy	The theory describes the observations accurately and serves to predict future observations.
Consistency	The theory is itself free of contradictions but is also consistent with other theories.
Broadness of Scope	The theory can explain many phenomena – perhaps more than the original observations on which it was based.
Simplicity	The theory 'invents the least and explains the most'. Occam's razor applies in a general sense.
Fruitfulness	The theory allows the discovery of hidden relationships between phenomena in addition to those it was intended to explain.

Paradigm shift? Faster-than-light neutrinos

“Researchers have found a flaw in the experiment that startled the science world last year by appearing to show particles travelling faster than light. The glitch may have affected measurements that clocked subatomic neutrino particles breaking what Albert Einstein considered the ultimate speed barrier.

Two separate issues were identified with the GPS system that was used to time the arrival of neutrinos at an underground lab in Italy, according to James Gillies, spokesman for the European Organization for Nuclear Research, or CERN. One could have caused the speed to be overestimated, the other could have caused it to be underestimated, he said. 'The bottom line is that we will not know until more measurements are done later this year,' he added.

The results of the experiment were received with great scepticism by scientists when they were published last September because they seemed to contradict Einstein's theory that nothing can travel faster than light. That rule is fundamental to modern physics and breaking it is seen as a step into the realms of time travel. Even researchers involved in the experiment cautioned at the time that the measurements would need to be independently verified by other scientists before a genuine finding could be declared.

The experiment involved neutrinos being fired from CERN's site on the Swiss–French border to a vast underground laboratory … 730 km away at Gran Sasso in Italy. ”

The Independent, **23 February 2012**

“ The experiment that was supposed to have proved Albert Einstein wrong by showing that sub-atomic particles can travel faster than the speed of light is more than likely to have been an error, scientists said yesterday.

Fellow scientists at the European Nuclear Research Organization (CERN) in Geneva announced that they had failed to replicate the findings of the rival Opera experiment last year when neutrinos were detected travelling fractions of a second faster than light speed on their journey to an underground laboratory at Gran Sasso, in Italy. Researchers involved in a similar experiment, named Icarus, said that the time it took for the neutrinos to travel … from Geneva to Gran Sasso did not suggest that they were capable of travelling faster than light, which would break Einstein's special theory of relativity – a fundamental pillar of theoretical physics.

'The evidence is beginning to point towards the Opera result being an artefact of the measurement,' said Sergio Bertolucci, the research director of CERN. The Icarus experiment uses an independent timing mechanism from that used on Opera. It measured seven neutrinos in the beam from CERN last year and these all arrived in a time consistent with them travelling no faster than the speed of light, Dr Bertolucci said. One suggestion is that the Opera experiment was marred by a loose cable in the delicate equipment used to measure the arrival times of the neutrinos sent from Geneva. ”

The Independent, **17 March 2012**

"The scientist who headed a European research team that last year measured particles travelling faster than light has resigned, weeks after a rival team cast doubt on the accuracy of those readings. Italy's National Institute of Nuclear Physics said today that Antonio Ereditato had stepped down from the leadership of the Opera experiment, whose measurements on the speed of neutrinos were widely questioned when they were announced in September. Mr Ereditato confirmed his resignation in an email but declined to comment further.

The Opera team itself had cautioned in September that the measurements needed to be checked by independent researchers because they appeared to go against a key tenet of modern physics – that nothing can travel faster than light. Breaking that rule, which underlies Albert Einstein's famous special theory of relativity, could have opened the door to a new kind of physics in which time travel and warp speeds might be possible.

In February, the Opera team acknowledged that it had found a flaw in the technical set-up of its experiment that could have affected the measurements, but held off on calling them wrong. Then, earlier this month, a rival team called Icarus clocked neutrino speeds using a different experiment and found they behaved just as expected. They travelled at, but no faster than, light speed.

Opera, Icarus and two other teams will try to settle the issue once and for all by conducting further tests at the European Organization for Nuclear Research, or CERN, in May."

The Independent, 31 March 2012

Exercises

104 What was the anomalous observation in the articles above?

105 What was the paradigm that was challenged by this observation?

106 How was the science community trying to resolve this situation?

107 Do the articles suggest that we are about to witness a paradigm shift at the heart of physics?

Knowledge questions

15 Does Kuhn's idea that science changes through a series of paradigm shifts undermine the possibility of objective truth in the natural sciences?

16 Is progress possible in the natural sciences?

4.6 Links to personal knowledge

Previous sections have dealt with the way in which individuals can contribute to the scientific project. Through their own personalities, character, interests, and perspectives scientists can lend individual and personal insights to what is essentially a collective endeavour.

Knowledge framework: Links with personal knowledge – What is the nature of the contribution of individuals to this area?

We have seen how the personal circumstances of individuals might make them able to solve problems impenetrable for the group. These individuals can show the way forward. Their ideas still have to go through thorough processes of validation, such as peer review and replication of experiments, but if they can satisfy the requirements established by pervious elements of the knowledge framework such as history and methodology, then their contributions will become knowledge.

Knowledge framework: Links with personal knowledge – Why is this area significant to the individual?

The influence between the individual and science flows in two directions. Scientific knowledge certainly has a big impact on us as individuals. Our lives are interlinked by information and computing technology, for example. It creates the very structure of our social lives in many cases. Technology also seems to shape the sort of experiences available to us in the work place and during leisure time. Information technology creates new ways of doing things and even new things to do.

The natural sciences impact on our personal sphere at a deeper level as well. Advances in medicine mean that we are living longer. We have a clearer understanding of the nature of our illnesses than ever before. Perhaps medical science gives us a view of being human – this vast complex of interacting systems – that is strangely at odds with the view we have of ourselves from a first-person perspective. How do we square the view of ourselves as material beings following deterministic laws, with our inner emotional life – our view of ourselves as possessing desires and dreams and, most problematic of all, being free?

Physics gives us a view of our place in the universe that is perplexing in many ways. The universe is vast and largely mechanistic. It has been around a long time. We are miniscule in comparison and our timelines are but a dot in the whole scheme of things. These are humbling thoughts. Yet there is a need to create a synthesis of our view of ourselves as important and highly valued with a physical understanding that emphatically contradicts this.

Taken on their own, perhaps, the natural sciences cannot tell the whole story but they nevertheless give us the physical background to other investigations we must do if we are to understand who we are.

Exercises

108 What impact have the natural sciences had on the way you understand yourself?

109 How has technology affected the form and content of your personal knowledge?

110 To what extent do you agree with the thesis of Nicholas Carr that information technology is changing the way we think?

111 How has your study of your group 4 subject affected the knowledge you employ in your day-to-day dealings with the world?

112 How does your personal perspective affect the knowledge that you produce as part of a team in the natural sciences?

Knowledge questions

17 How can we know how our personal perspective affects the knowledge that we produce as part of a group in the natural sciences?

18 How do we reconcile our personal experiences with the shared knowledge of natural science? If there is a conflict between the two, which side should yield?

19 Are the natural sciences free of personal perspectives because they are a group effort rather than being the work of one person?

20 What role does interpersonal politics play in the production of knowledge in the natural sciences?

Prescribed essay title 7: As an IB student, how has your learning of literature and science contributed to your knowledge of individuals and societies?

05 Human sciences

On previous page – The world population reached 7.2 billion in mid-2013. Do an internet search for 'Worldometers' for a real-time update of the current world population.

5.1 Introduction to human sciences

What are human sciences?

In May 2010, an article entitled 'Growth in a time of debt' appeared in the *American Economic Review: Papers and Proceedings*. The title was modest and the paper was short (barely 6 pages long) but its influence was enormous. In it, the authors, economists Professor Carmen Reinhart and former chief economist of the International Monetary Fund, Professor Kenneth Rogoff, both of Harvard University, suggested that there was a link between high public debt and low economic growth. By examining data about a number of countries, they concluded that high levels of government debt were correlated with low economic growth. This research was seized on by many governments in both economically developed and developing countries to justify a sharp decrease in government spending: so-called *austerity* policy. Such policies have had an enormous effect on millions of people through reduced government spending on public services, social programmes, unemployment benefit, healthcare, and education.

Thomas Herndon – the student who unearthed the flaw in Reinhart and Rogoff's paper.

In April 2013, Thomas Herndon – a Master's student in the economics department of the University of Massachusetts Amherst – tried to reproduce Reinhart and Rogoff's findings. He found that he couldn't reach the same numerical conclusions as their paper.

He thought he'd made a gross error. It seemed most likely that he, as a student, had made a mistake, not the Harvard professors. He met with his professor, Michael Ash, who told him he needed to sort it out. But he still couldn't replicate the results. So with encouragement from his professors, Herndon contacted Reinhart and Rogoff. After some correspondence, they sent him the data set they had used together with the spreadsheet they developed to analyse the data. And Herndon couldn't believe his eyes! He got his girlfriend to come over to check that his eyes weren't deceiving him. But he was correct. He had discovered a basic error in the spreadsheet: Reinhart and Rogoff had only included 15 of the 20 countries in their analysis in the key calculation of the average GDP growth in countries with high public debt. Australia, Austria, Belgium, Canada, and Denmark were missing.

Later investigation showed that the situation might be even worse than expected. Here is a report in the Huffington Post of 30 May 2013.

> “The Harvard economists have argued that mistakes and omissions in their influential research on debt and economic growth don't change their ultimate austerity-justifying conclusion: that too much debt hurts growth.
>
> But even this claim has now been disproved by two new studies, which suggest the opposite might in fact be true: Slow growth leads to higher debt, not the other way around. … University of Michigan economics professor Miles Kimball and

University of Michigan undergraduate student Yichuan Wang write that they have crunched Reinhart and Rogoff's data and found 'not even a shred of evidence' that high debt levels lead to slower economic growth ❞

Reinhart and Rogoff issued a correction to their original paper, and pointed out that they suggested a correlation between high public debt and low growth rather than a causal connection. But the damage was already done. Their reputation has taken a fairly severe knock and that of economics as a discipline with it.

Why study human sciences?

From a TOK point of view this case raises a number of interesting issues.

- How could an important paper such as this one, with big implications for crucial public decision-making, not be peer-reviewed in the same way as a natural science paper would be?
- What is the purpose of producing knowledge in the human sciences? Is it the same as the purpose of the natural sciences?
- Is there a difference in the methods of the human sciences and those of the natural sciences? Is there a difference in reliability?
- What is it about the 'human factor' in the human sciences that calls for different approaches in the human sciences than the natural sciences?

We shall examine these questions in this chapter. But first, we have to establish exactly what we mean by the human sciences.

Exercises

1 The authors of the economics paper claimed that they were merely suggesting that high debt was correlated with low economic growth not that it was an actual cause. What extra evidence would be needed on top of correlation to establish a causal link?

2 Mark each of the following statements 'true' or 'false' and try to produce reasons for your answers.

- **a** The human sciences are more suited for governing social policy than the natural sciences.
- **b** There is more space in the human sciences for personal factors such as political preferences to play a role.
- **c** It is not possible to make mistakes in the human sciences.

5.2 Scope and applications

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

Scope of human sciences

The disciplines that make up the AOK called the human sciences were staked out beginning in the 18th century, with economics leading the way followed shortly

afterwards by sociology, psychology, anthropology, and political science. Some are seen as venerable – economics, perhaps – demanding the respect that their mathematical findings deserve, while newer human sciences are creeping in from the margins. For instance, we find fields like gender studies, Asian studies, post-colonial studies wanting the same respect as the old guard. But there are doubts. Does 'studies' mean the same thing as 'science'? How is it that all these different fields belong within the same academic boundary? Some divisions on this map of knowledge sometimes look quite blurred, while others are in bold outline or not yet fully drawn. Are they all human sciences? Are they, in fact, sciences?

To begin to answer this question, it is good to remember that the human sciences – or social sciences as they are often called outside the IB – are diverse. While they differ in subject matter they all are obliged to make some kind of evidence-based statements or generalizations explaining the behaviour of human beings singly or as a group.

“The aims of the psychology course at HL and SL are to:

- interpret and/or conduct psychological research … for the **benefit** of human beings
- develop an awareness of how **applications** of psychology in everyday life are derived from psychological **theories**”

© International Baccalaureate, 2009

Varieties of human sciences

To get a fuller sense of the range of disciplines that make up the field of the human or social sciences, you could thumb through a university prospectus. Depending on the size of the university such courses may be collected together in one department called anything from Faculty of Social Sciences to Faculty of Humanities and including (or not) history and philosophy. However, traditionally both philosophy and history have their own (quite extensive) faculties or departments and research agendas at the higher academic levels.

It might be the case that the social sciences cannot be defined with satisfactory precision for good reasons – although we continue to try – and that each discipline, sub-discipline and discipline that would like to be known as a science should be content with its own purposes, if not its own definitions. Yet it seems safe to say that they are bound together by their common concern to investigate human beings in some kind of context. A central knowledge question is, what special challenges arise as a result of this concern?

IB group 3 was described as 'The Study of Man' until the protest of women forced a change in the mid-1980s. It is now called 'Individuals and Societies'. This change is itself a topic worthy of investigation. But the group also includes disciplines such as history and philosophy, areas not usually regarded as human sciences.

Exercise

3 In this table, try to write a word or phrase that defines each discipline.

Field of study	Definition
sociology	
economics	
anthropology	
psychology	
economic history	
political science	
communication	
urban planning	
criminology	
gender studies	
military science	
linguistics	
human geography	
international relations	
GLTG studies	

Defining the disciplines of the human sciences.

Human sciences and natural sciences

How do we establish general patterns of human behaviour given that we take for granted that human beings have a will and, to some extent, are free to exercise it? At first sight, this does not seem too promising. Are we looking for absolute laws of human behaviour analogous to the absolute laws of nature we seek in the natural sciences? But surely any such law would be disrupted by the fact that human beings are agents – we can decide how to act and could decide to act against the pattern, whatever it was. Yet surely the human sciences speak in terms of generalizations that cover human behaviour in general. We talk of laws of economics or laws of psychology. We make generalizations about the pattern of human settlements in geography and we confidently categorize people according to their socio-economic class in sociology.

Such problems don't exist in a natural science such as physics because, frankly, you can't get an electron with attitude. Electrons don't make decisions, they cannot disrupt our universal laws, and each is exactly like every other electron in the universe and follows the same laws. There is no space for individualism among electrons. The picture gets a bit more complicated in biology since here we are studying living organisms and some of them (especially the human ones) have a will. Nonetheless, it is the physical aspects that are interesting to the biologist and they are covered by the same deterministic laws. There is little mention of 'will', 'desire', or 'intention' in a biology book despite the famous joke that 'under controlled conditions of light, temperature, humidity, and nutrition the organism will do as it d**n well pleases'.

CHALLENGE YOURSELF

Economists derive some of their laws from a basic set of assumptions. The law of demand (i.e. As the price of a good increases, the quantity demanded decreases.) is derived from three premises:

- buying the good has an opportunity cost (you could have bought something else with the money)
- marginal utility is decreasing (e.g. the satisfaction produced by the consumption of each extra chocolate bar decreases)
- human beings are rational maximizers of utility (we want to get the best satisfaction for our money).

For an exception to the law, one (or more) of these assumptions must be violated. Think of a real-world example where the law of demand is broken. Now work out which of the assumptions above is not true in that case.

This difference in subject matter leads us naturally to the different ways the human sciences and the natural sciences handle exceptions to laws and generalizations. Economists, for example, don't get into a fluster if they discover an exception to one of their laws. Physicists do (witness the outcry over the observation that was interpreted as a neutrino travelling faster than the speed of light – Chapter 4, page 130). An economist just shrugs off exceptions to the law – he or she just concludes that one of the basic assumptions does not hold.

But if we encountered an exception to the law of physics that says the speed of light is a universal speed limit, that would be front-page news. We would have a fundamental contradiction between observation and theory that threatened the whole edifice of current understanding of the physical world.

On the surface, both the natural sciences and the human sciences seem to be looking for generalizations or laws. But dig a little deeper and it seems that the laws they produce are rather different in type. Where this difference comes from is a central knowledge question that deserves further investigation. But for a start, we could guess that laws in the human sciences might be statistical: that we are dealing with likelihoods rather than certainties. If this were true, it would have major implications for our ability to predict.

The natural sciences are good at prediction. That is one of their main uses. The human sciences, on the whole, are not so good. Very few people predicted the financial crisis that hit the developed world in 2008 and the sharp global recession that followed it. Those who did, such as Nouriel Roubini, now have superstar status. This is a job for us to examine in TOK: to explain where these differences in predictive power come from. After all, if we want to cure social problems and make a better world, we shall need knowledge that has predictive as well as explanatory power.

Exercises

'Prediction is very difficult, especially if it's about the future'. (Nils Bohr)

Perhaps this view is relevant to the human sciences as well as to physics. It's often easy to find a model that fits the past data well but quite another matter to find a model that correctly identifies those features of the past data that will be replicated in the future.

4 Can you think of an example in the human sciences where it is easy to have 20–20 hindsight but very difficult to make predictions?

5 Why do you think that so few economists predicted the financial crisis in 2008?

6 Some phenomena in the natural sciences are also difficult to predict; for example, the occurrence of earthquakes. Why is this? Are the factors the same here as in the case of making predictions in economics?

Clearly, the role of the human being as both investigator and object of investigation might go some way to understanding the difference between the human sciences and the natural sciences. But it raises further questions.

- Is this feature of the human sciences something positive or does it hinder our inquiries?
- Is it legitimate to draw on our personal experiences and inner intuitions in teasing out patterns of human behaviour?
- Could it be that the experimenter through observing him- or herself as an object of investigation is prone to *wishful thinking*, and observes precisely the sort of things that he or she is looking for?

These questions will be taken further in the later sections on the participant observer. It is sufficient now just to notice that they might help define the fault line between the human and natural sciences.

The impersonal nature of their subject matter, the methods of replication of results, and rigorous peer review render the natural sciences largely immune to these problems. After all, by the 19th century, natural science methods were well enough established to turn speculation into knowledge through balancing observation and theory.

And in this scientific age, the notions of rationality, objectivity, and prediction were so linked to knowledge that the opinion began to form that all other disciplines pale beside the claim of the hard sciences to give us the real map of the real world. And with hard or positive knowledge comes power and prestige – and envy – such that other disciplines want to model themselves on the methods of the natural sciences with the implied assumption that the more scientific they are, the better.

Prescribed essay title 1: For some people, science is the supreme form of all knowledge. Is this view reasonable or does it involve a misunderstanding of science or knowledge?

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Exercise

7 Go back to the list of human sciences at the beginning of this chapter and place them on a continuum from 'scientific' to 'non-scientific'. Which discipline turns out to be the most scientific and which the least? How do you understand 'scientific' at this point?

What's in a name?

But what does it mean to be a science? Surely some disciplines cannot, should not, or would not want to be thought of as scientific. So while we may think that economics, psychology, sociology, and anthropology make the strongest claim to be both 'social' – about humans interacting with one another – and 'sciences' – in setting out, or searching for, general laws with a high degree of rigour in method, you can be sure that there is always ongoing debate within (or even outside) the field. Here is an example in anthropology from Nicholas Wade (2010) about a rift between members of the American Anthropological Association (AAA).

> “ ***Anthropology a science? Statement deepens a rift***
>
> Anthropologists have been thrown into turmoil about the nature and future of their profession after a decision by the AAA at its recent annual meeting to strip the word 'science' from a statement of its long-range plan.
>
> The decision has reopened a long-simmering tension between two factions in anthropology, those researchers in what they call a science-based discipline and members who study race, ethnicity and gender and see themselves as advocates for native peoples or human rights.

To give you a sense of how much this matters to some within the organization – and how it is more than a semantic issue – consider the words of Dr. Peregrine of Lawrence University in Wisconsin who said that the dropping of the references to science 'just blows the top off' the tensions between the two factions. Even if we go back to the old wording, 'the cat's out of the bag and is running around clawing up the furniture.'"

Interestingly, the IB subject guide for Cultural and social anthropology does not use the words 'science' or 'scientific' in its description of the course but it does use 'understanding' and 'exploration'.

To learn more about the status of economics, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.1.

Exercises

8 On what basis did you make your subject choices in the IB Diploma programme? Did you choose maths and the natural sciences over the arts and human sciences, or vice versa? Did you perceive these AOKs as being fundamentally different? If so, in what way?

9 Do you think anthropology is a science? Does it matter?

10 Philosopher John Searle asks the provocative question: 'Why are the human sciences so boring?' Is there not a sense in which they cannot match the extraordinary discoveries made by the natural sciences and therefore the natural scientists might have some justification in being impatient with them?

11 Why do you think it is that we are fairly good at understanding and curing physical illness but are still rather poor at understanding and curing mental illness?

12 The Nobel Prize for economics is a separate institution by the Swedish Riksbank not in the original gift of Alfred Nobel. Is economics an area that deserves a Nobel Prize given that mathematics does not have one? Explain your reasoning.

5.3 Language and concepts

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

It is a good guess that we shall find language important in all areas of shared knowledge because, let's be blunt, how else can it be shared? This basic requirement is explored in depth in Chapter 12. Language is particularly important for the human sciences because: (a) they deal in social facts, which are constructed through language; (b) we use language borrowed from other disciplines (quite often physics) in the social sciences to help prime our intuitions – we call this use of language *metaphor*; and (c) like other AOKs, language names key concepts. We shall need to discuss what difference it makes that our objects of study can answer back because they are human. This means that we can give them surveys and questionnaires to fill out. It also means that they can report on their purported reasons for doing things. We might want to separate two key concepts: 'cause' and 'reason'. This is something that is not necessary when the object of study is non-human (or at least non-linguistic). All of these things require language and we might expect them to be sensitive to the sort of language used. Let us take each of these features in turn.

Social facts

Social facts are an important feature of the world studied by human scientists. They are facts such as whether a person is married or not, which side of the road we should drive on, what currency to use, and how to greet the host at a party. They are facts about human relationships and about human culture. In short, they are facts that are constructed by us rather than being built into the fabric of the universe, and are a necessary part of our social lives. Being so does not make them any less objectively factual. It is a fact that Bangkok is the capital of Thailand. There is a right answer (and a wrong answer) to the question: 'What is the correct side of the road to drive on in New Zealand?' These facts are no less solid because they are the result of social interaction. Non-social facts such as the fact that you will injure yourself if you jump out of a fourth-storey window are called *brute facts*. So we could say, broadly speaking, that brute facts are the concern of the natural sciences while social facts are the concern of the human sciences.

The philosopher John Searle tells a nice story about how social facts might come about. He asks us to imagine a city surrounded by a high wall. Let us suppose that the laws of the city only apply within the wall. Over the years the wall falls into disrepair and crumbles. But the laws of the city still hold within its boundary. Even when the wall is just a line of bricks in the earth it still *counts* as the boundary of the city. It can no longer physically contain the city or repel invaders but it functions as a social fact – the boundary of the city. In other words, social facts are those that are established by the group through formal agreement, informal practice, or even historical accident.

Social facts come into existence through a rather special use of language. In many societies a person becomes guilty when a suitably appointed person such as a judge says 'you are guilty' within the context of the institution of the criminal court. A piece of paper becomes money when a particular person (usually the head of the central bank) authorizes it. A goal is scored when the referee signals (using language) that it is so. Two people are married when the appropriate authority makes a suitable pronouncement in the appropriate circumstances, and so on. Social facts are made by the right person saying the right thing, in the right place, at the right time. We shorten this to saying that social facts are made by social institutions. And who makes social institutions? We do.

In creating social facts, language is used not to describe the world but to change it. It is almost magic. We call this usage 'performative'. We shall return to this theme in the next chapter on the arts but there is a word we used in the previous chapter that signals that something is a social fact – 'convention'.

The creation of social facts is important. It suggests that in the human sciences, we are interested in the meanings that attach to such facts. In the world of brute facts, meanings (at least in a first approximation) do not depend on us. The human sciences study a world that is observer-relative because we are the makers of the facts to which they refer. Take away all human observers and there would still be a solar system. But take away human beings and there is no longer money, marriage, or law.

How social institutions develop and have the social-fact-producing powers that they do is beyond the scope of this book but it is clear that human history is a constant jiggling of such institutions. The sum total of such institutions and the social facts they give rise to is called *culture*.

We have been discussing the **construction of social facts** in this section. This is quite a different matter from the **social construction of facts**. Unfortunately many authors, some of whom should know better, confuse the two. We have been suggesting that there are *some* facts, which we call social facts, that are constructed through social interaction. Brute facts, on the other hand, are independent of society. The assumption that all facts are socially constructed needs careful justification and should not be accepted uncritically.

CHALLENGE YOURSELF

Explain why it is difficult to define or name a social fact without sounding circular. For example: 'Money is what we treat as being money'. (Hint: see Chapter 6).

Exercises

13 Pick your own example of a social fact. Explain why it is so and identify the social institution that produced it. (Remember that a social institution does not have to be an organization – it could be something like promising, or contracting, or apologizing, or marrying; something that has evolved with society.)

14 What is considered a crime is, to some extent at least, a social fact. What social institution produces this social fact? Give examples to show how this has changed over time and space.

Metaphor

Knowledge framework: *Language and concepts* – What metaphors are appropriate to this area of knowledge?

In Chapter 4, we explored how metaphor could use everyday experience as a tool for helping us to understand things that were not at all part of everyday experience. We visualized molecules as being little balls bouncing around giving us a way in to understanding things like phase transitions and the ideal gas laws. Metaphors allow us to prime our intuitions by substituting the familiar for the unfamiliar – they act as intuition pumps.

Metaphors are also useful in the human sciences. Ironically, given the earlier discussion, they are often taken from physics. Psychology, especially in the hands of Freud, speaks of forces, psychic energy and drives, balance and equilibrium. This is not an accident because Freud's self-proclaimed project was to produce a physics of the mind, and his whole approach was at its base materialist and mechanistic.

Economics too is fond of physical metaphor. The economy grows and contracts, here too is balance and equilibrium, momentum and overheating, shake-outs, slack, and upward and downward movement. But there is an even deeper way in which physical metaphor attaches to economic thinking. Some of the mathematical ways of describing economic process are actually equations that are used to describe processes in physics. The mathematical language of physics is very well suited, in a literal sense, to economics. As we shall see later (page 158), the flows of money and goods in a national economy can be modelled by the flow of liquids through a set of pipes. So our metaphors are a good deal more than just convenient linguistic devices. They are patterns of thinking.

Exercises

15 Make a list of metaphors in your group 3 subject. What purpose do they fulfil?

16 What are the dangers of using metaphors?

17 Can you think of any other intuition pumps (metaphors or not) that help us understand a complex idea in one of the higher level subjects that you study?

Key concepts in the human sciences

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Wild words: culture

Culture and society are key words when discussing the human sciences. We observed that culture is the collection of social facts and the social institutions that produce

them. But these words are often used interchangeably and we might need a more explicit definition.

- **Society** – An organization or a structure of people within defined boundaries.
- **Culture** – A group's shared values, beliefs, language, norms, styles, and conventions.

Those living in the slums of a large city might belong to the same society as those residing in affluent gated communities, but they would have a markedly different culture – although there might be some blending – due to different lifestyles.

In the end, almost all central ideas in the human sciences are essentially contested concepts which means, as one student said, 'They're wild words, you can't tame them and make them settle down like a house cat, so you have to be careful how you handle them.'

Defining your terms in your TOK essay lets the reader know how you are using one term rather than another. For example, 'by culture, I mean …' – but don't run to the dictionary. Use your own understanding.

> TOK essays often use the word 'culture' as synonymous with a person's country in an unthinking way; for example, 'the culture of India', 'the culture of Africa', 'Asian culture', 'Western culture', as though people were all alike in these so-called cultures. In fact, within any population there can be just as many differences as similarities.

Operationalizing key terms

Whenever we are dealing in shared knowledge there have to be shared criteria for deciding whether something is the case or not, and there has to be a way in which others can look at our results and decide whether they are valid or not. It is not sufficient to say, 'Well, in my experience this patient is suffering from clinical depression.' In addition, we have to justify our gut feelings by providing either quantitative measurements or qualitative observations. It is because we are dealing with shared knowledge that we expect judgements to be grounded in some sort of testable criteria. This is why we require that the concepts we use are linked to such criteria or, to use the jargon of this section, why we require that they are operationalized.

Exercise

Psychologists use criteria from the Diagnostic and Statistical Manual of the American Psychological Association (the DSM – we are up to DSM 5) for identifying psychological disorders. This is a very clear example of operationalizing the terms used for psychological disorders – telling psychologists actually what to look for in making a diagnosis.

18 Look up the definitions/symptomology of a disorder such as depression in DSM 4 or DSM 5 (you can find both on the internet), then answer the following questions.

- **a** What are the problems of using such a system for identifying disorders?
- **b** What constitutes a psychological disorder in the first place?
- **c** How can we be sure that these definitions label distinct disorders?
- **d** Is there a sense in which such disorders have a socially constructed component?
- **e** Why might the definition of a condition such as Asperger syndrome or autism prove controversial?
- **f** There are a number of revisions between DSM 4 and DSM 5 (for example, for the definition of depression). How can the definition of a disorder change?
- **g** How do these definitions differ from definitions of a standard medical condition such as measles?

Causes and reasons

Intuitively, we would expect to find that concepts central to the human sciences have something to do with our will. Often, we do things because we decide to do them.

Human intention might mark the border between the human and the natural sciences. So there is an important distinction to be made between things that happen because we make them happen – which we might call *action*, and things that happen because of external causes – which we might call *movement*. The first has a **reason** (a human intention), the second has a **cause**. Social facts mostly concern reasons not causes. Two people are married because of their intentions and the purposes of the ceremony not (at least in a first analysis) because of any cause.

Many people in daily life use the words 'reason' and 'cause' without much precision. But take a closer look and there is a profound difference. Could it be that the elimination of 'reasons as explanations' in the hard sciences has removed meaning and purpose from the word in a literal and technical sense that some people feel at the emotional level? The earthquake that killed 650 000 people in Tangshan, China in 1976 – there was no reason. The tsunami of 2004 – there was no reason. Causes, yes; reasons, no. The attack on the World Trade Center in the US on 9/11 had reasons and, according to some people, maybe causes. The collapse of the twin towers had causes. Can you see the difference? And often we want to have both, which might explain our wish to project human intentions on the natural world and explain thunder and lightning in terms of the wrath of Thor.

Exercise

19 How do we best understand each of the events below? Write the word 'reason', 'cause' or 'both' depending on how you ascribe meaning to the events. Explain your answers.

- **a** Coming to school this morning
- **b** Coming late to school
- **c** Buying a car
- **d** Hitting a ball
- **e** Sneezing
- **f** Falling in love
- **g** Women being paid on average less than men
- **h** Preponderance of AIDS in South Africa

Use of language in polls, questionnaires, and surveys

Polls, surveys, and questionnaires are an important way in which human intentions can be measured. They are used extensively in the human sciences. In some countries, millions are spent on political polls to try to judge the depth of support for one candidate or another. In the same vein, big business wants to know how you feel about a comely tennis star before they fix her smile on their products. And if you think it is simple, try making a survey yourself. What criticisms could you make of the surveys you know about? With the advent of social media and web-based surveys, commercial enterprises of all kinds are gathering data constantly on customer satisfaction. How the questionnaire is constructed and how the results are interpreted might be a good subject for a TOK presentation involving language, heuristics such as framing and anchoring, the use of statistics, and issues of interpreting numbers in the real world.

To learn more about the importance of language in the construction of questionnaires, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.2.

Exercise

20 How well do you think the clip in weblink 5.2 portrays the dangers of interpreting the results of questionnaires?

5.4 Methodology

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Knowledge framework: *Methodology* – What counts as a fact in this area of knowledge?

Alice grew up and Alice grew down, and when she wanted to know how tall she was, she put her hand on top of her head. That didn't work, even in Wonderland. It's important to have the right method to find out what you need to know.

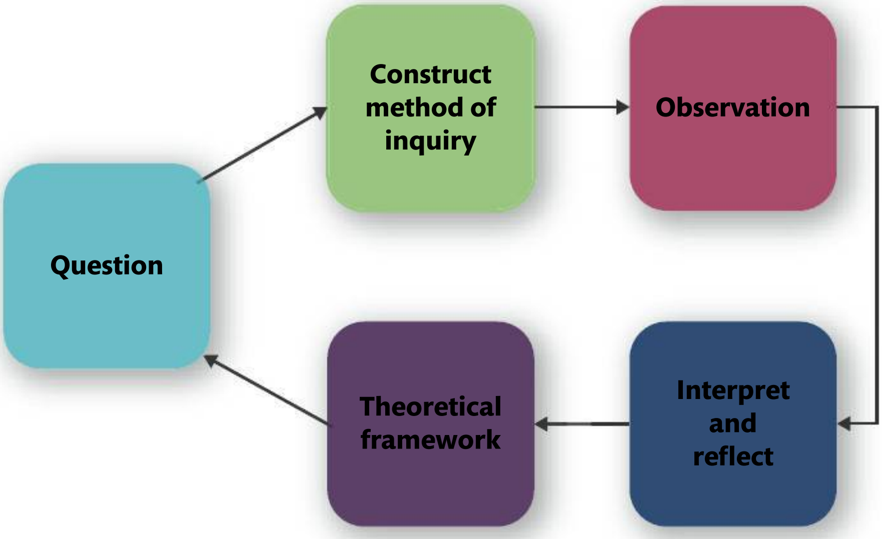
In this section, we shall examine the actual methods by which the human sciences come by knowledge. In particular, we shall be interested in the following questions.

- Is there a human scientific method akin to the methods of the natural sciences?
- Are all the human sciences about the mutual interaction between observation and theory?
- What is it about a human science that makes it possible for us to conduct experiments in it?
- How does the fact that the object of our inquiry is human affect the way we pursue it?
- How are models used in the human sciences?
- What assumptions about human nature, if any, do we need to make in order to justify our methods?

Observation and theory in the human sciences

Since the human sciences are about the outside world, there will have to be some element of observation as part of the process. But because knowledge is a map of reality, these observations will have to be slotted into a theoretical framework to give them meaning. It is not clear exactly which comes first, it seems like a chicken-and-egg situation. Theory guides observation – it tells us what to look for. But theory must depend on observation to get it started. In any case, it is clear that, just as with the natural sciences, the human sciences require both observation and theory in mutual interaction. The model might look something like Figure 5.1.

Figure 5.1 A simple model for the production of knowledge in the human sciences.



Exercises

21 Recall the learner profile attributes: inquirers, knowledgeable, caring, principled, risk-takers, reflective, thinkers, balanced, communicators, open-minded. Draw arrows on the diagram above showing where these attributes apply in the production of knowledge.

22 How well does this model apply to the process of producing an extended essay in the IB Diploma Programme?

The Phillips curve – a detailed example

A good example of the interaction between observation and theory can be found in the work of the economist AWH Phillips (1914–75). He was interested in two central concepts in macroeconomics: the rate of unemployment and the rate of inflation (Table 5.1).

Table 5.1 What the 'rate of unemployment' and the 'rate of inflation' mean and how they are measured.

Concept	Definition	Usual method of measurement
rate of unemployment	$\frac{\text{(number of people willing and able to work but without a job)}}{\text{(total number of people willing and able to work)}}$ expressed as a percentage	government statistics about how many people are claiming unemployment benefit
rate of inflation	a sustained rise in general price level expressed as a percentage increase per year	the prices of a basket of typical household items is recorded on a yearly basis (these might be weighted according to their importance in the typical expenses of a household) usually expressed as an index with the base year being 100

It is worth pointing out at this stage that Table 5.1 shows how abstract ideas of economic theory have to be 'cashed out' in a way that is measurable – they have to be operationalized. There is some argument about the best way to do this. (Economics students should find out about the different methods for measuring inflation in the 20th century.)

Phillips did not invent these concepts, they had been part of economic theory long before he came along. What he did was to propose that there was an inverse relationship between them: as unemployment fell, inflation would rise and vice versa. His suggestion was based on a mixture of theory and observation. The starting point was a theoretical argument that went something like this: the key component of the price of a good is the wage paid to the workers producing it. When unemployment was relatively high, workers would be willing to accept lower wage rises rather than join the increasing mass of unemployed workers. This would cause inflation to be lower. On the other hand, if unemployment were relatively low, firms would not be able to turn to a ready pool of labour and would have to offer higher wages to tempt workers from other firms. This would have the effect of increasing inflation.

The next step was to test this reasoning. Phillips found that a lot of the data for the UK economy between the end of the 19th century and the middle of the 20th century fitted the hypothesis, as shown in Figure 5.2.

This finding was immensely helpful to government policymakers. It meant that they could trade off higher inflation for lower unemployment. But it also left them with a

conundrum because it meant that both were not achievable at the same time and there would have to be a compromise. Much economic policymaking in the late 1960s focused on achieving an acceptable balance between the two.

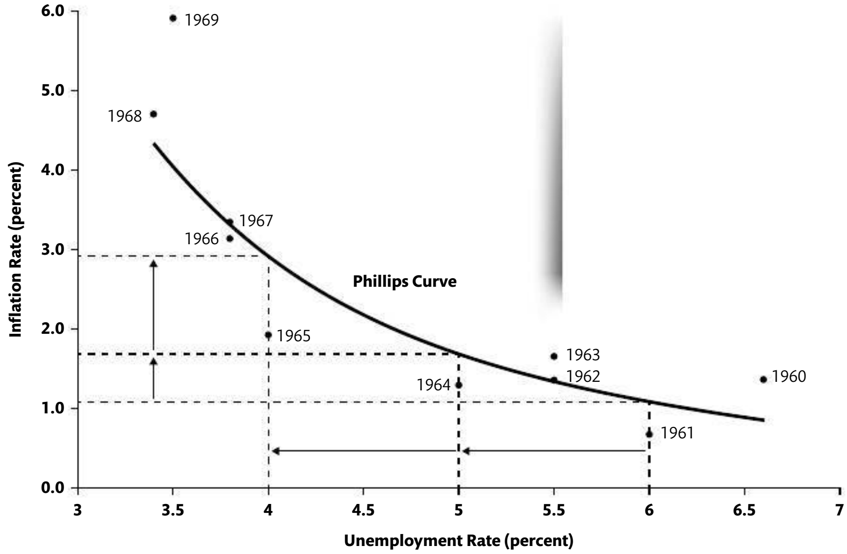
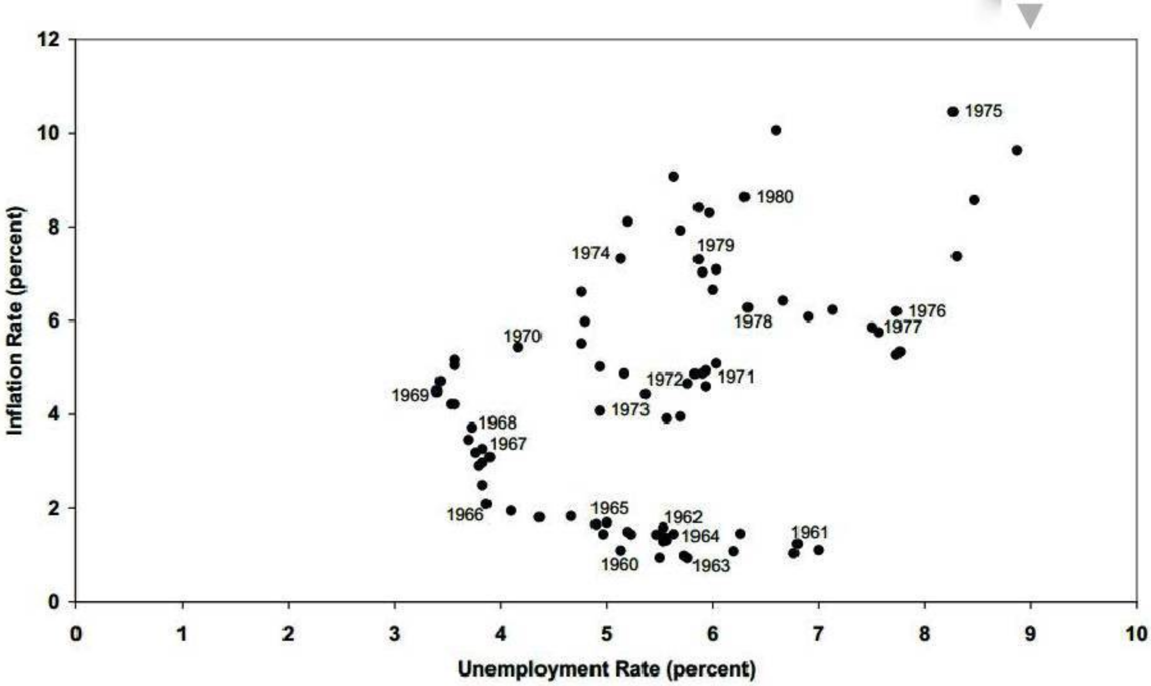


Figure 5.2 Phillips curve for the UK economy for 1960–69.

But along came economists Milton Friedman and Edmund Phelps with a slightly different set of assumptions about how labour markets worked. They thought that pay claims would automatically take into account the expected rate of inflation, so higher inflation would spur on yet higher wage claims – a so-called wage–price spiral. The result would be that a permanent reduction in unemployment would require a constantly accelerating rate of inflation. If inflation stabilized, then unemployment would return to its old value, called by economists the 'natural rate of unemployment' or NAIRU. This was quite a different theory with really quite different policy implications.

Who was right? How could economics decide between the two theories? A natural science would devise an experiment which could distinguish between their different predictions. But it is difficult to do an experiment with the whole economy of a country. Instead, Phelps and Friedman looked to existing economic data. Figure 5.3 is a plot for the years 1960–80. It is clear that the original relationship has now broken

Figure 5.3 Scatter plot of the unemployment and inflation rates, quarterly data, 1960–80.



down, and there is a situation in which an economy can suffer both from high inflation and high unemployment: the so-called *stagflation* (stagnation plus inflation) that was not possible according to Phillips.

This data seems to show that Phillips was wrong. His theory had to be altered to take into account expectations of future inflation. Phillips' supporters also pointed out that an external shock, namely the huge hike in the oil price in the early 1970s, changed the mechanism of the whole system.

In this example, the methods of economics do not seem to be so different from those of the natural sciences. Two different theories giving different predictions are tested against empirical evidence. Various statistics had to proxy for direct measurement of relevant variables, but this is something that happens in the natural sciences too. Perhaps the biggest difference is what happens to the theories after they are compared to the evidence. In the case of the natural sciences, unsuccessful theories are generally eliminated from the story. The scientific community rejects them. In the case of economics, theories are modified and rehabilitated.

Perhaps there are political reasons why economists do not want to let go of the original ideas of Phillips – in particular the idea that governments should spend more in bad times to stimulate demand in the economy, an idea that is attractive to many on the left of the political spectrum. On the other hand, Friedman's view that increasing the wages of workers only serves to increase inflation might be more attractive to those on the political right.

Interestingly there is room, in this example, for political intuitions to play a role – something that is rare in the natural sciences.

Exercises

23 Is it a strength or a weakness of the methods of economics that there is room for political intuitions to play a role?

24 Can you identify a real-life situation where political considerations play a role in the actual methodology of the natural sciences?

25 Why might political considerations play a smaller role in the natural sciences than the human sciences?

The role of experiment in the human sciences

Clearly, the whole of the economy, in the example above, does not lend itself easily to experiment. Yet some human sciences (e.g. psychology) are able to conduct experiments to gather empirical data while others (e.g. social and cultural anthropology) are not able to in the same way. We might ask what conditions have to be satisfied by a field in order to be experimental.

Exercise

26 Try to write down a short definition of 'experiment'.

Did you find this difficult? It is true that a large variety of activities fall under the umbrella term 'experiment'. But let us try to produce a working definition. An experiment sets up a sort of ideal replica in a controlled environment of a situation in the complex real world in which we are interested. For example, experiments in

the chemistry lab are ideal replicas of the sort of chemical processes that are going on in the real world. We can control precisely the nature of the chemical compounds involved and how they interact as well as other factors which might or might not be significant such as temperature, pressure, strength of electric field, even the colour of the experimenter's socks.

In the human sciences, we might be concerned with putting human beings in certain situations and then observing how they respond. This could range from giving out a questionnaire and eliciting a written response to a complex interactive simulation.

This broad definition of an experiment suggests a number of conditions that must hold in order for a field to use experimental methods.

- It must be possible to create an ideal replica of the real-life situation preserving the features that we are interested in.
- It must be possible to control the various variables in the experiment.
- It must be possible to interpret the results of the experiment back into the real world.
- Since we are dealing with human beings, the experiment must be ethically permissible.

Experimenting on the whole economy does not meet three of the four conditions above. Although there are a number of interesting economic games and simulations that mimic aspects of the whole economy, it is more likely that economists will use mathematical models to try to understand how the economy would evolve. But on a small scale microeconomics can (and does) involve itself in a lot of experiments from basic questionnaires to behavioural experiments designed to explore how people make decisions (see below).

Similarly, the whole of society is rather too big to reproduce in the lab so sociologists might have a hard time doing experiments. Nevertheless, certain questions can be settled using some sort of experimental data collection. Let us not forget that the multi-trillion-dollar world advertising industry is really just applied sociology. Vast resources go into exploring how different groups of people respond to advertisements.

Economic history does not lend itself to experiment any more than ordinary history does. The past is gone and cannot be replayed. Economic history instead relies on mathematical modelling found in areas like cliometrics. Using these methods, economic historians are able to do impressive things such as calculate world GDP back to the time of Homer.

Perhaps the discipline that is most amenable to experiment is psychology. Unlike Freudian or Jungian psychology, which dealt more with interaction between a psychologist and a patient, modern perspectives are predominantly evidence based. With ingenuity, experiments can be devised that mimic the sort of complex situations facing the individual human mind. These can be carried out in the lab and, especially with modern information technology, many of the salient variables can be controlled.

Exercises

27 Find out about the 'halo effect' in psychology. What is the experimental evidence for this effect?

28 In general, how can we assess how well an experiment replicates the significant features of the real-world situation we are interested in?

To learn how behavioural economists investigate cheating, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.3.

CHALLENGE YOURSELF

After watching Dan Ariely's entertaining TED talk at the above weblink, answer these questions.

- How well do you think his ingenious experiments replicate the salient features in the real world?
- Do you think that his conclusions are justified on the basis of the reported results of his experiments?

Ethics and experiments in the human sciences

Knowledge framework: *Methodology* – What ethical thinking constrains the methods used to gain knowledge?

The fourth condition above is an ethical constraint limiting experiments on the grounds that they either violate some right of the experimental subject or that the consequences are harmful. Clear ethical guidelines are important in disciplines such as psychology where experiments on human beings and animals are a primary means of gathering data.

The IB Psychology guide (2009) gives the following guidelines to be applied to all experimental studies.

- Any experimental study that creates anxiety, stress, pain or discomfort for participants must not be permitted.
- Any experimental study that involves unjustified deception, involuntary participation or invasion of privacy, including the inappropriate use of information and communication technology (ICT), email and the internet, must be avoided. There may be rare occasions when such infringements cannot be avoided, in which case the approval of other experienced psychologists should be sought before proceeding.
- All participants must be informed before commencing the experimental study that they have the right to withdraw at any time. Pressure must not be placed on any individual participant to continue with the investigation beyond this point.
- Each participant must be informed of the aims and objectives of the research and must be shown the results of the research.
- Young children should not be used as participants. Experimental studies involving children need the written consent of parent(s) or guardian(s). Students must ensure that parents are fully informed about the implications for children who take part in such research. Where an experimental study is conducted with children in a school, the written consent of the teachers concerned must also be obtained.
- Participants must be debriefed and given the right to withdraw their own personal data and responses. Anonymity for each participant must be guaranteed.
- Teachers and students must exercise the greatest sensitivity to local and international cultures.
- Students must avoid conducting research with any adult who is not in a fit state of mind and cannot respond freely and independently.
- If any participant shows stress and/or pain at any stage of an experimental study, the investigation must finish immediately, and the participant must be allowed to withdraw.
- Non-human animals must not be used for experimental study.
- All data collected must be kept in a confidential and responsible manner and not divulged to any other person.
- Students must regard it as their duty to monitor the ways in which their peers conduct research, and to encourage public re-evaluation of any research that contravenes these guidelines.
- Experimental studies that are conducted online, using ICT methods, are subject to the same guidelines. Any data collected online must be deleted once the research is complete. Such data must not be used for any purpose other than the conduct of the experimental study.

- Students found to have carried out unethical work will be awarded no marks for the internal assessment component.

Listed below are some classical experiments from social psychology. Choose three experiments from the list. Find out the aims of the experiments and how they were conducted. Do they fail any of the IB guidelines?

1. Jane Elliott blue eyes/brown eyes experiment
2. Hawthorne works experiment
3. Stanley Milgram experiment
4. Sherif Robbers cave experiment
5. Stanford prison experiment, Zimbardo *et al*.
6. David Reimer case
7. Asch conformity experiment
8. Watson 'Little Albert' experiment

Exercises

29 Do you consider the IB ethical guidelines in psychology adequate? Are there any extra rules you would want to add? If so, what are your reasons?

30 Are there any rules that you would want to take away? Why?

31 How do we decide where to balance the interests of the psychological community in advancing knowledge (that might well give benefits in the future) with the protection of the experimental subject?

32 Why is it not always possible to tell the subject the aim of the experiment beforehand?

Approaches to observation and experiment

Behaviourism *vs* humanism

We've more than hinted at the huge divide in the human sciences between the behaviourist and the humanist approaches with our brief discussion about *movement* and *action*, the latter supposedly linked to meaning and purpose, and demanding a different kind of methodology from one required for movement. Behaviourism or, in its broader form, positivism is an approach to all the human sciences that stresses the importance of measurable or observable variables. The behaviourist is suspicious of any explanation that is grounded in something that cannot be observed. In psychology, where the term originated, the primary observable is behaviour. Humanism, on the other hand, is the idea that human experience, thoughts, hopes, and desires are as much part of any explanation of human activity as behaviour.

These two positions can be nicely illustrated by the simple example of observing someone drinking.

> “Suppose we bring someone into a room and place a glass of water before him. Will he drink? There appears to be only two possibilities: either he will or he will not … It is of no help to be told that … 'he drinks because he is thirsty …' if it means that he drinks because of an inner state of thirst. Such a state cannot be observed and if it cannot be observed it cannot be explained and if it cannot be explained it is not science.”

Skinner, 1980

"Now, to paraphrase AJ Ayer, the late British philosopher, consider the same man with a glass of wine. He either drinks the wine or he does not, but suppose we ask, when we see him take a sip, what is the meaning of this action? What is going on? Is he toasting someone, is he measuring the claret for its fineness, or is he celebrating a private achievement or a soothing a personal anxiety? Perhaps he wants to summon up his courage as Ayer tells us. Any of these and more could be the explanation, the reason, the motive, in short the meaning of the action. And to plumb such meaning would require a knowledge of the man's intentions within the larger context and the particular circumstances of the situation."

The Skinner quotation representing the behaviourist viewpoint, shows the most radical attempt to eliminate any reference to what we might call *purpose* or what is going on *inside* someone. In this account, all non-observables must be eliminated. Yet, as we can see from Ayer, the strictly behaviourist approach may well miss the point (i.e. what is human about this act) by confusing movement and action.

The behaviourist approach is radical because it removes from the picture the usual internal human *reasons* for action. This is strange in the context of everyday life because we are used to giving these reasons as explanations for our behaviour:

A *Why did you hit Johnny?*
B *Because he was annoying me.*

But the humanist alternative is not without problems either. Internal reasons are not directly visible from the outside and have to be inferred from behaviour.

A *Why did Katie hit Johnny?*
B *Because she was annoyed.*

A *How do you know she was annoyed?*
B *Because she hit Johnny.*

If we are not careful we have a nasty circularity here. Put differently, we cannot falsify the statement 'Katie is annoyed' so it fails Popper's falsifiability test (Chapter 4).

So behaviourists and any others committed to strictly observable variables argue that only when social behaviour can be analysed and stripped of all its meaning will we be able to speak of social sciences, *qua* sciences, since any kind of meaning, like mental states, is not *observable*. Others contend that it is only when we pay attention to, or seek to discover, the meaning that people attach to their behaviour (what *they* think they are doing) will we be able to interpret what is going on and understand this behaviour. These are two really quite different approaches that might produce controversy between disciplines and within them.

Interestingly, in psychology both disciples of Freud and evolutionary psychologists would argue that we are quite good at kidding ourselves about the reasons for a particular action. To use the terminology of the previous section, the reasons we give might be quite different from the cause.

Exercise

33 What would someone from another planet make of the following examples?

a A crowd making a lot of noise while 22 men or women chase and kick a spherical object on a rectangular patch of grass.

b A young man with a bag standing by the side of the road with his arm outstretched and his thumb pointing up.

c People mumbling with their heads bowed as a box is lowered into the ground.

d People moving about between shelves in a large building, pushing carts with wheels and taking some things and not others, and putting them in the carts.

Participant observer methodology

While the behaviourist approach and the humanist approach to the methodology of the human sciences seem irreconcilable, it is possible that they could be combined into a first-person behaviourist approach. This is called the participant observer methodology.

• Introspection

There is one person who can directly observe both behaviour and its reasons: the experimental subject. If we use the subject's first-person reports as evidence in the investigation, then we can directly observe the reasons for action, pleasing both the behaviourist and the humanist. This is sometimes known as the *verstehen* approach in the human sciences after the German word for 'understanding'. We could summarize it with the phrase, 'What was it like for me?'

There are two types of behaviourism. Be careful that you do not confuse them. **Methodological behaviourism**, discussed here, is the idea that behaviour is the only 'observable' in the human sciences. **Logical behaviourism** is the radical view that there is nothing more to human beings than behaviour. Feeling pain, in this view, is precisely the same as behaving in a certain way. It is fair to say that logical behaviourism has not withstood the considerable criticism it has received and is no longer taken seriously by all but a handful of thinkers. Critics of methodological behaviourism ridicule the use of animals such as rats in the laboratory as proxies for human beings.

This method underlies much research that is conducted using surveys and questionnaires. The expectation is that experimental subjects will give direct and accurate responses to questions about their reasons.

But, and we are getting used to this by now in TOK, this approach does produce problems of its own. Most of these arise from doubts about the reliability of first-person testimony (particularly about a person's own motivations). We cannot avoid the sneaking feeling that perhaps we don't really know why we acted in the way we did. It could be that Freud and the evolutionary psychologists are right and that we can have motives for action that don't make it to consciousness.

And then there is always the question of whether the responder answered the questions honestly. In some situations, especially where the questions are about delicate or sensitive matters, the responder might be embarrassed to answer honestly even if the survey is anonymous. The answers to the questions might have implications for self-esteem and there might be a tendency to try to preserve a positive self-image.

Finally, there are a number of processes subconsciously affecting our judgement. For example, reports such as in a sample of European males, 95% thought they were better drivers than average. Similarly 94% of a TOK class thought they were above average intelligence. If by 'average' we mean the median (the middle value), then by definition only 50% can be above average. The others just kidded themselves. This is an example of a heuristic called *positivity bias*. We tend to overestimate our own abilities and underestimate those of others.

Exercise

34 Identify an investigation in a group 3 subject that requires introspection. Assess whether the use of introspection in this case is a valid investigative tool. List your reasons.

- **The observer as part of the system**

In Chapter 4, we discuss the basic problem of observation – that any observation necessarily requires an interaction with the system being observed – and can therefore change it. This is no less true in the human sciences. We shall discuss this issue through taking a detailed look at anthropology.

The IB course is called 'Social and cultural anthropology', a subset of the overall discipline of anthropology. In the subject guide, it is defined as:

> "… the comparative study of culture and human societies … seeking an understanding of humankind in all its diversity … reached through the study of societies and cultures and the exploration of the general principles of social and cultural life."

Methods mentioned include 'a tradition of participant observation', and 'an in-depth empirical study of social groups'.

> "How do we reconcile our knowledge that we can never be objective with the assumptions of some disciplines that objectivity is taken for granted?
>
> Are the findings of the natural sciences as reliable as those of the human sciences?
>
> Who validates knowledge?
>
> Do cultural differences limit mutual understanding?"

IB Social and cultural anthropology guide

Many of the foundational studies conformed somewhat to the stereotype picture of the study of small groups far from the university centres where research began. Today, in sociology and anthropology, fieldwork is as likely to be set in an urban environment or to focus on how people live together in nursing homes, prisons, small artisanal farming communities, the circus, or life aboard a marine biology research vessel.

In answering the fundamental question of the anthropologist – what it is to be human – and the specific questions guiding the study, the participant observer spends time gathering information that is both wide-ranging and detailed, which is eventually published as an ethnography. Although quantitative data is part of the study, the final product seldom looks like the graphs and mathematical relationships found in, say, the economist's dissertation. The mode of expression is most likely a narrative setting out the findings of the investigation. For instance, one research question might be, 'What child-rearing practices in a refugee Haitian community change as a result of a new environment in a new country?'

Exercise

35 The German thinker Hans Georg Gadamer (2004) argues that to truly understand a culture, you have to be of that culture. He suggests that contact with an alien culture has the effect of making you more aware of your own culture, a process he calls the 'fusing of horizons'.

- **a** To what extent do you agree with Gadamer?
- **b** What evidence do you have for your view?
- **c** How does the anthropologist, perhaps of a privileged background, integrate into the lives of the group he or she is studying?
- **d** How would the status of an anthropologist affect his or her work investigating the Haitian refugee community?
- **e** Since you don't have to be a baby to study babies – do you have to be a criminal to study criminals? Or old to study nursing homes? Or a man to study men? Or a musician to study musicians? Or a widow to study grieving? Why or why not?

By intention, the ethnographer brings his or her own subjectivity and experience to bear on the study, which reminds us that sense perception (as a WOK) is shaped by social and psychological assumptions and value judgements. In short, the observer is the instrument through which the phenomena of the investigation are selected and interpreted as well as evaluated in making this particular map of reality. The best ethnographers need to work their way into the lives of people and at the same time keep an analytic distance. This requires cleverness, empathy, sympathetic imagination, tolerance, and warmth of personality. People must feel safe with you around.

But just as with introspection, there might be parallel problems with the participant observer. To what extent does presence of the observer change what is being observed?

The cultural anthropologist Margaret Mead (1901–78) made many important contributions to our understanding of, among other things, attitudes towards sex in South Pacific cultures. Her book *Coming of Age in Samoa* about female sexuality in Samoa was extremely influential. It drew on methods of a participant observer gaining the confidence of the society in which she was embedded in order to be granted access to their traditions and knowledge. Despite her influence, her work sparked controversy. After her death, the New Zealand anthropologist Derek Freeman suggested that she had been the subject of misinformation and joking by the Samoan girls in her confidence who, he suggested, had exaggerated or even invented their accounts of traditional practices. The controversy continues to this day although Mead's reputation seems to have survived the challenge.

This example illustrates how difficult it is for the human sciences to produce definitive theory that is above controversy, since there is little way in which contestable claims can be definitively assessed. Participant observer methodology is not without its problems.

Exercises

36 Can you think of a situation where the behaviour of a group of people being observed is affected by the presence of an observer?

37 How can the 'observer effect' be reduced or eliminated in this situation?

38 Look up the 'Hawthorne effect' in a psychology textbook or on the internet. Can you identify other situations where the presence of an observer has improved the productivity of those being observed?

The role of mathematical models in the human sciences

Knowledge framework: *Methodology* – What role do models play in this area of knowledge?

The key to understanding the role of mathematical models in the human sciences is the observation that such models can be used to gain a general understanding of a phenomenon without being complex or detailed enough to provide predictions. After all, if knowledge is a simplified map of the real world, there are two elements here that need to be balanced: simplicity and accuracy. In the human sciences, a model that is accurate might not be simple and vice versa. A good example here is the model used by the UK Treasury to map the whole of the UK economy. It is precise but complex. This is not to say that there are not good predictive models it is just that, in general, the human sciences prefer models that might be more explanatory than predictive.

To learn more about the UK Treasury's economic model, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.4.

Economics is well known for its use of models. In the 19th and early 20th centuries, economics looked increasingly towards the natural sciences. The aim was to produce a rigorous, almost experimental, discipline that used the same sort of modelling techniques as physics. In some cases, literal physical models were used. One such model is the machine built by Newlyn and Philips in 1949. The UK economy was modelled by the flow of coloured water round an intricate system of pipes, float chambers, and tanks. The tanks and pipes were shaped carefully to reflect the sort of relationships that were thought to hold between different economic variables, and were arranged to mimic the different time lags between an action in one part of the economy and its effect in another. Readings were made of the water level in various chambers corresponding to government debt, interest rates, and GDP, and the device was attached to a chart to record the dynamic behaviour of the model.

The Newlyn–Philips water model of the UK economy (Leeds University Economics department).

Today, such a mechanistic model would be implemented by a computer program but the essential features would be the same. As we saw in the section on language and concepts, the use of physical metaphors in economics goes very deep.

Modern economic models reflect the idea that the fundamental relationships are not deterministic and law-like, as are those of classical physics, but are susceptible to chance. They reflect the intuition that although we are all free, within certain limits, to act as we wish, our behaviour generally follows certain statistical patterns. Many contemporary economic models are statistical.

You can access a version of the UK Treasury model online at the weblink on the left, above. Try out the consequences of reducing income tax or indirect taxes, increasing social benefits, and changing interest rates. The model produces charts that trace the predicted course of unemployment, government debt, balance of payments, and inflation for up to five years after the intervention by the user.

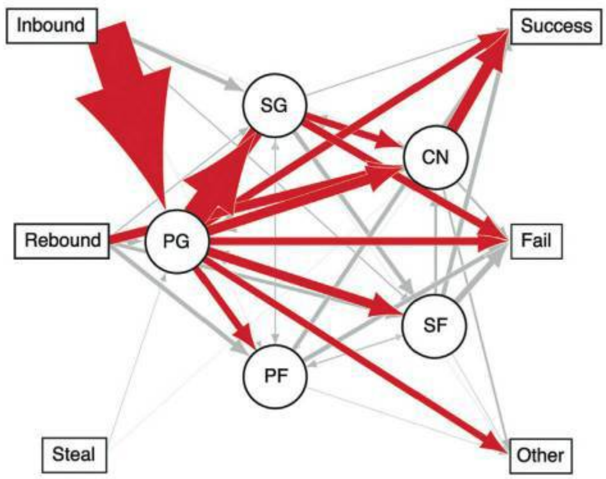
Exercises

39 What are the benefits of such a sophisticated mathematical model as this?

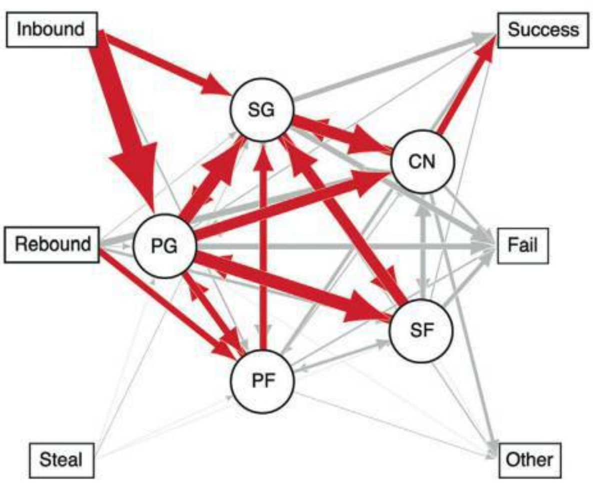
40 In what sense might the very sophistication of such a model be a disadvantage?

It is not only in economics that we find statistical modelling. Almost every human science employs statistical models of one sort or another. Here are two examples of the use of mathematical models in basketball by Jennifer Fewell and Dieter Armbruster of Arizona State University.

The research team used network analysis to analyse basketball games. They turned the players into nodes in a network and passes into paths. Then they could create a chart that maps the most likely ball movements. The thicker the arrow, the more likely the ball is to follow this path. Here are the charts from the Chicago Bulls and the LA Lakers in the 2010 NBA playoffs.



To produce a single number for each graph, the researchers borrowed a technique from theoretical physics – they calculated the *entropy* or amount of system disorder.



They discovered that winners in general had more entropy than losers. It seems that random unpredictable passing wins games.

To learn more about the role of models in the 2008 economic crisis, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.5.

CHALLENGE YOURSELF

Having read the article in *The Economist*, to what extent do you think article blames the crisis on models (in particular, macro models such as the dynamic stochastic general equilibrium model)?

Which team won the match?

To learn more about Nate Silver and his statistical models, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.6.

To learn more about statistical models and predictive policing, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.7.

CHALLENGE YOURSELF

Clearly the sorts of model that Nate Silver produces make the assumption that, given large enough numbers, people behave in law-like ways that can be quantified. All those idiosyncratic individual choices fit a nice smooth probability distribution. To what extent do you agree with this? Does this sort of modelling need a strong assumption about human nature?

You will learn more about this in the next section.

To learn more about Nate Silver's analysis, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.8.

It might surprise you (if you have not seen the film *Moneyball*) that complex mathematical models could be used in sport. But these days, it is difficult to find a sport untouched by mathematical and statistical modelling. Do you think that the use of 'big data' in sport detracts from the spontaneous theatre that sport produces?

But it is not only in sport where statistical modelling produces highly effective real-world strategy. In the world of political forecasting, modelling is proving to be far more effective than traditional political pundits. Mathematical models are proving very accurate at predicting the results of elections. In 2008, Nate Silver used his models to correctly call 49 states out of 50; in 2012 he got them all right despite being ridiculed by the media pundits.

Exercises

After reading ***The Economist*** article on statistical models and predictive policing (weblink 5.7), answer the following questions.

41 Identify the benefits stated in the article for directing police resources to the 'pink' squares identified by the model.

42 What might be the risks associated with such a policy?

43 What are the ethical issues of using statistical models for making decisions to do with parole or the profiling of potential offenders?

44 Does the use of mathematical models in baseball, basketball, football, cricket, rugby, or Australian rules football in any sense detract from the enjoyment of the sport?

Also recommended are the following books:

- Emanuel Derman, *Models Behaving Badly,* Wiley 2011
- Nouriel Roubini, Stephen Mihm, *Crisis Economics,* Allen Lane 2010
- Mark Buchanan, *Forecast,* Bloomsbury, 2013.

Assumptions underlying the methodology of the human sciences

We saw in Chapter 4 that the methods of the natural sciences only work if we make certain prior assumptions about what the universe is like – for example that it is uniform and that our particular part of the universe is not somehow special. When human beings form the subject matter of our investigation, it is clear that we are only concerned with our own local corner of the universe so we can relax some of these assumptions. Instead of the uniformity of the whole cosmos, we are concerned just with the uniformity of human beings – *human nature*.

Human nature

Many of the human sciences make assumptions about human nature. By 'human nature' we mean the set of traits and capacities that we all have in common. In political science, the classical theorists used the device of the 'state of nature' as a way of thinking about the origins of political order. They imagined what human beings would be like outside political structures like the state. For example, the Florentine political theorist Niccolo Machiavelli (1469–1527) assumed that without strong government, human beings were likely to be lazy and corrupt. Thomas Hobbes (1588–1679) took a similar view and thought that left to our own devices we would be fearful of cut-throat competition for resources, which would motivate us to form a political society to protect ourselves from each other. Jean-Jacques Rousseau (1712–78) had a more

positive view of man in the state of nature as a somewhat solitary peaceable figure: the noble savage. It was the effect of social institutions (such as money and social status) that was corrupting.

There might be a grain of truth in all these views. Jonathan Haidt (Chapter 9) suggests that we have evolved five moral capacities: caring, fairness, ingroup loyalty, respect for authority, and purity that control our moral natures. The first two are particularly valued by political liberals and might be associated with Rousseau's picture, while political conservatives value all five capacities and place more emphasis on the last three, a position more in keeping with Machiavelli and Hobbes.

To learn more about Haidt's views, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 5.9.

A deeper problem might be the question of whether humans have a nature at all. The view that we do not tends to be associated with the philosopher John Locke (1632–1704). He saw the human being as a *tabula rasa* (blank slate) at birth and that we are shaped by our subsequent experiences. This view was attractive to those who thought, in the 1960s and 70s, that socialization was the only cause of differences between sexes and that there was no essential male or female nature. More recently, writers such as Janet Radcliffe Richards have shown that arguments for gender equality do not have to assume the lack of essential nature. Moreover, the psychologist Steven Pinker (1954–) points out that in order for environment to have any effect on us at all, we must have the inbuilt capacity (human nature) to be able to learn from our experiences. He argues that evolution has equipped us at birth with a large number of systems all ready to go to enable us to survive and flourish as human beings. As an appendix to his book *The Blank Slate: The Modern Denial of Human Nature,* Pinker (2003) provides a list of 320 features of human beings observed by anthropologists in every known human society. Some of these features are listed in the chart below. The implication is that the list of features and capacities we all share is far from being negligible, and that the blank slate theory is false.

Some human universal features		
abstraction in speech and thought	aesthetics	baby talk
universal facial expressions	crying	politeness
beliefs in supernatural/religion	binary cognitive distinctions	body adornment
childhood fear of strangers	classification of colours	classification of kin
classification of sex	collective identities	conflict
conjectural reasoning	cooking	customary greetings
culture	division of labour	dream interpretation
explanation	facial expressions of anger, contempt, disgust, fear, happiness, sadness, surprise	females do more direct childcare
folklore	food sharing	attempts to predict future
admiration of generosity	gift giving	distinguishing good and bad
gossip	government	grammar
group living	hairstyles	hospitality

(*continued*)

incest taboos	in-group distinguished from out-groups	inheritance rules
insulting	interpreting behaviour	jokes
language	language employed to misinform or mislead others	law (rights and obligations)
leaders	logical notions	male/female adult/child seen as having different natures
males more aggressive and more prone to lethal violence	marriage	murder proscribed
music	numerals	personal names
past/present/future	play	poetry/rhetoric
preference for own children and close kin	promise	right-handedness as population norm
wary of snakes	social structure	sweets preferred
true and false distinguished	turn taking	visiting

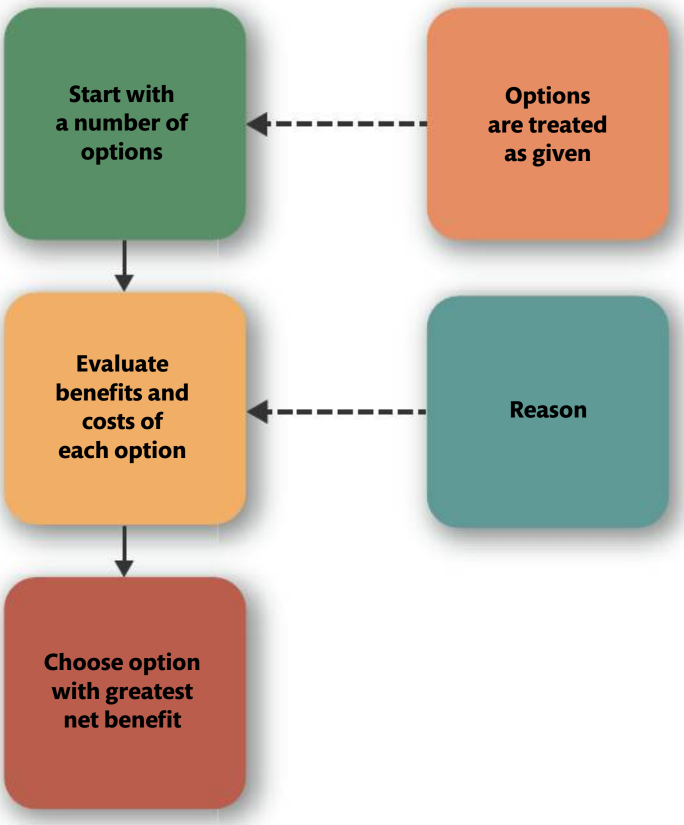
Assumptions of rationality and heuristics

The human sciences also make assumptions about the nature of human rationality. Rationality means the processes we use for making decisions and judgements. It differs from logic in that it might change over time and between cultures. The new TOK programme recognizes that what might be a rational course of action in one epoch might not be thought to be so in another. It makes sense to study the history of our systems of knowledge to observe how norms of rationality change over time (as do our methods of inquiry, standards of evidence, and interests).

But how exactly does human rationality depart from logic? The key lies in reason, intuition, and emotion. The weaker essays in TOK typically treat these WOKs as somehow being independent of each other. As we saw in Chapter 3, this is not helpful. They work together in such a way as to make them difficult to separate.

Let us consider the everyday problem about making a decision. One model might be that the individual looks at each option in turn, evaluating it according to some criterion (call it utility) and then chooses the option that yields the greatest utility. We might call this model the classical model of judgement making (Figure 5.4).

Figure 5.4 Classical model of judgement.



An alternative model might be that the person uses imagination, intuition, emotion, and reason together to set out what options (from an infinite set) might be possible. Then the individual first judges which of them 'feels right' and then provides reasons. The individual might then discuss the judgement with others and modify it in the light of this discussion. This is the social intuitionist model and seems to be more in line with what we actually do when we make judgements (Figure 5.5).

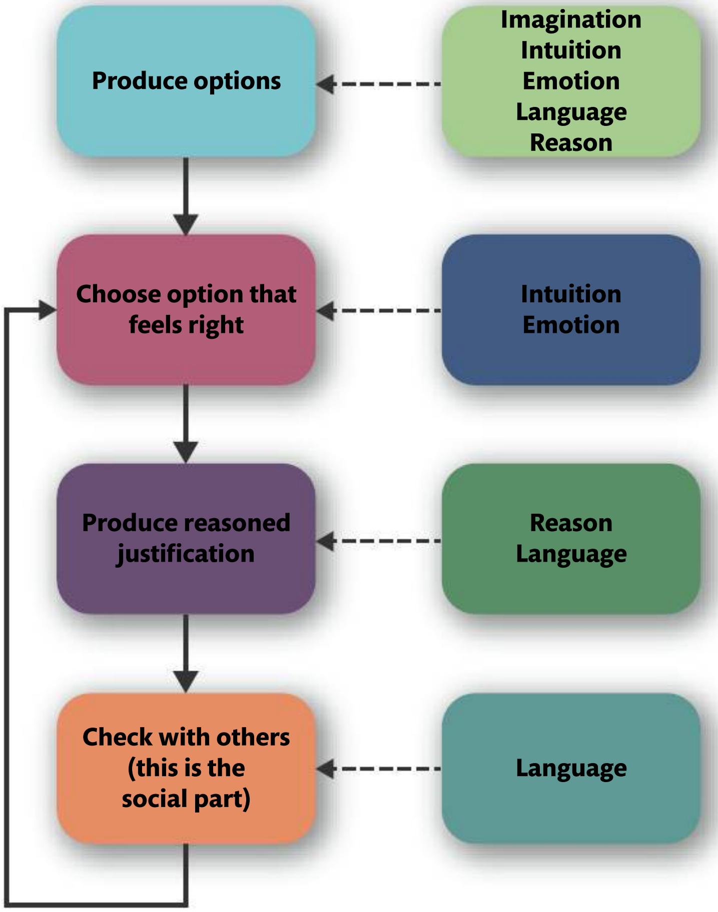


Figure 5.5 Social intuitionist model of judgement.

What is interesting about this model is that in some cases, especially when we have to make very quick judgements, we place a good deal more reliance on intuition and emotion than we might place on mathematical-style reasoning. This is well demonstrated not only in everyday decision-making, but also when we make moral or ethical judgements (Chapter 9 – discussion of Jonathan Haidt).

But it then seems important to ask how the quality of the judgement might be affected by factors that are below the radar of our consciousness, the factors that go into providing the intuition or the emotion, the facts that make the judgement 'feel right'.

There is a whole field devoted to studying how human beings make such judgements. It is called 'behavioural economics' and has been around since the pioneering work of Amos Tversky (1937–96) and Daniel Kahnemann (1934–) in the late 1960s. Kahnemann won the Nobel prize for Economics in 2002 for this work which falls under the general title of Prospect theory.

So what did Kahnemann and Tversky notice about human rationality? They built on the work of previous psychologists who suggested that, broadly speaking, human beings had two reasoning systems (Table 5.2).

Table 5.2 Two reasoning systems in humans.

System 1 – Automatic system	System 2 – Reflective system
uncontrolled	controlled
effortless	effortful
associative	deductive
fast	slow
unconscious	self-aware
skilled	rule-following

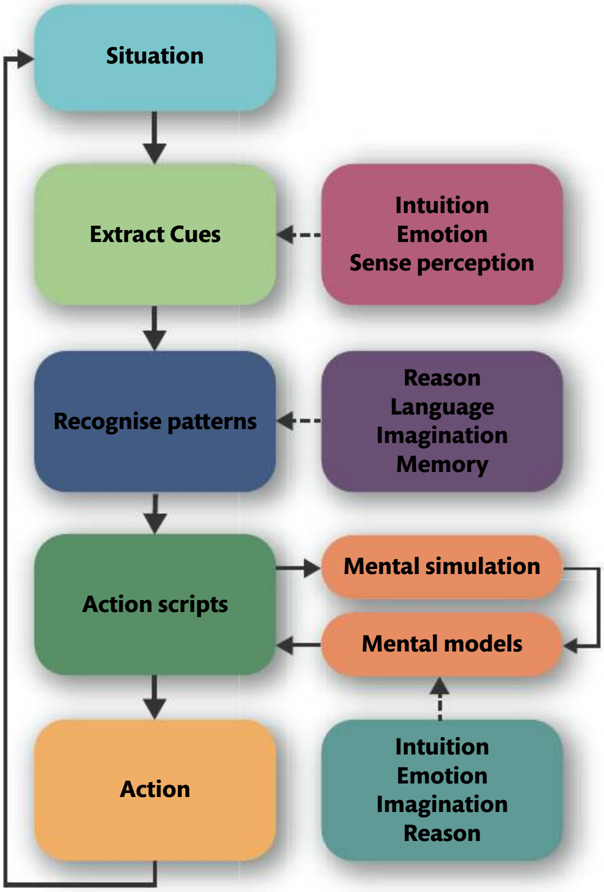


Figure 5.6 Recognition primed decision-making model of judgement.

The automatic system (system 1) saves our lives. If something is coming rapidly towards us, with staring eyes and an open mouth showing large fangs, we could sit down and reason that 'it might be dangerous but on the other hand it might be benign', but by that time we might well be dead. No, the automatic system cuts in and says, 'Run!' It does this primarily by invoking the emotion of fear. That is why we might sometimes be afraid of a perfectly harmless spider or even piece of string. It is better, in evolutionary terms, to make the error of thinking the piece of string is a snake rather than the other way round. Through evolution, organisms with developed, fast intuitive automatic systems have been selected for. An example of such an organism is the human being.

Unfortunately, the automatic system can let us down.

Try to answer the following questions as fast as possible without actually stopping and reasoning them out.

- If a bat costs 1 dollar more than a ball and they cost US$1.10 together, how much does the ball cost?
- The patch covered by water-lilies on a lake doubles every day. If it takes 48 days to cover the lake, how long does it take to cover half the lake?
- If it takes 4 men 4 days to make 4 widgets, how many days does it take 16 men to make 16 widgets?

Did you give the answers 10 cents, 24 days and 16 days? If you did, then you were fooled by your automatic system. In the first question, if the ball cost 0.10 dollars, then the bat would cost 1.10 dollars and together they would cost 1.20 dollars. The correct answer is that the ball costs 5 cents.

The automatic system relies on **heuristics** – rules of thumb. They are at work when you make any sort of judgement. Here is an example.

Which of these options would you prefer?

- **Option A** Receive 200 dollars cash
- **Option B** Play a game where you have 1/5 probability of receiving 1200 dollars

Probabilistically speaking, the expected payout is 200 dollars for option A and 240 dollars for option B. Nevertheless, most people go for option A. Classically speaking, *this choice is not rational*. But our automatic system prefers it. This is an example of the risk-averse heuristic. We tend to be risk-averse in situations where we are presented with a gain.

Here is another example. Suppose you have committed a minor motoring offence such as parking your car in a no-parking zone. The parking attendant happens to be interested in behavioural economics and offers you two choices.

Which of these would you prefer?

- **Option A** Pay 200 dollars cash fine
- **Option B** 1/5 probability of paying 1200 dollars

Now the heuristic is reversed. Most people facing this judgement go for option B even though it has a higher expected payout. It seems that we are risk-embracing when it comes to losses. This is a system 1 choice – the automatic system. From the point of view of system 2, option A is better. This is called the risk-embracing heuristic.

This heuristic brings the wording of the question sharply into focus. If the question is framed as a gain then we are risk-averse. If the question is framed as a loss then we are risk-embracing. But it might be the same question. Unsurprisingly, this phenomenon is called *framing*.

There is a related heuristic called *anchoring*. We tend to make quantitative judgements by setting up a reference point and measuring a deviation from it. Consider Figure 5.7 which shows offers in two different shops for the same item.

Classical (system 2) reasoning suggests that it doesn't matter which we go for since they both cost the same. But it is a fairly good bet that more people will go for offer A because they consider it to be a better bargain (system 1 reasoning). They are anchored to the old price so perceive offer A to be a gain.

Anchoring is used to great effect in negotiations. The first bid made tends to be used as a reference bid against which concessions can be measured. This is the principle

CHALLENGE YOURSELF

Gary Klein is a psychologist who has developed an explanation of how we make rapid decisions under pressure. Use a search engine to find out more about the recognition primed decision model (RPD) shown in Figure 5.6 (opposite), and see if you can answer the following questions.

1. To what extent is Klein's model (as a piece of human science) testable?
2. Is it plausible?
3. Do you think that it is useful?
4. What applications can you envisage for it?

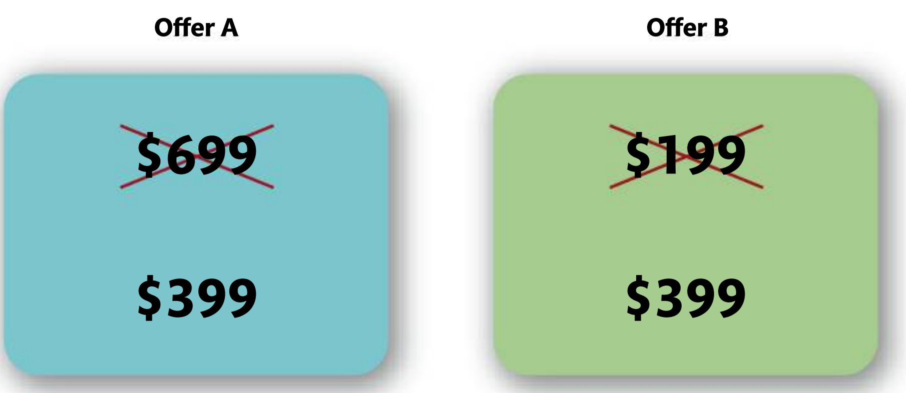


Figure 5.7 Which offer do you go for?

behind bargaining in the bazaar, pay negotiations, and discussions with the teacher about the date of the essay deadline.

There are many more heuristics that work in a systematic and predictable way affecting how we make judgements. They are a consequence of system 1 thinking – a product of our automatic system. We have seen that they are a part of human rationality.

But here is the problem: classical economics, classical political theory, and classical ethics assume primarily that system 2 is in charge – they assume the classical model of judgement. But the work mentioned above shows that this is not what human beings are actually like. We do have a nature that is embedded in our system 1 thinking and it has a big impact on our behaviour.

Contemporary microeconomics reflects these developments and builds in realistic heuristic models of human decision-making. Contemporary ethics is beginning to catch up and question the classical basis on which ethical judgements were supposed to rest. Psychology and sociology are safe – they have never assumed that humans were classically rational.

Exercise

45 Find out as much as you can about the following heuristics:

framing, availability, planning fallacy, positivity bias, negativity bias, representativeness, affect heuristic, conjunction fallacy, prospect theory

How many of these heuristics do you recognize in your own behaviour?

There is much literature on heuristics, a lot of it online. For an entertaining and readable account, see *Predictably Irrational* by Dan Ariely (2008), published by Harper.

5.5 Historical development

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

We have already hinted that knowledge as a map is continually changing. We can see that if we look at school textbooks over the years: while a single textbook might appear settled if not fixed, looking at their evolution in time often reveals changes. The creation of knowledge is difficult, but tremendously exciting. New ideas not only have to be tested and pass the mark of peer review, but well-established theories, methods, and modes of explanation do not give way easily. And why should they? In many cases they have stood the test of time and represent a coherent system of understanding the world – they have done a job well and there is a reluctance to replace them. Remember, a new mode of explanation has to explain everything that was covered by the old and more besides.

Exercise

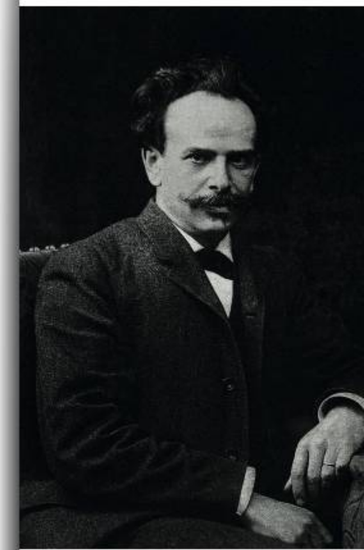
46 What does it mean to say that the burden of proof rests on the paradigm shifters? Do you agree? Give reasons.

Anthropology

We can easily find examples of such changes. A good example is the dramatic paradigm shift in anthropology initiated by Franz Boas. In simple if not simplistic terms, prior to Boas there was an understanding among anthropologists that 'the deeper you dug, the simpler the structure'. In other words, there was a trend in human societies from simple to complex. This was often stated using some version of the words 'civilization' and 'progress'. Of course, the implication was that the culture of the anthropologist was the current endpoint of the social evolutionary chain and therefore the most 'civilized'. Boas changed this and got rid of the idea of a hierarchy of societies altogether. Anthropologists should observe and record what they see without passing any sort of judgement about where a society lay on some abstract spectrum of civilization.

Boas would stand behind the philosophy and mission of the IB to view others as a rich source of diversity who 'in their differences, can also be right'.

Anthropologist Clifford Geertz fought for the view that meaning and interpretation are the key concepts in anthropology. He thought the attempt to raise consciousness had succeeded, because people were more aware of gender concerns than before.



Franz Boas (1858–1942).

Psychology

Psychology has gone through a number of transformations, although vestiges of previous ways of thinking can still be found today. Freud was a hugely influential figure with his elaborate theoretical structure explaining human psychosis as largely developmental in its origin. His understanding of mental processes below the level of consciousness proved to be prescient and his emphasis on sexuality has been partially validated by contemporary thinking in evolutionary psychology. However, his theories of child development seem rather dated now.

Psychology has moved on through phases of behaviourism, through functionalism to modern conceptions such as cognitive psychology, attachment theory, and positive psychology. Evolutionary psychology – the understanding of psychological processes through references to their biological and evolutionary origin is particularly strong currently, and one might expect further developments in this area.

CHALLENGE YOURSELF

You will recall from the Chapter 4 that Karl Popper asked us to try to falsify our hypotheses, not try to prove them. Critics claim that one of the key concepts central to Freudian thought – repression – was not falsifiable. Can you see how this could be true?

Economics

In economics, there was the transformation from the rational utilitarian approach of Smith, Ricardo, and Mill to modern behavioural and statistical economics. The classical economists built their theory from three basic ideas: opportunity cost, diminishing marginal utility, and the assumption that man wanted to maximize utility or satisfaction. From this they showed that markets would develop which matched suppliers and demanders in such a way as to maximize the utility of each group and, at the same time, convert their selfish motives into an optimum allocation of resources for the whole of society.

Modern insights show us increasingly clearly that this is mistaken. Not only are its fundamental assumptions flawed but it is also a formula for ecological disaster. If we were to think of economics solely in terms of how to allocate resources in order to maximize human happiness, we would end up plundering the planet of its precious and non-renewable supplies of stuffs necessary for the maintenance of human life. Moreover, the markets envisaged by Smith are insensitive to whether the goods provided are ethically or morally desirable. Free markets produced child prostitution in Victorian London. Not all human wants are fit to be satisfied through the market. Something else is needed – some other way of thinking about making good lives for human beings.

Change in the development of human sciences

Knowledge is a dynamic map of reality. It changes as our interests change, as our conceptual frameworks change, and as our methods change. In the human sciences, these changes tend to be changes in emphasis. They are rarely like their counterparts in the natural sciences, complete changes in direction. There are still Keynesians and Monetarists, there are still Freudians and Jungians, and probably other behaviourists around. Rarely has theory been categorically refuted in the human sciences.

Ideal knower Amartya Sen

Amartya Sen (1933–).

Contemporary economics is beginning to recognize these issues. The Indian economist Amartya Sen (1933–) was awarded the Nobel Prize 1998 for his work in producing an alternative approach to Smith and Ricardo, in which the capabilities of human beings are recognized for what they are, not in terms of their exchange value. In Sen's eyes, human beings are reservoirs of potential for flourishing lives, not resources, to be exploited. He has contributed greatly to our understanding of welfare economics. More than this, he has shown that there is room in economics for a different approach that does not treat human beings and their natural environments as resources to be exploited.

Sen was born in Santiniketan in India and studied at Presidency College, Calcutta and Trinity College, Cambridge. He has taught at universities in both these cities as well as the University of Delhi, LSE, Oxford, and Harvard. Much of his work has been in social choice theory, a body of economic literature inspired by the ideas of Kenneth Arrow. In 1951, Arrow used an abstract mathematical formalism to show that, under some fairly mild conditions, no system could be devised that converted ranked preferences of individuals into a community-wide ranking in a consistent way. How public bodies produce social decisions and the effect of these decisions on welfare became his major concern.

Sen writes in his Nobel biography (1998) about his experiences in Dhaka before the partition:

> “I had to observe, as a young child, some of the mindless violence [of sectarian Hindu and Muslim communities in India]. One afternoon in Dhaka, a man came through the gate … bleeding profusely. [He was] a Muslim daily labourer called Kader Mia … He had been knifed on the street by some community thugs in our largely Hindu area. As he was being taken to the hospital by my father, he went on

saying that his wife had told him not to go into a hostile area during the communal riots. But he had to go to ours in search of work and earning because his family had nothing to eat. The penalty of economic unfreedom turned out to be death, which occurred later on in the hospital. The experience was devastating for me, and suddenly made me aware of the dangers of narrowly defined identities, and also of the divisiveness that can lie buried in communitarian politics. It also alerted me to the remarkable fact that economic unfreedom, in the form of extreme poverty, can make a person a helpless prey in the violation of other kinds of freedom. Kader Mia need not have come to a hostile area in search of income in those troubled times if his family could have managed without it. ”

5.6 Links to personal knowledge

Knowledge framework: *Links to personal knowledge* – Why is this area significant to the individual?

Knowledge framework: *Links to personal knowledge* – What are the implications of this area of knowledge for one's own individual perspective?

Knowledge framework: *Links to personal knowledge* – What is the nature of the contribution of individuals to this area?

Part of who you are and what you think (if these are different) come down to your responsibility to make up your own mind about the ideas that will furnish your mind. Innovation is often exciting and open-mindedness is to be commended, but a healthy scepticism is also a fine feature of the TOK student. How you will manage your life between the new ideas that tempt your assent and the rubbish that the charlatans will throw your way is still a personal human balancing act. To paraphrase Einstein, '*If most of us are ashamed of shabby clothes and shoddy furniture, let us be more ashamed of shabby ideas and shoddy philosophies.*'

In our first look at personal knowledge linked to the human sciences, we are not talking about knowledge that cannot be shared because it is ineffable, tacit, and difficult to express. Here we are talking about that piece of the overlapping circles where personal knowledge intersects with shared knowledge, the awareness that as we map our life's journey, our own map is unique. While it is true that most of our knowledge is shared – it comes from and refers back to others – and while we share this knowledge with a number of different groups each with its own perspective, it is equally true at some point that our personal knowledge is ours alone to accept, refine, or reject as we meet new ideas and new experiences.

The AOKs called history, ethics, art, maths, and science tell us much about the map of a world that is larger than we can think about consciously at any one time. Moreover, some of what we learn will seem to have nothing to do with us as individuals. Yet it is difficult to come across anything in the field of the human sciences without realizing that they are talking about us at some level – whether as a single person or as a member of a group.

This brings forward the question, what do you want to know about people and for what? For satisfying curiosity, understanding the diversity of the planet, or making a better world? Each one can have a pragmatic value. In this chapter, we have discovered that while it is important to see the connection between the goal of knowledge and methodology, it is perhaps even more important to connect method with the view of what it means to be a person.

06 Mathematics

On previous page – Symmetry is not just limited to mathematics; it surrounds us in both living and non-living organisms, as illustrated in this close-up of the Bagworm moth's compound eye.

6.1 Introduction to mathematics

Structures and patterns in mathematics

According to Marcus du Sautoy, maths is everywhere, even in the apparently random, paint-splattered canvases of Jackson Pollock.

> “By looking at Pollock's paintings from a mathematical perspective, you understand why people respond to them. Pollock was creating a fractal structure. The scattering of paint has a property shared by clouds and the branches of trees: whether you zoom in or out, it retains the same complexity. Pollock was painting nature.”
>
> du Sautoy, 2011

Professor Marcus du Sautoy of Oxford University sees mathematics as a code that we can use to unlock the secrets of our world. When we scratch beneath the surface we find that the world is essentially mathematical. This is the **Platonist** view, named after one of its early advocates.

A second view is that mathematics is fundamentally artificial; that it is a human invention, a lens we have constructed through which to view the world. This is usually known as the **constructivist** view (although it can be called **mathematical humanism**).

As we shall see later, each view comes with knowledge questions. The job of TOK is to examine these knowledge questions and try to understand how mathematics works as an AOK.

More specifically, Sautoy touches upon two concepts central to the idea of mathematics: structures and patterns. In this chapter, we shall see how mathematics is built on some very simple structures and that it uses these to investigate patterns.

Whether you agree with Sautoy's analysis or not, mathematics is a compulsory part of most state education systems. Clearly, we value mathematics sufficiently to make children study it, in many cases, into their teens.

Exercises

1. Design your own high school curriculum. What subjects do you think should be available for students to study at the age of 16?
2. What subjects, if any, should be compulsory?
3. If you included mathematics as part of your curriculum, why did you do so?
4. What role does mathematics play in your life?

Mathematics in contrast to other areas of knowledge

Mathematics is crucial in TOK because it offers a strong contrast to the other AOKs both in methods and in subject matter.

One area of contrast is the ability of mathematics to generate absolute certainty. This feature places mathematics in stark opposition to the natural sciences which, as we have seen, can at best generate only provisional results. If scientific knowledge is a map of reality, then there is always the possibility that it gets revised. But with the standard definition of the symbols '2', '4', '+', and '=', 2 + 2 = 4 is not just highly likely to be true – it is absolutely *certain*. The reason is that we can prove that (given the standard meaning of these symbols) 2 + 2 *has to be* 4. *It cannot be otherwise*. In fact, it is a contradiction to say that 2 + 2 is not 4.

This strong contrast with the natural sciences can be illustrated by the respect we tend to pay ancient mathematics compared to long bygone science. Do we still learn the mathematics of Pythagoras, Archimedes, and Euclid? Are these results still true? Are they still used? The answer is immediate: of course. Every schoolchild can recite the famous theorem about the right-angled triangle and quote the formula for the area of a circle. We need this mathematics on a daily basis in our everyday lives, whether we are designing garden ponds or calculating if we can get the model plane we are building through the workshop door.

But do we still learn the science of the 4th and 3rd centuries BC? Is this science still true or still useful? The answer is just as immediate: of course not. We don't even spend much time on the science of the 19th century, let alone the science of the ancient world. Aristotle thought that there were four chemical elements and that the brain was used for cooling the blood. We now know that there are more than 100 and that the brain is used for thinking. Ancient science is really of interest only to the specialist historian of science.

It is very clear that mathematics and the natural sciences are quite different in their nature. Science changes rapidly and things that we thought true in the last century, the last decade, even last year, can be rejected today. This does not happen with mathematics. The question that TOK requires us to ask is, why?

6.2 Scope and applications

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

What is mathematics?

Some AOKs lend themselves to neat closed definitions. Mathematics does not. There is an irony in that a young child might have less difficulty defining mathematics than an IB student. The 6-year-old might suggest that mathematics is to do with numbers. He or she might suggest that mathematics is concerned with the idea of counting things using positive whole numbers. For these children counting numbers are found wherever there are a number of similar things to count – pure and simple. But, as Oscar Wilde remarked about truth, such things are rarely pure and never simple.

For a start, we might reflect that many of the things familiar to us in our mathematics classes have very little to do with counting – for example, the number 0 or negative numbers and fractions. We are unlikely to need them for counting things. It doesn't seem to make sense to point at an object and say 'zero'.

Perhaps we could argue that mathematics is somehow an abstract extension of the idea of counting. We use rational numbers (ratios of whole numbers) for expressing things like mass and length. But this still leaves us with a puzzle regarding 0 and negative numbers and numbers that are not expressible as fractions, such as $\sqrt[3]{7}$. These numbers play no part in real life measuring. Furthermore, HL maths students work with complex numbers like the so-called **imaginary number** $\sqrt{-1}$. It is difficult to see how this number could be used in measurement or counting. Strangely enough, $\sqrt{-1}$, or i as it is known, turns out to be very useful in describing real-life things, such as electrical circuits containing inductors and capacitors.

Some parts of mathematics appear not to have anything whatsoever to do with counting or measuring. The 6-year-old might spend some time drawing triangles and circles on a flat piece of paper, or constructing cubes and tetrahedra using cardboard but not think of these activities as being mathematical. The IB student, on the other hand, understands these as geometrical objects and uses mathematics to explore their properties. The IB student might reflect that the equilateral triangle possesses three axes of reflection symmetry and rotational symmetry of order three, while the isosceles triangle only possesses one axis of reflection symmetry and no rotational symmetry. These symmetries are expressed by a set of mappings that leave the shape of the object the same. If we combine two of these symmetry mappings we always get a new symmetry mapping (see below). We say that the set of symmetries of the shape is *closed* when you combine them. Here we are getting to the essence of mathematics: mappings between sets of objects and things that stay invariant under those mappings.

This is quite an abstract definition and seems to be too general to distinguish mathematics from other AOKs. But we shall discover that mathematics is itself abstract and any definition is, of necessity, general. In any case, mathematics might, like the natural sciences, best be described by its methods and modes of thought.

CHALLENGE YOURSELF

Symmetry of two types of triangle.

The isosceles triangle only has two symmetry mappings (Figure 6.1):

I = identity mapping (leave the triangle as it is)

F = reflection in AX

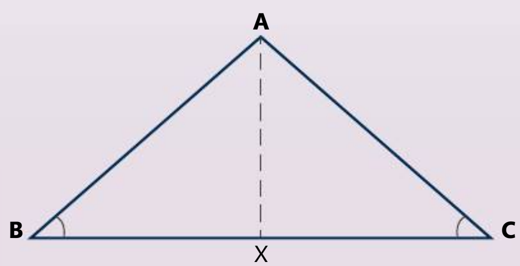


Figure 6.1 Isosceles triangle diagram

These two mappings combine in the following way.

Symmetries of the isosceles triangle

	I	F
I	I	F
F	F	I

The equilateral triangle has six symmetries: three rotations and three reflections (Figure 6.2).

I = identity mapping (leave the triangle as it is)

R^1 = Rotation centre O 120°

R^2 = Rotation centre O 240°

F_1 = Reflection in AX

F_2 = Reflection in BY

F_3 = Reflection in CZ

These mappings combine in the following way.

Symmetries of the equilateral triangle

	I	R	R^2	F_1	F_2	F_3
I	I	R	R^2	F_1	F_2	F_3
R	R	R^2	I	F_2	F_3	F_1
R^2	R^2	I	R	F_3	F_1	F_2
F_1	F_1	F_3	F_2	I	R^2	R
F_2	F_2	F_1	F_3	R	I	R^2
F_3	F_3	F_2	F_1	R^2	R	I

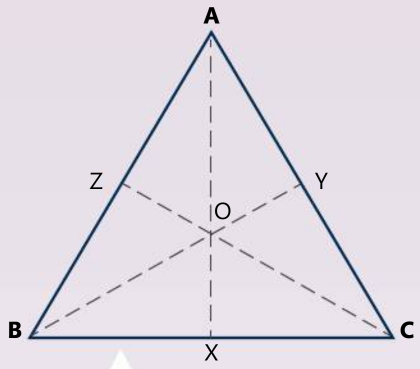


Figure 6.2 Equilateral triangle diagram.

The results are a type of magic square. This is a special mathematical structure called a group. Almost all the important things in mathematics are groups.

Try constructing the group table for the eight symmetries of the square.

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

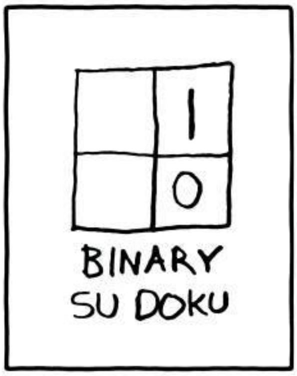
What is the purpose of mathematics?

Returning to the view of knowledge suggested by the TOK subject guide – that knowledge is a map of reality designed to solve certain problems – we might want to consider what sort of problems mathematics attempts to solve. With the natural sciences we found that these problems fell naturally into two distinct groups: internal and external. The internal problems are problems that are purely about matters within natural science or 'knowledge for its own sake'. The external problems are problems of application, such as how to make strong, light materials for the turbine blades in jet engines.

In mathematics, the same distinction holds. Mathematicians divide their subject into two broad categories: pure mathematics and applied mathematics. Pure mathematics solves problems that are internal to mathematics itself. These could be, for example, how to solve a particular type of differential equation. Applied mathematics is more concerned with matters such as how this equation could be used to model a particular real-world situation.

Pure mathematics

Doing pure mathematics is a bit like solving a Sudoku puzzle. There is need for strategy, inspiration, and a good deal of creativity. Guesswork and serendipity might also have a role to play. All the while, the rules have to be followed and the final solution sought. For certain, it is not blind, cold logic. As with the Sudoku, when the solution is found there is a great deal of satisfaction but there is no outside application.



And the answer is ....

But there is a little more to pure mathematics than this analogy suggests. For example, the connection between different Sudoku puzzles is not important. But pure mathematics is a huge integrated field where progress in one area leads to progress elsewhere.

We *can* ask mathematical questions such as the following about Sudoku puzzles.

- How many different Sudokus are there (given a suitable notion of 'different')?
- What is the best general algorithm for solving them?
- Is there a rule for how much information is needed to generate a unique solution to the Sudoku?
- Can we generalize the result about how many 'different' puzzles there are to a more general type of Sudoku played on a larger grid?

Although our analogy with Sudoku only works so far, pure mathematics, nevertheless, involves solving puzzles, largely for their own sake, through the use of imaginative strategy subject to the rules of the game.

We shall use number theory to illustrate pure mathematical thinking. It is an important field within pure mathematics. Number theory explores topics such as the distribution of prime numbers. This is a question that goes back to the ancient Greeks. A prime number is defined as a whole number that can only be exactly divided by itself and 1. Euclid showed that any whole number can be written uniquely as a product of prime numbers, so they really are the building blocks of the system of numbers.

So, for example, the number 240 can be expressed as:

$$240 = 2 \times 2 \times 2 \times 2 \times 3 \times 5 = 2^4 \times 3 \times 5$$

Moreover this way of building 240 is unique up to rearrangement of the factors. So if we present them in ascending order, as here, then the decomposition is unique.

Euclid had already proved that there were infinitely many prime numbers (page 193). But how are they distributed? At first sight the distribution seems haphazard and there doesn't seem to be a pattern. Here are the primes below 100:

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

One might hope that the pattern settles down as the numbers get larger but it is not the case. For example, there are no fewer than nine primes among the 100 numbers below 10 000 000 but there are only two in the 100 numbers above 10 000 000 (du Sautoy 2003). The project of finding a formula for the number of primes less than or equal to n is a classic piece of pure mathematics. It is still very much an open question, though we are closer to a solution now than we were, thanks to the work of Carl Friedrich Gauss (1777–1855) and Bernard Riemann (1826–66).

There really does not seem to be much chance of this sort of work being useful in the world outside mathematics. But, as we shall see shortly, this is not the case. In fact, it is difficult to find an area in mathematics that has not led to important and useful applications.

Applied mathematics

Applied mathematics is oriented towards the solution of real-world problems. The mathematics it produces can be just as interesting from an insider's viewpoint as the problems of pure mathematics (and often the two are inseparable), but in the final analysis, it is judged by whether or not it has practical external benefit.

Below is an example of applied mathematics at work. It is an example that could occur in an SL maths course or indeed (and this is the point) in a physics course.

A stone is dropped down a 30 m well. How long will it take the object to reach the bottom of the well, neglecting the effect of air resistance?

We know that the acceleration due to gravity is 9.8 m/s^2, we also know that the distance travelled S is given by the equation:

$$S = \frac{1}{2}at^2$$

where a = acceleration and t = time

So, we substitute the known values into the equation:

$$30 = \frac{1}{2}(9.8)t^2$$

Rearranging the equation gives us:

$$\frac{60}{9.8} = t^2$$

so

$$t = \sqrt{\frac{60}{9.8}} = 2.47 \text{ seconds}$$

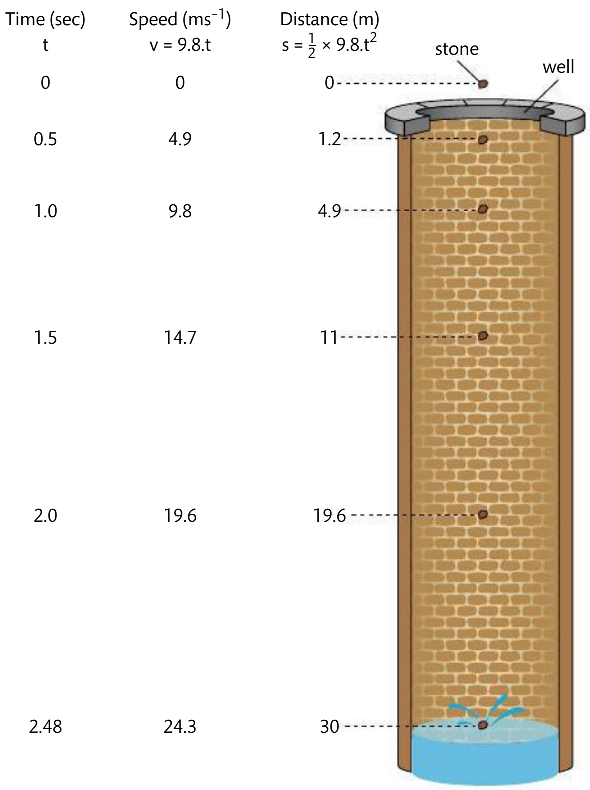
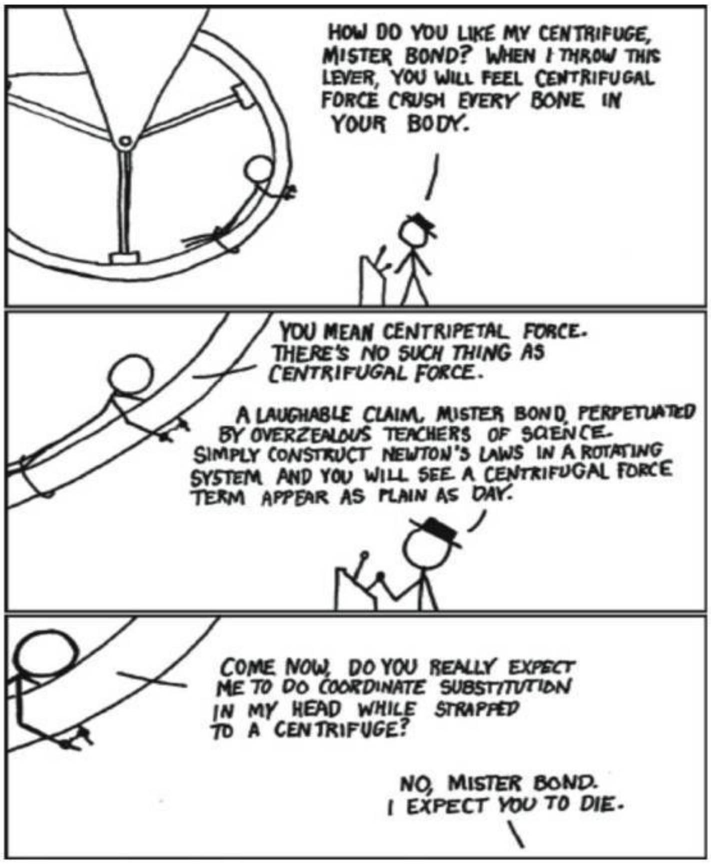


Figure 6.3 Visualizing the acceleration-due-to-gravity calculation.

There are two points to note here.

- The formula only works if we neglect air resistance and if the stone is dropped and not thrown down the well (Figure 6.3).
- The number 9.8 m/s^2 is arrived at by observation of things accelerating in our physical world. It is not a mathematical fact.

These points are typical of this sort of problem. We have to simplify the description of the problem and idealize it in some way before we can apply the appropriate mathematics. This is strongly reminiscent of the idea of the map being a simplified representation of reality. Moreover, the whole calculation requires the input of observations of the real world to furnish us with the correct value for acceleration due to gravity – it is based on empirical evidence. Neither of these requirements are necessary in pure mathematics.



How important is empirical evidence?

A mixture?

The distinction between pure and applied mathematics becomes blurred in the hands of someone like Gauss. We noted above that he had worked on the distribution of prime numbers. The same Gauss as a young man had enabled astronomers to rediscover the minor planet Ceres after they had lost it in glare of the Sun. He calculated its orbit from the scant data that had been collected on its initial discovery in 1801 and then predicted where in the sky it would be found more than a year later. This feat immediately brought Gauss to the attention of the scientific community. His skills as a number theorist presented him with the opportunity of solving a very real scientific problem.

Who would have guessed that prime number theory would one day give rise to a system of encoding data that is used by banks all over the world? The system is called 'public key cryptography'. The clever part is that the key to the code is a very large number which is the product of two large primes. The bank holds one of the primes and the computer of the client the other. The key can be made public because, in order for it to work, it has to be split up into its component prime factors. This task is virtually impossible for large numbers. Imagine trying to find the two large prime factors of the following 677-digit number. Such a task as this would take a very long time, even on the fastest modern computer:

25,195,908,475,657,893,494,027,183,240,048,398,571,429,282,126,204,032,027,777,
137,836,043,662,020,707,595,556,264,018,525,880,784,406,918,290,641,249,515,082,
189,298,559,149,176,184,502,808,489,120,072,844,992,687,392,807,287,776,735,971,
418,347,270,261,896,375,014,971,824,691,165,077,613,379,859,095,700,097,330,459,
748,808,428,401,797,429,100,642,458,691,817,195,118,746,121,515,172,654,632,282,
216,869,987,549,182,422,433,637,259,085,141,865,462,043,576,798,423,387,184,774,
447,920,739,934,236,584,823,824,281,198,163,815,010,674,810,451,660,377,306,056,
201,619,676,256,133,844,143,603,833,904,414,952,634,432,190,114,657,544,454,178,
424,020,924,616,515,723,350,778,707,749,817,125,772,467,962,926,386,356,373,289,
912,154,831,438,167,899,885,040,445,364,023,527,381,951,378,636,564,391,212,010,
397,122,822,120,720,357

du Sautoy, 2003

But this number is indeed of the form of the product of two large primes. If you know one of them, it takes an ordinary computer a fraction of a second to do the division and find the other. And who was the mathematician who said that such a number should have prime factors in the first place? It was Euclid, 2000 years ago in his fundamental theorem of arithmetic.

Just as we found in the natural sciences that internal problems produced solutions (pure science) that could also be used for technological or engineering applications, so in mathematics, problems motivated purely from within the most abstract recesses of the subject (pure mathematics) give rise to very useful techniques for solving problems, with direct applications in the world outside mathematics.

Prescribed essay title 1: '… mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true.' (*B. Russell, Mathematics and the Metaphysicians*) Critically assess this assertion. What does it mean? If this is the case, how does mathematics differ from other forms of knowledge?

6.3 Language and concepts

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

Language and different representations

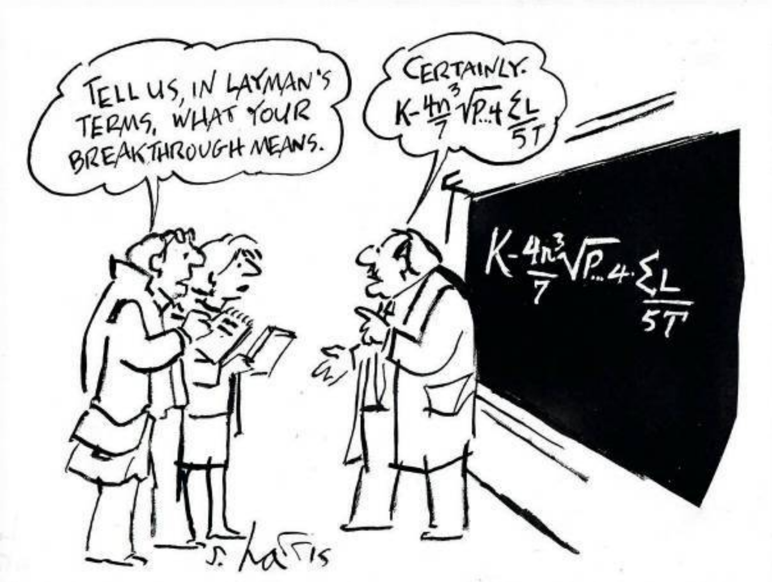
“*non notationes, sed notiones* (not notations, but notions)”

Gauss

Knowledge is a representation of the world. That is the starting point for our investigations in TOK. But how exactly does mathematics do this?

Numbers are one of the basic pieces of furniture in the house of mathematics. Exactly what sort of thing a number is and what type of existence it enjoys are difficult questions in the philosophy of mathematics, and somewhat outside the scope of this book. Instead, we are concerned with the mathematical language we use to express numbers and how we construct them in the first place.

How do we express mathematical ideas?



Numbers should not be confused with the symbols we use to represent them. Take fractions, familiar from your mathematics courses, as an example. The symbols $\frac{1}{3}, \frac{2}{6}, \frac{3}{9}$, 0.3333… all name the same number despite appearing to be quite different (perhaps the infinity of different ways of representing fractions is one of the reasons why students have so much difficulty with them).

We might think that we are on safer ground with decimals. But consider the symbol 0.9999… (the three dots mean that the 9 is repeated indefinitely). This is just a very complicated way of writing 1.

Exercises

5 What is named by the expression ***the smallest number expressible by a decimal bigger than 1***?

6 What is named by the following expressions: ***the tallest tree in the world***, ***the shortest tree in the world***, ***the most westerly tree in Canada***?

7 Are there any differences in mathematical conventions in your class? Do you all do long division the same way? Does it matter?

8 Prove that 0.9999… = 1. What makes your proof decisive? Does it matter if people are not convinced by it? Is it still true if nobody apart from you believes that it is true? What makes it a proof? What if there is a mistake in it that no one has ever spotted?

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Basic concepts

In trying to tie down exactly what mathematics is about, we suggested that the idea of a set as a collection of things might somehow be a crucial foundation on which the more complex notions of mathematics can be built. This is an appropriate place to develop this idea.

Sets

A set is a collection of elements which can themselves be sets. Sets can be combined in various ways to produce new sets. The concepts of a set and membership of a set are *primitive*. This means that they cannot be explained in terms of more simple ideas. This may seem a modest idea on which to build the complexities of modern mathematics but, in the 20th century, there were a number of projects designed to do just that – to reduce the whole of mathematics to set theory. The most important work here was by Quine, von Neumann, Zermelo, and Russell and Whitehead.

It is tempting to think that the existence of different conventions for writing mathematics means that mathematics possesses regional variations. People write 0.3 in the UK and 0,3 in Sweden; does this show that mathematics is different in the UK and Sweden? No, clearly the notation is different but the underlying mathematics is the same.

Exercise

9 Choose one of your HL subjects in the IB Diploma programme. Identify a primitive concept in this subject. Find another non-primitive concept that incorporates the concept you have chosen. For example, a primitive concept in physics is energy. The idea of work requires the primitive concept of energy.

We can define a set by listing its elements. In mathematics, we do this by enclosing the set in curly brackets { }. This tells us that the order of elements in the set does not matter (the use of parentheses () in mathematics tells us that order *does* matter).

So, we can define the set M of months of the year as follows:

M = {January, February, March, April, May, June, July, August, September, October, November, December}

We can also define a set by specifying a rule for membership:

M = {x: x is a month of the year}

Paradoxically, one of the most important sets in mathematics is the set without any members; this is called the *null set* {}. Using this set and the idea that no set can be a member of itself (see exercises below), we can construct another important set: the natural numbers.

N = {1, 2, 3, 4, 5, 6, …}

The three dots here indicate that there is no end to the set: it contains an infinite number of elements; it has no greatest member.

Mathematicians are comfortable with the idea of infinite sets, since most of the sets they deal with are infinite. However, this should worry us a little bit as TOK students. For a start, it is difficult to visualize an infinite collection of things. Secondly, and

In mathematics, the term *induction* does not mean the same as it does in our discussions of, say, the natural sciences. In the natural sciences, inductive inferences are generalizations from a finite data set to a whole population. The process involves a leap of faith and is not entirely secure. Mathematical induction, on the other hand, is an entirely rigorous deductive process.

perhaps more seriously, we should worry about how we specify an infinite list. After all, the lists we make in everyday life are finite.

Mathematicians have a neat trick for generating infinite lists. In the case of the set N, observe that every number n has a unique successor $n + 1$. So we can generate the whole set by specifying the first member 1 and then giving the rule that if n is a member then $n + 1$ is the next member. This is called an **inductive definition**.

Exercises

10 Some sets can be defined that are self-referential. Consider the 'set of all things that can be described in eleven words'. Clearly this set can be defined in eleven words (we just did it). So technically, it is a member of itself. But this type of self-reference should ring a warning bell. Russell played with this idea when he challenged Gottlob Frege with the following conundrum. ***Consider the set of all sets which are not members of themselves. Is it a member of itself?*** Try solving this puzzle.

11 Here is a similar puzzle. ***In the town of Seville, there is only one barber. He shaves all those men in the town who do not shave themselves***. What is puzzling about this?

Mappings between sets

Once we have established sets in our mathematical universe, we want to do something useful with them. One of the most important ideas in the whole of mathematics is that of a mapping. As you know from your IB mathematics course, a mapping is a rule that associates every member of a set with a member of a second set. The first set is called the *domain* and the second set (the target set) is called the *codomain*. We represent mappings by arrows joining the domain to the codomain.

This is precisely what we do when we are counting something. We set up a mapping between the natural numbers and the set of objects we want to count (Figure 6.4).

Figure 6.4 Counting is a mapping between two sets.

Another interesting mapping is the doubling mapping that maps the set of natural numbers onto the even numbers (Figure 6.5).

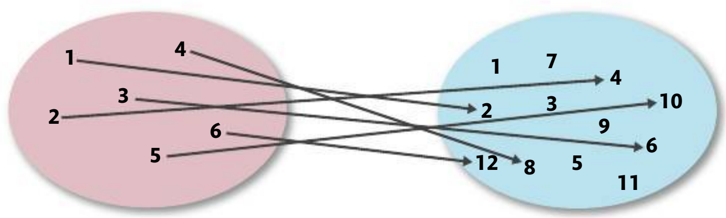


Figure 6.5 The doubling mapping.

There are some special classes of mappings that require our attention. A mapping where only one arrow is associated with every element of the domain is called a **function**. Functions are very important in the mathematics that is studied in the IB Diploma. A function that maps distinct elements in the domain to distinct elements in the codomain is called an **injective** or **one–one** mapping (Figure 6.6). A mapping where every element of the codomain has an arrow pointing to it is called a **surjective** or **onto** mapping (Figure 6.7). If a mapping is both injective and surjective then it is called a **one–one correspondence**.

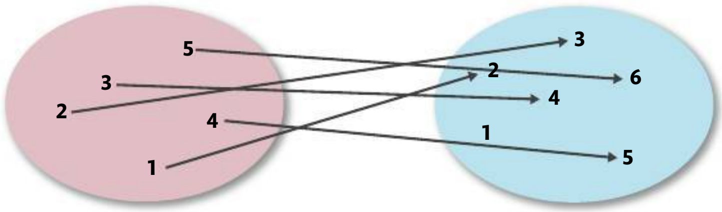


Figure 6.6 An injective mapping.

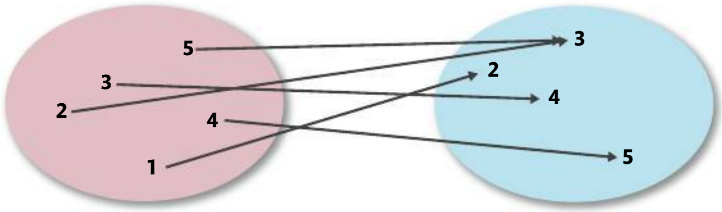


Figure 6.7 A surjective mapping.

The counting mapping above is a one–one correspondence. It is important when counting objects that you (a) do not count anything twice (injective) and (b) that you count every object (surjective).

This idea of counting as a one–one correspondence with N is very powerful. It allows kindergarten children to count sheep (finite sets) and it allows mathematicians to count infinite sets. If we can find a one–one correspondence between them then we can say that, in an important sense, they have the same 'number' of elements.

Infinite sets

Take a look at the doubling function (Figure 6.5). Clearly it sets up a one–one correspondence between the set of natural numbers and the set of even numbers. You can check this yourself. No element of the codomain has more than one arrow pointing at it (meaning different elements of the domain map to different elements in the codomain), and every element of the codomain has an arrow pointing at it. So this means that there are as many even numbers as there are natural numbers. But this is strange. If we start with the set of natural numbers and then remove the set of odd numbers, we get the even numbers. But we are saying that the set that is left over has as many members as the original set, even though we have removed an infinite number of odd numbers. The strangeness here is characteristic of infinite sets (indeed it can be used to define what we mean by infinite). A set is infinite if it can be put in a one-one correspondence with a proper subset of itself. In other words, you can take things out of an infinite set (even an infinite number of things if you choose well) and still have the same number of things remaining.

But the story doesn't stop here. Using sets and mappings we can show that there are many different types of infinity. The set of natural numbers contains the smallest type of infinity usually denoted by the Hebrew letter aleph with a subscript 0 ($\aleph_0$) which we call *aleph nought*. In the 19th century, the German mathematician Georg Cantor (1845–1918) showed that the number of numbers between 0 and 1 is a bigger type of infinity than $\aleph_0$.

To learn more about the ingenious argument of Georg Cantor, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 6.1.

It turns out that there is in fact an infinity of different types of infinity – a whole hierarchy of infinities, and it probably does not surprise you anymore that there are more infinities than numbers. It is instructive to examine how mathematicians deal with infinity. For a start, there need not be a problem of visualization. There are many ways in which infinity can be handled in a finite fashion. For example, imagine a series of points X_1, X_2, X_3, X_4 on a line AB. Now draw lines from each point X_n to the pole, P, of circle, C, sitting on the line. The point where each line cuts the circle is designated Y_n. It is clear that the mapping X_n to Y_n is a one–one correspondence between AB and C (HL maths students should prove this). The question now is, what point corresponds to P itself? It is the point at ∞ (Figure 6.8).

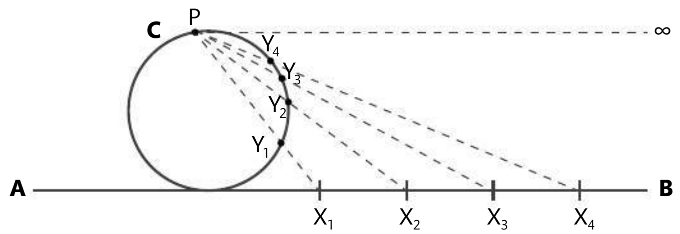


Figure 6.8 Visualizing infinity.

Another way to handle infinity can be illustrated by a story. Imagine a frog at the side of a pond. There is a princess sitting on a water lily in the centre of the pond. The frog has to get to the princess and, as these things usually go, he has to be kissed by her and thence be transformed into a handsome prince. The pond is circular with radius 2 m. But there is a problem. The frog can only jump half the remaining distance to the princess with every jump. With the first jump he covers 1 m, the second ½ m, the third ¼ m and so on until infinity (Figure 6.9). He gets very close to the princess but never actually reaches her. The situation seems quite hopeless. But then let us imagine that the first jump takes 1 second, the second jump takes ½ second and the third ¼ second and so on. This means that the frog covers 1 m in 1 second, ½ m in ½ second, ¼ m in ¼ second. In other words, the frog is travelling at exactly 1 m per second. As the distance to the princess is originally 2 m, the frog takes just 2 seconds to reach the princess and be kissed and so transformed into a prince. In the mathematics of infinity, as well as in fairy tales, there is a happy ending.

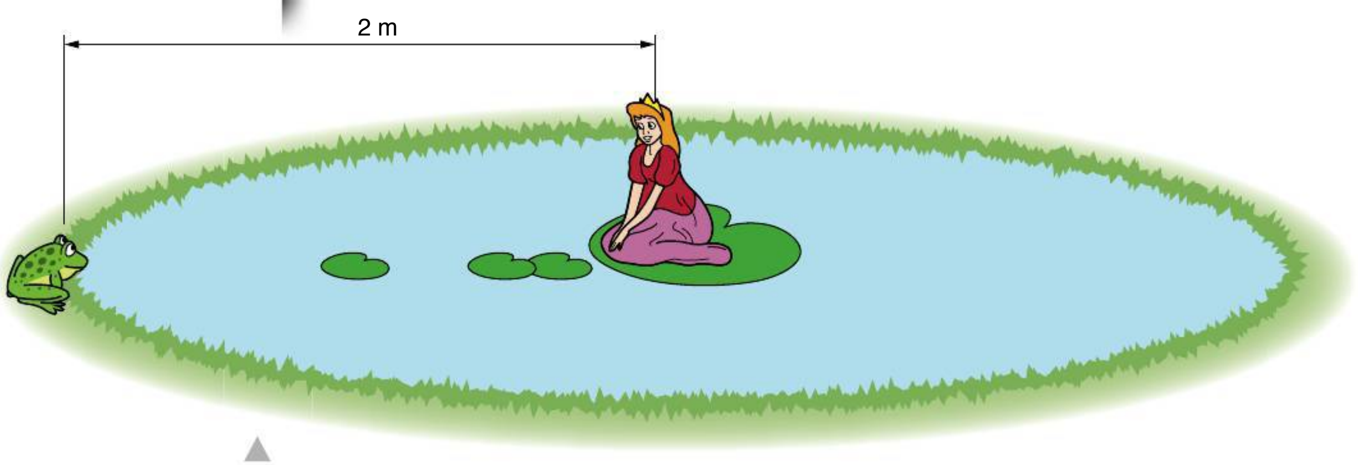


Figure 6.9 Can the frog and the princess ever meet?

This story illustrates the fact that the series:

$$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots = 2$$

In other words, although there are infinite terms in the series they have a finite sum. This is because each successive term is a certain fraction (in this case ½) the value of the previous term. The terms get successively smaller and the sum gets closer and closer to 2, so that after an infinite number of terms it actually is 2.

Of course, this is an informal argument, and mathematicians need to worry about what they mean by a sum that contains an infinite number of terms. Nevertheless, there is a place for such visual intuition in mathematics that is so often about things that are so different from our everyday experience as to be literally unimaginable. Mathematicians are used to dealing with spaces of four, five, and six dimensions and have to describe geometrical objects in these spaces. Indeed, there are fields within mathematics that routinely work in infinite dimensional space. Despite this, mathematicians go on cheerfully with their work by adopting some sort of informal picture to guide their intuitions.

Fractals

A very striking use of the notion of infinite sets and mappings is in the area of dynamical systems, more popularly known as chaos theory and fractals. A fractal is a set produced by repeating a mapping an infinite number of times. Again, Georg Cantor produced some very interesting mathematics in the 19th century that steered mathematicians towards fractals.

Here is a recipe for producing a Cantor set (Figure 6.10).

1 Draw a line segment of length 10 cm.
2 Cut it into three equal pieces.
3 Delete the middle third.
4 Take each of the two remaining pieces and divide each into three equal pieces. Delete the middle third of these.
5 Carry out this operation indefinitely. What is left over?

It should be obvious that the points that are the end points of any line segment at any finite stage in the process are never deleted. So some points are left over in the limit set obtained by doing the deleting process an infinite number of times. It is clear that there are an infinite number of such points. It should also be obvious that it is impossible to draw these points properly on the diagram and that no point in the set is connected to any other point in the set. Less obvious is that there are 'more' points left over than the

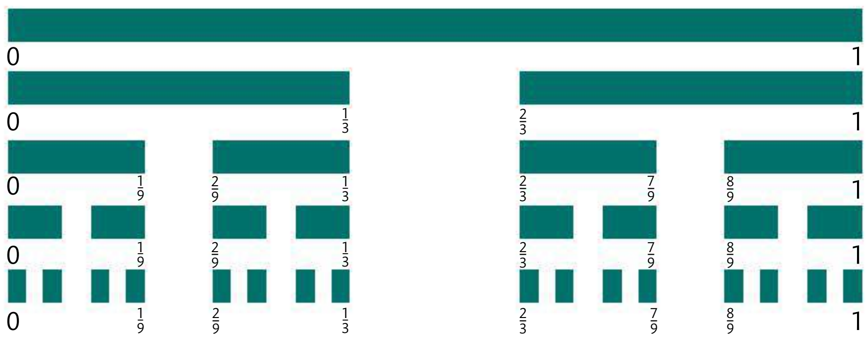
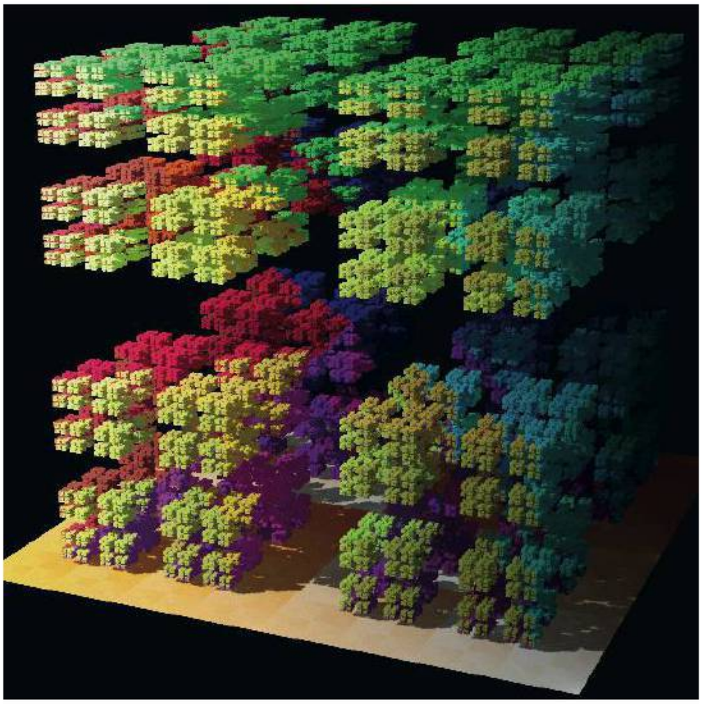


Figure 6.10 How to produce a Cantor set.

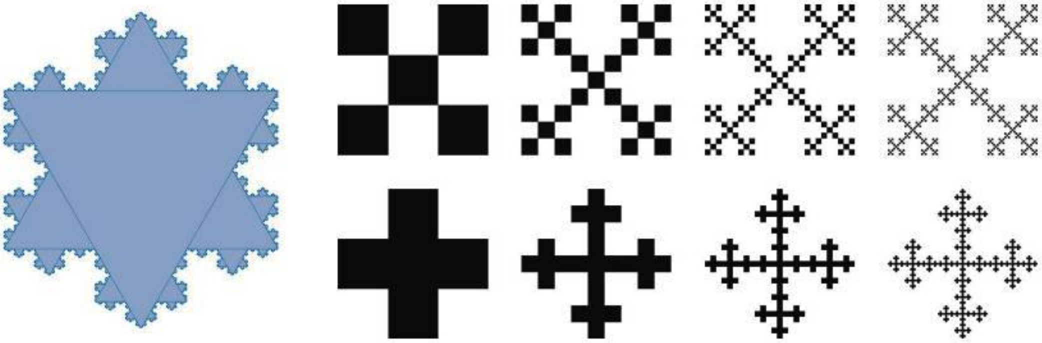
natural numbers, in other words the infinity of these points is bigger than $\aleph_0$. Because of the infinite way in which the set is constructed, it is clear that if we look at a small part of the Cantor set under a microscope it looks like the whole set. In other words, there is a one–one correspondence between the whole set and itself that preserves the structure of the set. We say that the Cantor set is *self-similar*. All fractals possess the property of self-similarity.

A 3-D Cantor set of a cube shows clearly how the middle third is deleted from a cube in all three dimensions. What is left over is a set of scattered points. The self-similarity of the original figure to one of its smaller 'sub-cubes' is clear.



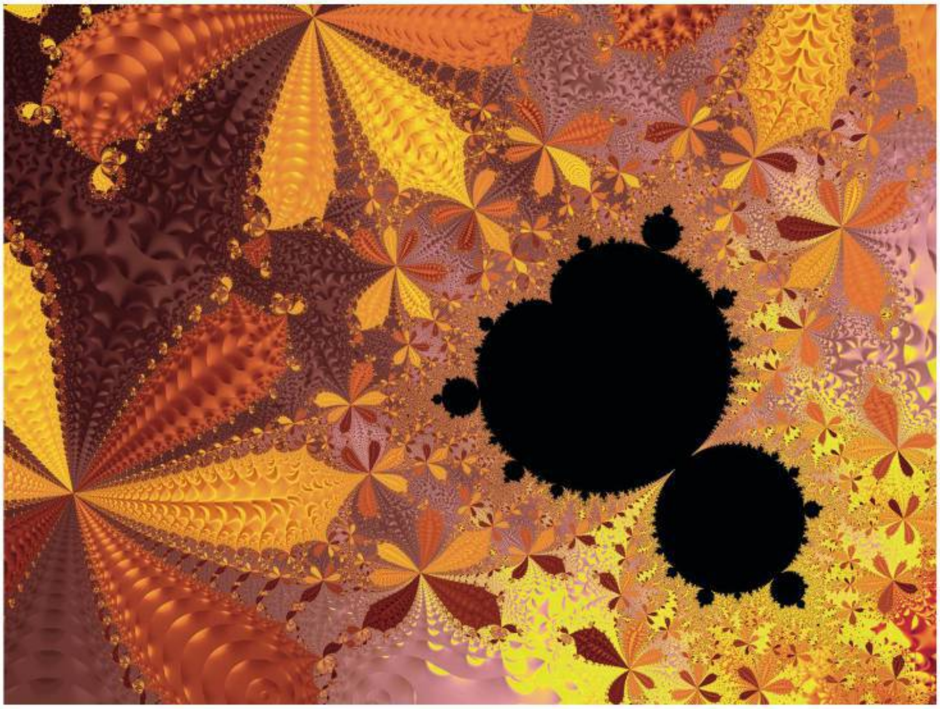
3-D Cantor set of a cube.

Using similar repeated operations, we can make two-dimensional self-similar figures or fractals. The second row in the picture of 2-D Cantor sets shows how to produce the famous Koch snowflake. Notice how similar these figures are to the original Cantor set.



2-D Cantor sets.

Among others, the French–American mathematician Benoit Mandelbrot (1924–2010) brought the stunning beauty of these interesting sets to the attention of a wider public in the mid 1980s.



A Mandelbrot set.

Mathematics, then, is based on some important and simple ideas. Sets and mappings are the building blocks. We need to add a bit more structure to a set to allow us to perform the usual algebraic operations on it. The resulting structure we met earlier is called a *group,* and is arguably the most important building block in mathematics. These simple ideas are highly abstract and cannot really be found in the pure state in the world outside mathematics.

6.4 Methodology

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Knowledge framework: *Methodology* – What are the assumptions underlying these methods?

Proof

Now we have explored some of the basic raw materials of mathematics, we need to take a look at what mathematicians do with them in order to produce knowledge. The starting point for this investigation is the method that is at the centre of mathematical activity: proof.

Proof is a formal method that establishes the truth of statements in mathematics. The main idea is simple: once a statement has been proved we can say that it is true, that it has always been true and will always be true. Mathematical proof is the guarantee of the sort of timeless truth that Plato envisaged was characteristic of all AOKs. What we shall discover is that, because of its special subject matter and methods, mathematics might be unique among our AOKs in this respect.

Knowledge questions

1 What it is about the methods of mathematics that give us this cast-iron guarantee that its results are absolutely certain and that there is not a glimmer of doubt attached to them?

2 Is it irrational to doubt a mathematical statement that has been proved satisfactorily?

One way of thinking about mathematics is that it is a big abstract game played by human beings according to invented rules. This view is called ***formalism***. In a sense mathematics is just like the eponymous glass bead game in the novel by German writer Hermann Hesse (1877–1962). Interestingly, the hero of the novel has to learn music, mathematics, and cultural history in order to play the game. There are very strong connections between mathematics and music.

Let us then imagine that mathematics is like a game. As with a game, mathematical proof has to start somewhere. Mathematical proof starts with a collection of statements called ***axioms***. These statements are in mathematical language (the language of sets, for example). They themselves cannot be proved. They are simply taken as self-evidently true. Mathematicians are free to choose the axioms that suit their purposes up to a point. Choosing a different set of axioms can lead to a different sort of mathematics (although it doesn't have to – there are equivalent ways of choosing axioms for mathematical systems).

Once the game is set up, we can start playing but only in sequence and according to the rules of the game. The same is true of a mathematical proof. One applies the rules (these are typically the rules of algebra or, more generally, rules of logic) to a line in the proof to get the next line. The whole proof is a chain of such moves.

Finally, the game ends. Similarly, a mathematical proof has an end. This is a point where the statement that was to be proved is finally derived at the end of the chain of reasoning. This result is called a ***theorem*** (Figure 6.11).

The word *theorem* only applies to mathematical or logical statements. It cannot be used outside mathematics or logic. The human and natural sciences hardly use the word at all. It might be used in economics but only when the result is proved using mathematics. The same is true in physics or chemistry.

Exercises

Consider this proof. It says that the result of adding two odd numbers is always an even number.

Theorem: Let x and y be odd numbers. Then $x + y$ is an even number.

Proof: Because x is an odd number, it can be written as an even number plus 1. An even number can be written as $2n$ for some integer n.

So we can write: $x = 2n + 1$

Similarly: $y = 2m + 1$ for some integer m.

So: $x + y = (2n + 1) + (2m + 1)$
$= 2n + 2m + 2$
$= 2(n + m) + 2$
$= 2(n + m + 1)$

But $(n + m + 1)$ is an integer (because n and m are integers) so $x + y$ is an even number, QED (*quad erat demonstrandum* – which was to be shown).

12 Why do we use different letters n and m to construct the odd numbers in the proof?

13 What is the advantage in using letters to stand for general numbers?

14 What properties of addition and multiplication of whole numbers does your proof depend on? (These are the axioms of the proof.)

It is possible to illustrate the idea of proof without actually using mathematics (but still doing mathematical thinking). We owe the example below to the English mathematician Ian Stewart (1995) in his book *Nature's Numbers* (who in turn borrowed it from a colleague at Warwick University).

Start off with the four-letter English word SHIP. Write down a vertical list of four-letter English words. Each word differs from the one above it by changing only one letter. The aim is to arrive at the word DOCK.

SHIP

SHOP

…

DOCK

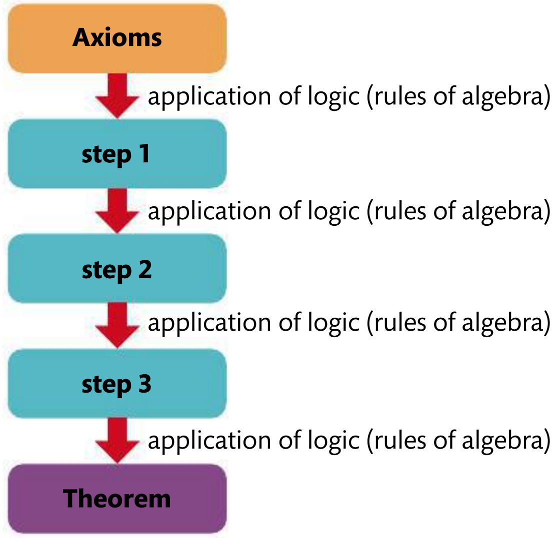


Figure 6.11 A model of a mathematical proof.

Before reading on, try to solve the puzzle. It will help with understanding what comes next. Remember that you can only change one letter per move. The other letters have to be left alone; you are not allowed to rearrange them. For example, you might want to write SHOP as the second word.

Exercise

15 While you are trying to solve the SHIP to DOCK puzzle, be aware of your thought processes.

- **a** What strategies are you using?
- **b** Have you tried working both forwards and backwards?
- **c** What about the problem getting them to meet in the middle?
- **d** Do you think your emotions play a part in this process?
- **e** What about your intuition? What is the role of reason?
- **f** How do you feel when you have solved it?
- **g** How do you feel not being able to solve it?

Although this is not a mathematical proof, it uses similar methods.

Did you feel that the problem lay at the centre of the 'proof'? Perhaps you tried to solve this by starting at the end and working backwards and then got into trouble in the middle. Let's consider two solutions.

SHIP		SHIP
SHOP		SLIP
SHOT		SLAP
SOOT	and	SOAP
LOOT		SOAK
LOOK		SOCK
LOCK		DOCK
DOCK		

Did you arrive at either of these solutions? In fact, there are many solutions, but seven steps is thought to be the shortest. If we allow words to repeat (and there was nothing said in the rules that this was not allowed) then there is an infinite set of solutions. Notice that in the centre of our 'proof', the keystone of the bridge is a word with two vowels in it.

We might be tempted to make a conjecture – a mathematical statement that has not yet been proven. Let us conjecture that every solution of the puzzle requires at least one word with two vowels in the middle somewhere. Let us see if we can prove it. We might also notice that the vowel in the word SHIP is in the third position while the vowel in the word DOCK is in the second position. The puzzle requires us to 'move' the vowel from the third position to the second position. Maybe at this point there is a glimmer of light in the darkness. Reformulating the problem in this way makes it clearer to see what we have to do to solve the original problem, but also how we might prove the conjecture. We need one fact about English words: every English word contains at least one vowel (counting 'y' as a vowel in certain circumstances). Remember that we are only allowed to change one letter at a time. This means that in order to move the vowel from the third position to the second position we have to write a word with two vowels (we can't write a word with no vowels – English grammar doesn't allow words with no vowels). So, every one of the infinite set of solutions to this puzzle has to contain at least one word with two vowels. We have proved the conjecture and it becomes a fully fledged theorem. Given the rules of the game, this result is certain – it is not just likely, it has to be true.

While there might be something attractive about the idea of mathematical proof (starting with axioms and using a finite number of rules to deduce each line from the preceding line, thus finally getting to the result), you might be rightly suspicious. A number of questions can be raised at this point.

- How can we *choose* the axioms just like that?
- On what basis do we make that choice?
- Surely if we choose a sufficiently different set of axioms, we get a different mathematics?
- How do we know that the axioms we choose will yield the sort of mathematical results that we intuitively expect?
- How do we know that the axioms fit with each other and don't produce contradictions?
- Shouldn't the axioms be true or false in relation to the world?

These questions capture both the essence of mathematics and some of its central knowledge questions. Truth in mathematics is something that is conventionally established. We might even regard it as a social truth in some sense (see the views of Reuben Hersh, below). It is precisely this lack of reference to the outside world that gives mathematics its absolute certainty but also its slightly other-worldly quality.

Prescribed essay title 2: Mathematicians have the concept of rigorous proof, which leads to knowing something with complete certainty. Consider the extent to which complete certainty might be achievable in mathematics and at least one other area of knowledge.

Euclidian geometry

To explore these questions let us examine one of the first axiomatic systems ever produced. This is the system of axioms and derivation rules set up by Euclid in the 3rd century BC in his book *Elements*, in which he proves many important results in geometry.

Here are Euclid's axioms. He called them postulates. Technically, most of them tell us how to move from one line of a proof to another. In this sense, they are more like rules of the game of geometry.

1 Any straight line segment can be drawn joining any two points.
2 Any straight line segment can be extended indefinitely in a straight line.
3 Given any straight line segment, a circle can be drawn having the given line segment as radius and one endpoint as centre.
4 All right angles are congruent.
5 If two lines are drawn, which intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, then the two lines inevitably must intersect each other on that side, if extended far enough.

In some sense Euclid's axioms express mathematical intuitions about the nature of geometrical objects (in this case: points, line segments, circles, and right angles). What is clear is that we cannot establish the truth of these postulates by observing the external world. Objects such as points, lines, and circles do not exist in the real world as perfect mathematical objects. It is easy to understand why Plato placed these special objects in the perfect world of the Forms, and not in our messy everyday world.

We could try to use Euclid's postulates to do some geometry. Let us try to construct an equilateral triangle on a given line segment. We are only allowed to use a straight edge and a pair of compasses because Euclid's postulates only refer to line segments and circles.

Step 1: Draw two circular arcs of radius AB centred on points A and B (Figure 6.12).

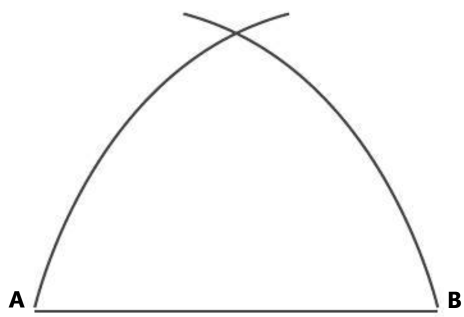


Figure 6.12 Step 1.

Step 2: Label the intersection point of the arcs C. Draw line segments AC and AB to complete the triangle (Figure 6.13).

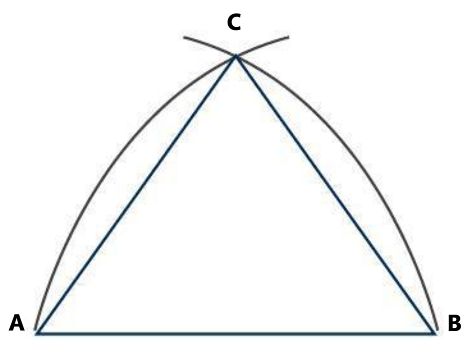


Figure 6.13 Step 2.

It follows from step 1 that the line segments AC and BC are both equal to AB. Therefore, they must be equal (this is sometimes quoted as a separate axiom: that two things equal to the same third thing must be equal; however, it follows from our modern definition of equality of sets).

With arguments like these, Euclid established a pattern for establishing the truth of mathematical statements; a pattern that is still used today.

Exercise

16 Consider the following set of axioms:

- A committee is a set of three members.
- Each member is on exactly two committees.
- No two members can be together on more than one committee.
- There is at least one committee.

a What are the primitive ideas in this axiom system?

b Try to construct a situation that satisfies these axioms (this is called a model).

c Is yours the only possible model of these axioms?

Non-Euclidian geometries

Let us look more closely at Euclid's fifth postulate. It cannot be deduced from the other postulates (this can be proved). Euclid himself only used the first four axioms in the first 28 propositions (effectively theorems) of the *Elements*, but he was forced to use the fifth – called the parallel postulate – in the 29th proposition. This is an independent axiom of the system, and like all axioms, we can choose whether we accept it or not. If we accept it, we get the familiar geometry of our everyday life on the surface of the Earth. We can use it to construct buildings, roads, and other familiar objects.

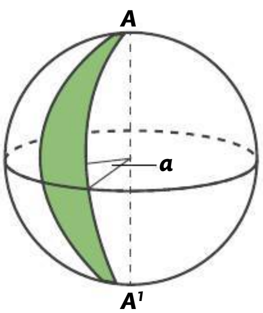
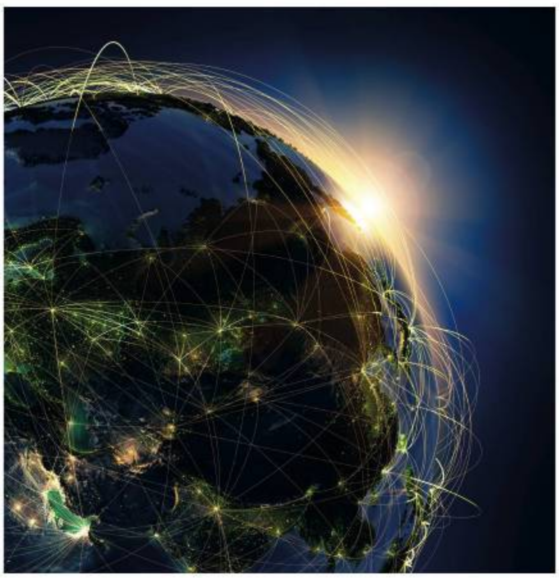


Figure 6.14 Lines parallel at the equator converge towards the poles.

In 1823 Janos Bolyai and Nicolai Lobachevsky independently realized that entirely self-consistent non-Euclidian geometries could be constructed in which the fifth postulate did not hold – in other words, that parallel lines do not behave in quite the way we expect from everyday life. There are two typical cases. The first is where parallel lines converge and actually meet at a point – this is called **elliptic geometry** (Figure 6.14).



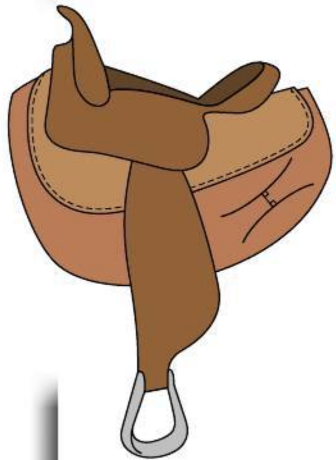
Airline routes show that the shortest distance between two points on Earth's surface is a curve.

A good example of this is long distance travel around the Earth. As you will know if you have ever taken an intercontinental flight, the shortest distance between two points on the Earth's surface, such as Stockholm and New York, is part of a circle (called a great circle).

Lines of longitude are great circles. It is clear that they are (in a special technical sense) parallel but it is also clear that they meet at the poles.

The second case is where parallel lines diverge and become ever farther apart. This is called **hyperbolic geometry**. This would be like drawing parallel lines on a saddle (Figure 6.15).

Figure 6.15 Lines parallel at some point on a saddle diverge continuously.



What is clear from this discussion is that we can choose the axioms according to what we want to do with them. Standard Euclidian geometry is useful for describing spaces we encounter in our local, day-to-day world. But we need elliptic geometry if we are to fly planes from one place to another on the Earth's surface, and this requires us to reject the fifth postulate of Euclid. At the time of writing, hyperbolic geometry is largely of interest to pure mathematicians but who knows what applications might spring up asking for a hyperbolic treatment?

The axioms are a little like the rules of a game. Change the rules and you get a different game. But this leaves us with a problem. It is difficult to see how a game, such as chess, can tell us anything about the world.

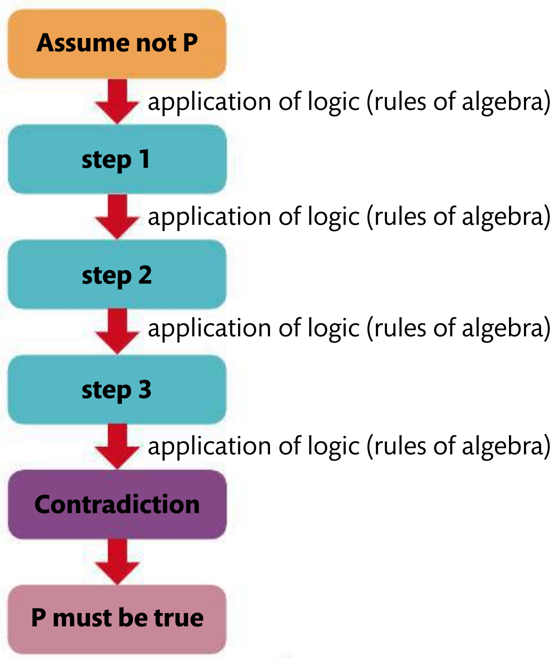
Knowledge question

3 If the rules are made up, how could they apply usefully to mapping the world? How can mathematics, conceived as built on a set of human-made axioms, have anything useful to say about the world beyond mathematics?

Proof by contradiction

A very powerful technique used by mathematicians is the idea of proof by contradiction or, to give it its Latin name, *reductio ad absurdum*. If we want to prove a proposition P, then we start by assuming (not P). We then need to show that this leads to a contradiction. If we assume that the axiom system that we use to derive the contradiction is consistent (this is an interesting assumption, see Gödel's theorems (page 202)) then we can only conclude that our original assumption (not P) is false, and the proposition P is true (Figure 6.16).

Figure 6.16 A model of proof by contradiction.



One of the most elegant examples of this method was the proof by Euclid that there are infinitely many prime numbers (i.e. there is not a largest prime number). The proof relies on his fundamental theorem of arithmetic. This states that every number can be expressed uniquely as a product of prime numbers.

Armed with this, we can attack our target. But remember, proof by contradiction is based on an *indirect* method of attack. We assume the contrary of what we want to prove, thus here we assume that there is a finite number prime numbers, say n of them: $p_1, p_2, \ldots, p_n$ where p_n is the largest prime number.

Now, let's form the product of all of these prime numbers and add 1:

$$q = p_1 p_2 \ldots p_n + 1$$

There are just two possibilities: either q is prime or q is not prime. If q is prime, then it contradicts the assumption that p_n is the largest prime because clearly q is greater than p_n.

If q is not prime, then by the fundamental theorem of arithmetic, q has prime factors. So we must ask ourselves what they are. We can see that they cannot be any of our list of primes $p_1 p_2 \dots p_n$ because when we divide q by any of these we get a remainder of 1 (by the definition of q). (Remember that when a division by p yields a remainder it means that p is not a factor.) So this means that the prime factors of q are not in the list. But this contradicts the original assumption that the original list of prime numbers is complete.

Either way we end up with a contradiction. Hence the original assumption must be false. Therefore, there are infinitely many prime numbers.

Later, we shall see that there are a number of deep problems associated with the idea of proof in mathematics. For now, let us look at another important method used by mathematicians, modelling.

Prescribed essay title 3: When mathematicians, historians and scientists say that they have explained something, are they using the word *explain* in the same way?

Knowledge framework: *Methodology* – What role do models play in this area of knowledge?

Models

We have already discussed an example of a mathematical model on pages 177–178. There we used a mathematical model to describe a physical situation – the motion of a stone dropped down a well shaft. The mathematical model was a simplified map of the situation constructed using algebraic equations to represent the position and velocity of the stone. The basic idea of representing a situation in some ideal way is central to mathematics. It is not only used in connection with modelling situations drawn from the outside world – mathematicians often use one type of mathematical object to represent a mathematical situation of another type.

The following example will illustrate the method. It is a famous mathematical puzzle. Try to solve it yourself before you look at the mathematics of the situation.

The wolf, goat, cabbage problem

A ferryman has to ferry a wolf, a goat, and a cabbage across a river. (As always in these problems, we do not know why he would want to do this.) Unfortunately, the boat will only hold the ferryman and one other life-form (wolf, goat, or cabbage) per trip. Clearly the ferryman will have to make a number of journeys. Also there is a problem. If left unsupervised, the wolf would eat the goat, or the goat would eat the cabbage. The wolf, however, is not at all interested in the cabbage. What strategy should the ferryman use to ferry the life-forms across the river? Try to solve the problem yourself before reading on.

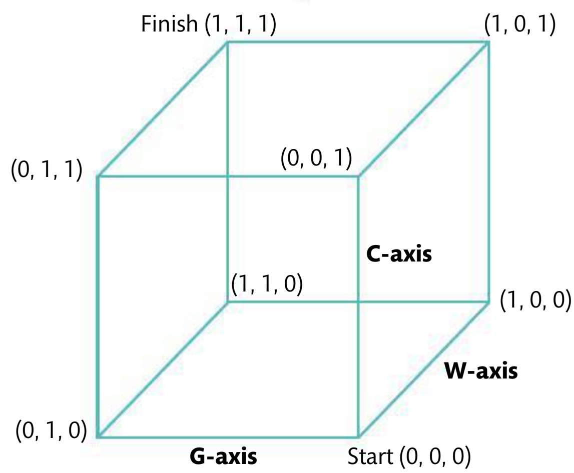
The problem is a logical one. It fits the idea of a game defined by a set of rules, an opening position, and a final winning position. One way to solve it would be to look at the permitted moves and find a combination of these that leads to the required conclusion. But the problem here is knowing what strategy would lead to the required conclusion.

- What method did you use to solve the problem?
- Did you use trial and error to find the solution?

Mathematicians have a number of strategies for dealing with problems like this. One method is to transform the problem into one we can picture – a geometrical problem. Then we can use our geometrical intuitions to solve it. But this problem does not seem to be at all geometrical. This is where imagination and creativity play a big role in mathematics. The trick here is to represent the situation of the position of the wolf, goat and cabbage as being a single point in three-dimensional space. We sometimes call a notional space like this a **phase space**.

We can use a series three numbers to represent the positions of the wolf, goat, and cabbage (in that order). If the number (coordinate) corresponding to a particular life-form is 0, then it means that this life-form is on the near bank of the river. If 1, then the life-form is on the far bank.

Figure 6.17 Geometrical representation of the wolf, goat, cabbage problem.



So (1, 1, 0) represents the situation in which the wolf and the goat are on the far bank and the cabbage is on the near bank; while (0, 1, 0) represents the situation in which the wolf and cabbage are on the near bank, and the goat is on the far bank.

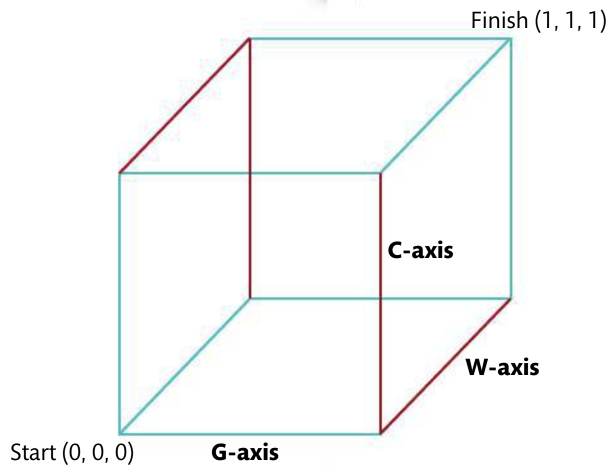
So the set of all combinations of the life-forms forms the vertices of a cube in 3-dimensional space (Figure 6.17).

We can only move one life-form at a time, and available moves are along the edges of the cube. So, the original problem reduces to a geometrical one about getting from the start where each life-form is on the near bank (0, 0, 0) to the finish when they all end up on the far bank (1, 1, 1).

But there is a complication: certain combinations are not permitted. We cannot leave the wolf and the goat unattended on the same bank while we transport the cabbage, and we cannot leave the goat and the cabbage unattended while we transport the wolf.

These conditions translate into illegal moves between (0, 0, 0) and (0, 0, 1), or (1, 1, 0) and (1, 1, 1), when the wolf and goat are unattended. Similarly, there are illegal moves between (0, 0, 0) and (1, 0, 0), or (0, 1, 1) and (1, 1, 1), when the goat and cabbage are unattended. In geometrical terms, these prohibited moves correspond to four edges of the cube that are ruled out of play – these are coloured red in Figure 6.18.

Figure 6.18 Constraints of the problem translated into geometrical conditions.



The standard solution of the problem is now clear and is indicated by the green line (Figure 6.19, overleaf).

However, what is interesting about the geometrical representation is that it indicates a second solution (Figure 6.20, overleaf).

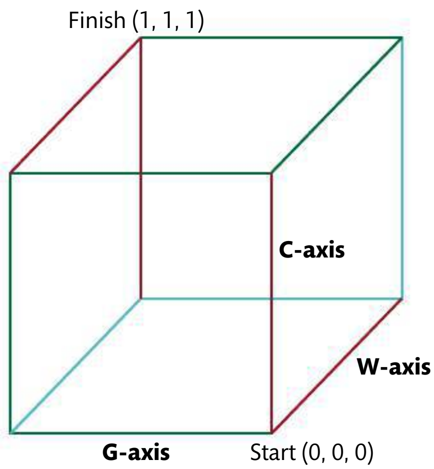


Figure 6.19 The solution is indicated by the green line.

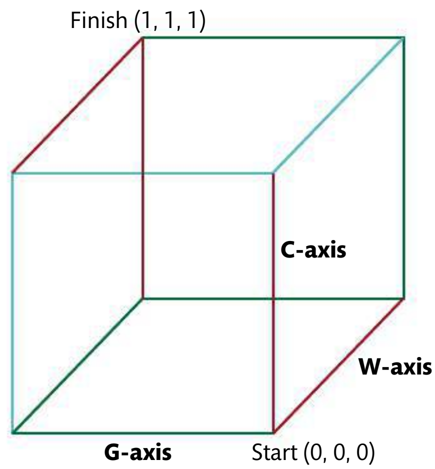


Figure 6.20 A second solution is indicated by the new green line.

As you can see from this example, the modelling process seems to follow the following steps.

1 Representation of the problem in some abstract space.
2 Solve the problem using methods appropriate to that space.
3 Translate the answer back to the original situation.

This process is exactly the same as that used for making models in the natural and human sciences (Chapter 4, pages 121–122; Chapter 5, page 158). But it is also very similar to the process of making a map, which is the basic metaphor for knowledge in this book and in the TOK subject guide.

6.5 Historical development

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

A constructivist view of mathematics

The history of mathematics is important if we are to think of it as a human invention: an elaborate game invented and played by human beings. This is commonly known as a **constructivist view** of mathematics. We have acknowledged this raises a serious knowledge question: if mathematics is purely an invention of human beings why is it so useful in describing the (non-human) world? Why is mathematics important when it comes to building bridges and constructing buildings, doing physics, doing chemistry, even doing economics?

In this view, mathematics is what might be called a **social fact**. This is a term coined by, among others, the philosopher John Searle (1932–) in his book *The Construction of Social Reality*. In it, he argues that there are many facts in our lives that are true because society stipulates them to be so. He uses money as his central example. Money is money because we believe it is money. It has value because of a whole set of social agreements to use it as such. As soon as these agreements break down, money loses its value. This idea is explored further in Chapter 8, but for now it is important to note that social facts are no less real or definite than those about the natural world. Marriage is another example of a social fact. It is clear that the statement *John is married* is definitely either true or false.

Reuben Hersh (1927–).

Hersh and the humanist view

The American mathematician Reuben Hersh argues for a type of constructivism that he calls **humanist mathematics**. He regards numbers (and any other mathematical objects) as constructed social facts. Here he is defending this view on the *Edge* website:

> “[Mathematics] … is neither physical nor mental, it's social. It's part of culture, it's part of history, it's like law, like religion, like money, like all those very real things, which are real only as part of collective human consciousness. Being part of society and culture, it's both internal and external: internal to society and culture as a whole, external to the individual, who has to learn it from books and in school. That's what math is.”

This view suggests a strong link between the shared and personal aspects of mathematics that will be explored later.

Hersh called his theory of mathematics humanism because it's saying that mathematics is something human. There's no mathematics without people. On the same website, he says:

> “Many people think that ellipses and numbers and so on are there whether or not any people know about them; I think that's a confusion.”

Hersh admits that we do use numbers to describe physical reality and that this seems to contradict the idea that numbers are a social construction. But then he argues that we use numbers in two distinct ways: as nouns and as adjectives. When we say nine apples, nine is an adjective.

> “If it's an objective fact that there are nine apples on the table, that's just as objective as the fact that the apples are red, or that they're ripe or anything else about them, that's a fact.”

The problem occurs when we make a subconscious switch to nine as an abstract noun in the sort of problems we deal with in mathematics class. Hersh thinks that this is not really the same nine. They are connected, but the number nine is an abstract object as part of a number system. It is a result of our maths game – our deduction from axioms. It is a human creation.

Hersh sees a political and pedagogical dimension to his thinking about mathematics. He thinks that a humanistic vision of mathematics chimes in with more progressive politics. How can politics enter mathematics? As soon as we think of mathematics as a social construction, then the exact arrangements by which this comes about – the institutions that build and maintain it – become important. These arrangements are political. Particularly interesting for us here is how changes in mathematics teaching and learning could be suggested by the approach taken by Hersh.

“Let me state three possible philosophical attitudes towards mathematics. Platonism says mathematics is about some abstract entities, which are independent of humanity. Formalism says mathematics is nothing but calculations. There is no meaning to it at all. You just come out with the right answer by following the rules. Humanism sees mathematics as part of human culture and human history. It's hard to come to rigorous conclusions about this kind of thing, but I feel it's almost obvious that Platonism and Formalism are anti-educational, and interfere with understanding, and Humanism at least doesn't hurt and could be beneficial. Formalism is connected with rote, the traditional method, which is still common in many parts of the world. Here's an algorithm; practice it for a while; now here's another one. That's certainly what makes a lot of people hate mathematics. (I don't mean that mathematicians who are formalists advocate teaching by rote. But the formalist conception of mathematics fits naturally with the rote method of instruction.) There are various kinds of Platonists. Some are good teachers, some are bad. But the Platonist idea, that, as my friend Phil Davis puts it, Pi is in the sky, helps to make mathematics intimidating and remote. It can be an excuse for a pupil's failure to learn, or for a teacher's saying 'some people just don't get it'. The humanistic philosophy brings mathematics down to earth, makes it accessible psychologically, and increases the likelihood that someone can learn it, because it's just one of the things that people do.”

There is a possibility that the arguments explored in this section might cast light on an aspect of mathematics learning which has seemed puzzling – why it is that mathematical ability is seen to be closely correlated with a certain type of intelligence? Moreover, it seems to polarize society into two distinct groups: those who can do it and those who cannot. Those who cannot, often feel either the stigma of failure or that there is an exclusive club whose membership they have been denied. On the other hand, those who can do it often find themselves labelled as 'nerds' or as people who are, in some serious sense, socially deficient. Whether this is something that should be attributed to a formalist or Platonic view is another question. If mathematics is out there to be discovered, it does seem reasonable to imagine that the particular individual who does not make the discovery might experience a sense of failure. The interesting question in this case is what consequences in the classroom would follow from a humanist view of mathematics.

Exercises

17 Is Hersh right in attributing the polarization of society into maths-friendly sociopaths and mathematical illiterates to a formalistic or Platonic view?

18 Is Hersh right to suggest that if maths is just a meaningless set of formal exercises, then it will not be valued in the main by society?

19 Do you think mathematics textbooks reflect the way we actually do mathematics?

To learn more about Hersh and his ideas, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 6.2.

The Platonic view

There is another view of mathematics that sidesteps the awkward question of why mathematics applies so well to the world. It is simple: mathematics is already out there in the world. It has an existence that is independent of human beings. All we do (as we do with other things in the natural world) is to discover it. Of course, mathematics has a lot to say about the world external to human beings because it is part of it.

Plato was committed to a view that mathematics existed independently of human beings. Indeed the objects of mathematics were just examples of the many perfect inhabitants of his world of Ideas. Mathematical objects such as a perfect circle or perfect triangle or the number 2 exist in this world of ideas while only inferior imperfect versions exist here on Earth. Most mathematicians have at least some sympathy with this view. They talk as though they are accountable to mathematical truths in the same way as we are accountable to physical facts about the universe. They feel that there really is a mathematical world out there and all we are trying to do is discover truths about it.

This view is itself not entirely without problems. The big knowledge question that could be asked here is, if maths is out there in the world, where is it? We do not see circles, triangles, $\sqrt{2}$, π, i, e and other mathematical objects obviously floating around in the world. We have to do a great deal of work to find them through inference and abstraction. Perhaps the first place we should look for mathematics is in the natural living world.

Mathematics in nature

Despite these problems, there are some valiant attempts to show that hidden not too far below the surface of our reality we can find mathematics.

Prime numbers

We saw earlier that there were an infinite number of prime numbers and that they were, in some sense, the building blocks of the whole number system. The Platonist might want to try to find them somewhere in nature.

One place where the Platonist might start is in Tennessee. In the summer of 2011, the forests were alive with a cicada that exploits a property of prime numbers for its own survival. These cicadas have a curious life cycle. They stay in the ground for 13 years. Then they emerge and enjoy a relatively brief period courting and mating before laying eggs in the ground and dying. The bizarre cycle is then repeated. There is another batch of cicada that has the same cycle and no less than 12 that have a cycle of 17 years. There are, however, none that have cycles of 12, 14, 15, 16 or 18 years.

This is a somewhat puzzling situation.We need to find some explanation for this strange cycle.

A Tennessee cicada.

The cicadas are preyed on by birds, so let's consider the position of the predators. For obvious reasons, predators might be expected to have somewhat similar life cycles to their prey. But that is unlikely with the insect prey having such long life cycles. If the birds had, say, a two-year cycle, then the huge number of birds that would result from the flock gorging of the wave of cicadas at year 0 would starve at year 2 because the cicada wave did not make a second appearance. The birds would die and there would be no repeating pattern of population waves. The birds could only be waiting in huge flocks for the insects to appear if their life cycle were a multiple of that of the cicada. But 13 and 17 are prime numbers – divisible only by themselves and 1. This is what guarantees there being no resonance between the predator and the prey.

Fibonacci sequence

Some theorists such as Nicholaas Rupke (2009) suggest that the mathematical forms permitted by the basic material of living things limit the sort of structures that might be available for natural selection. Therefore, the emphasis might not be on the actual mechanisms of heredity so much as on what mathematics allows to be available to the organism. This leads to a reappraisal of Darwin's ideas about evolution.

For example, many spirals in nature are formed from the sequence:

1, 1, 2, 3, 5, 8, 13, 21, 34, … (Figure 6.21)

This is called the Fibonacci sequence after the Italian mathematician Leonardo Pisano Bigolio (1170–1250), known as Fibonacci.

Many plants have leaves that are arranged according to Fibonacci sequences.

The ratios of successive Fibonacci numbers approximate to the so-called golden ratio. This is represented by φ (Greek letter *phi*) and is equal to 0.61803398875… (Table 6.1).

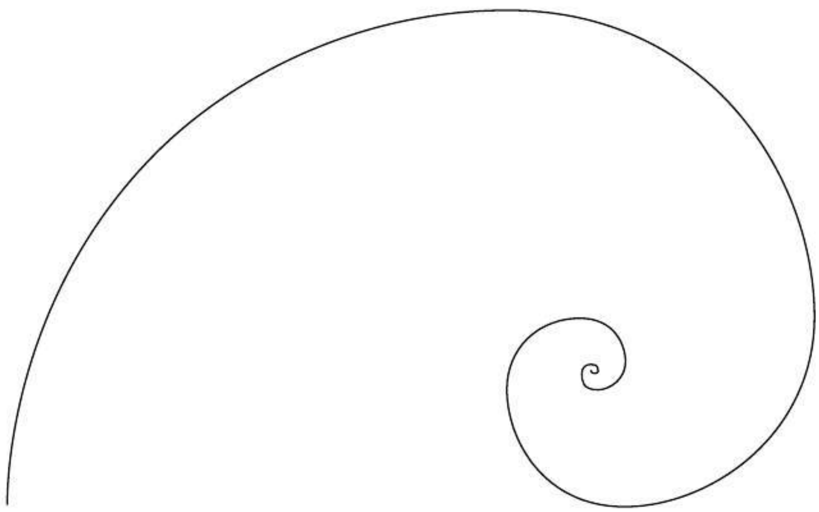


Figure 6.21 A spiral formed according to Fibonacci sequence.

Fibonacci numbers	Ratio of Fibonacci number to succeeding number
1	$\frac{1}{1} = 1$
1	$\frac{1}{2} = 0.500$
2	$\frac{2}{3} = 0.666$
3	$\frac{3}{5} = 0.600$
5	$\frac{5}{8} = 0.625$
8	$\frac{8}{13} = 0.615$
13	$\frac{13}{21} = 0.619$
21	$\frac{21}{34} = 0.6176$
34	$\frac{34}{55} = 0.61818$
55	$\frac{55}{89} = 0.61797$
89	$\frac{89}{144} = 0.61805$
144	$\frac{144}{233} = 0.61802$
233	

Table 6.1 Ratios of Fibonacci numbers.

The beautiful Romanesco cauliflower is formed on Fibonacci spirals.

This number also crops up a lot in discussions about mathematics in art and music.

There is an alternative formulation of these ideas which is arrived at by dividing each number in the Fibonacci sequence by the number *preceding* it instead of the number succeeding it. In this case, φ is equal to 1.61803398875…

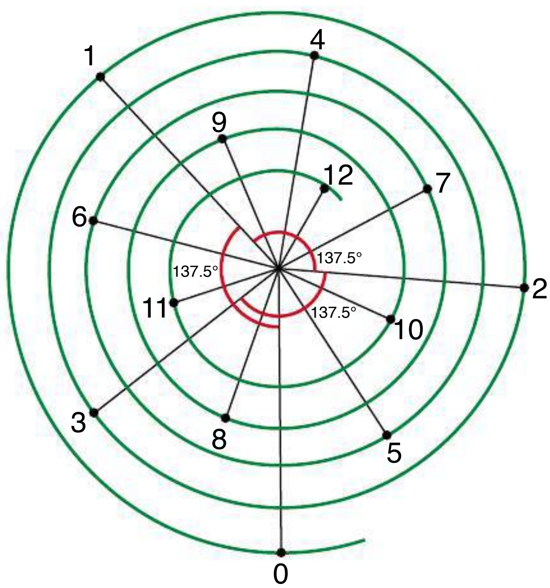
We can observe that plants grow new leaves at a constant angle to the previous leaf – this is called the divergence angle and is usually close to 137.5° (Figure 6.22). Why is this? It is an arrangement of the leaves in which lower leaves are not in the shadow of higher ones.

What is interesting mathematically is that the full circle around a stem is 360°; and 360 divided by φ (when φ is equal to 1.618) is 222.5; 360° – 222.5° = 137.5°, which is the angle of divergence we observe.

There are many other examples of Fibonacci sequences in nature and examples of the significance of φ.

The golden ratio φ is the most irrational number there is – that is, it is the number least able to be approximated by a fraction.

Figure 6.22 A diagram showing how mathematics enables plants to grow so that lower leaves are not in the shadow of upper leaves.



CHALLENGE YOURSELF

Use an internet resource to find out all you can about Gödel's Incompleteness Theorems. In the first theorem, Gödel showed that we could not prove that mathematics is complete and consistent. The second theorem is even more worrying: that any system that is rich enough to prove its own consistency is inconsistent!

1 What is meant by a formal system being consistent?
2 What is meant by a formal system being complete?
3 What implication does Gödel's first theorem have regarding the method of proof by contradiction?
4 In what way might Gödel's theorems undermine mathematics' claim to absolute certainty?
5 Why are contradictions in an AOK problematic? The following story might help in the answer:

   One day Bertrand Russell was teaching a student this and pointing out that 2 = 3 is such a contradiction. The student then challenged Russell, 'Since you can prove anything from a contradiction, can you prove that if 2 = 3 then you are the Archbishop of Canterbury?' Quick as a flash Russell is supposed to have answered, 'If 2 = 3 then subtract one from both sides so we have 1 = 2. Consider the set of me and the Archbishop of Canterbury. This set has 2 members. Since 2 = 1, it has one member. Which means the Archbishop of Canterbury and I are the same person.'

Exercise

20 Discover whether you are a constructivist or a Platonist.

Consider the decimal expansion of π = 3.141592653589793... The decimal goes on forever without terminating or repeating.

Now think about these two questions:

a Is there a point in this number where there is a sequence of digits that matches your telephone number?

b Is there a definite answer to (a)?

We are led to believe that most questions of fact have a definite answer one way or another. If your telephone number is 31 41 59 26 then the answer is definite – *my telephone number is in the decimal expansion of* π. This would also be true if you found it embedded at, say, the millionth decimal place. But what if you can't find it (which is much more likely)? Is there still a definite answer?

If you are a Platonist, you believe that there is a definite answer – mathematics is out there – it is just that we cannot find it.

If you are a constructivist, you think there is no definite answer. Things that have not yet been constructed do not have some sort of mysterious independent existence.

The history of mathematics has demonstrated that since proof is central to mathematical truth, the (proved) failure to be able to prove its own consistency is a huge setback. Thinking of mathematics historically has emphasized its human origins. At the same time the ubiquity of mathematics in nature and it sheer usefulness in tackling problems in the world outside mathematics suggest that it is more than just a fun game played by human beings for their own entertainment.

6.6 Links to personal and shared knowledge

Knowledge framework: *Links to personal knowledge* – Why is this area significant to the individual?

Knowledge framework: *Links to personal knowledge* – What is the nature of the contribution of individuals to this area?

In this section, we examine how mathematics impinges on our personal thinking about the world and also examine how people with particular qualities are well placed to make important contributions to mathematics. Perhaps surprisingly, one of the aspects of personal knowledge with the strongest link to mathematics is the aesthetic.

There seems to be a two-way connection between mathematics and beauty. The first is the long held view that we find certain things beautiful because of their special proportions or some other intrinsic mathematical feature. This is the thinking that has inspired architects since the times of ancient Egypt and generations of painters, sculptors, musicians, and writers. To paraphrase Keats, truth is beautiful. Things are beautiful because of specific objective relations between their parts as demonstrated by certain mathematical truths. As we shall see when discussing the arts in Chapter 8, this is a view held by the thinkers of the aesthetic movement in the 19th century and many others.

But Keats also put it the other way round: the beautiful is true. Could we allow ourselves to be guided to truth in mathematics because of the beauty of the equations? This is a position taken by, surprisingly, many mathematicians. They look for beauty and elegance as an indicator of truth.

Let's explore both approaches.

Mathematics in beauty

The ancient Greeks were well aware that underlying the world was a coherent structure. If something was beautiful there was a good reason for it. By around the late 4th century BCE, it was well established that the reasons underlying the nature of most things in the world were mathematical. Beauty was not an exception.

We have already mentioned the number φ, *phi* the golden ratio or golden section. We have seen how this is the limit of the ratio of the terms in the Fibonacci sequence. The Greeks were interested in this number for other reasons. Euclid divided a line segment AB of length 1 by placing a point X in such a way as to make the ratio of the shorter piece to the longer piece the same as the ratio of the longer piece to the whole line (Figure 6.23).

Figure 6.23 Beautiful linear proportions

In other words:

$$XB/AX = AX/AB$$

If AB = 1 (as defined above), and we write AX = x, then

$$\frac{(1-x)}{x} = \frac{x}{1}$$

Rearranging:

$$1 - x = x^2$$

Which gives a quadratic equation:

$$x^2 + x - 1 = 0$$

Solving the equation using the quadratic formula gives:

$$x = \frac{-1+\sqrt{5}}{2} = 0.61803398875\ldots = \varphi$$

or

$$x = \frac{-1+\sqrt{5}}{2} = -1.61803398875 = -\varphi - 1$$

So the golden ratio turns up here as well.

The original question was one of proportional symmetry so we might not be surprised to learn that the Greeks thought we would find this proportion naturally beautiful. Rectangles in which the ratio of the shorter side to the longer side was equal to the golden ratio were thought to be especially beautiful. Try this out yourself in the rectangle beauty contest (Figure 6.24, overleaf).

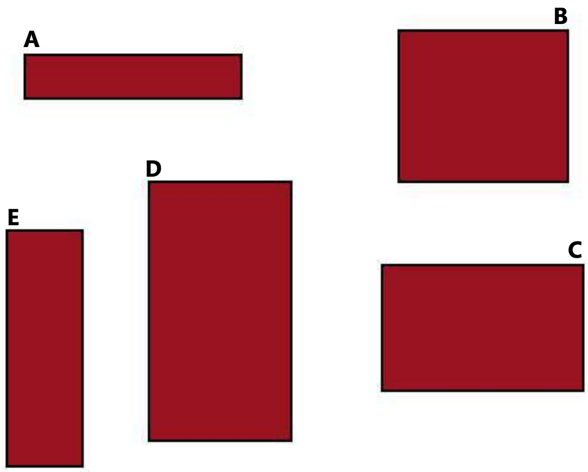


Figure 6.24 Rectangle preferences: Which rectangle do you find most pleasing?

A4 paper has dimensions of 210 mm × 297 mm. The ration of the sides is given by 210/297 = 0.707, which is a little high for the golden ratio. A4 paper is a little too wide to be a golden rectangle. Measure some rectangles in your school or home environment. How close are they to golden rectangles?

These ratios were exploited by the Greeks in their designs for temples and other buildings. The Parthenon in Athens is constructed using the golden section at key points (Figure 6.25).

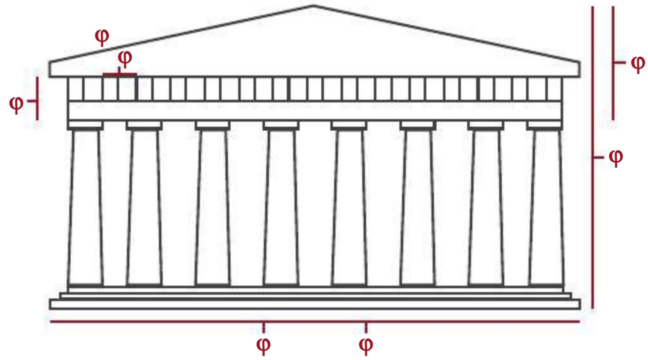
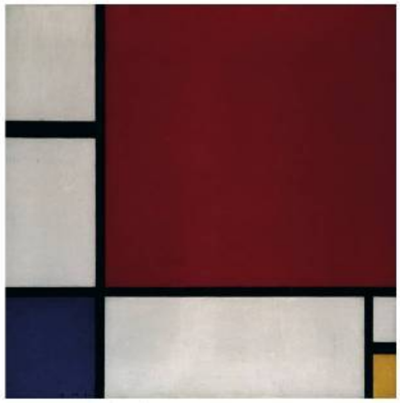


Figure 6.25 How the golden ratio is used in the Parthenon.

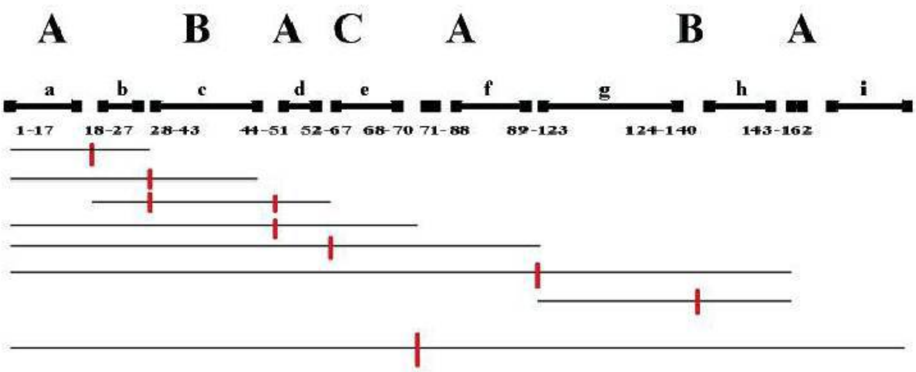
But it is not only in nature and architecture that we can find the golden ratio. It is widely used by painters and composers – and has been since the time of Euclid. The Dutch painter Piet Mondrian uses it quite self-consciously in his work.

We find the ratio also in the work of the French composer Claude Debussy. In his orchestral piece *La Mer,* the 55-bar introduction to *'Dialogue du vent et la mer'* breaks down into five sections of 21, 8, 8, 5, and 13 bars which are all Fibonacci numbers. The golden ratio point at bar 34 is signalled by the entry of trombones and percussion.

There are similar occurrences in the work of Mozart and Chopin.



Composition in red, yellow and blue (1926) by Piet Mondrian.



Golden sections in Mozart Piano sonata in B♭ K.281.

More generally, we can ask ourselves how many pieces of music (or films, plays, or dance performances) have some sort of structurally significant event occurring roughly two-thirds of the way through the piece.

But the golden section is not the only way in which mathematics makes itself known in the arts. A recent discovery has shown that the original papyrus copies of Plato's *Republic* give indications that Plato structured his great work according to very definite harmonic relationships (again to do with proportions). Mathematics not only formed the basis of his world view, it also structured his exposition of it.

It comes as something of a surprise to most people to realize how much mathematics goes into constructing a piece of modern classical music. Since the second Viennese school of Schoenberg, Berg, and Webern at the beginning of the 20th century, composers have used, among other things, variations of serialism. This is a technique that applies mathematical transformations to rows of notes. These transformations form mathematical structures we have met before – groups (Table 6.2).

P = prime = leave sequence as it is

R = retrograde = play sequence backwards

I = inversion = play sequence upside-down (ascending intervals are replaced by descending ones and *vice versa*)

RI = retrograde inversion = play sequence backwards and upside-down

	P	R	I	RI
P	P	R	I	RI
R	R	P	RI	I
I	I	RI	P	R
RI	RI	I	R	P

Table 6.2 A group table of the four types of serial transformation.

This view of mathematics would suggest that beauty is not so much in the eye of the beholder but that it is in the mathematics.

Beauty in mathematics

Einstein suggested that the most incomprehensible thing about the universe was that it was comprehensible. From a TOK point of view, the most incomprehensible thing about the universe is that it is comprehensible in the language of mathematics. In 1623, Galileo wrote:

> “Philosophy is written in this grand book, the universe … It is written in the language of mathematics, and its characters are triangles, circles and other geometric figures …”

Perhaps what is more puzzling is not just that we can describe the universe in mathematical terms – but that the mathematics we need to do this is mostly simple, elegant, and even beautiful.

To illustrate this, let's look at some of the famous equations of physics. Most people will be familiar with some of the following equations:

Relation between force and acceleration: $F = ma$ (more generally, $F = d/dt(mv)$)

Gravitational force between two bodies: $F = Gm_1m_1/r^2$

Energy of rest mass: $E = mc^2$

Kinetic energy of a moving body: $E = ½\, mv^2$

Electrostatic force between two charges: $\mathrm{F} = kq_1q_2/r^2$

Maxwell's equations:

$$\nabla . \mathbf{E} = \frac{\rho}{\varepsilon_o}$$

$$\nabla . \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_o\,(1 + \varepsilon_o \frac{\partial \mathbf{E}}{\partial t})$$

Einstein's field equations for general relativity: $R\mu v - ½\, g\mu v = 8\pi T\mu v$

It is extraordinary that the whole crazy complex universe can be described by such simple, elegant, and even beautiful equations. It seems that our mathematics fits the universe well. It is difficult to believe that mathematics is just a mind game that we humans have invented.

But the argument from simplicity and beauty goes further. Symmetry in the underlying algebra led mathematical physicists to propose the existence of new fundamental particles, which were subsequently discovered. In some cases, beauty and elegance of the mathematical description have even been used as evidence of truth. In 1963, the physicist Paul Dirac noted:

Paul Dirac, theoretical physicist (1902–84).

> It seems that if one is working from the point of view of getting beauty in one's equations, and if one has really a sound insight, one is on a sure line of progress.

Dirac's own equation for the electron must rate as one of the most profoundly beautiful of all. Its beauty lies in the extraordinary neatness of the underlying mathematics – it all seems to fit so perfectly together:

$$\left(\beta mc^2 + \sum_{k=1}^{3} \alpha_k p_k c\right) \psi(\mathbf{x}, t) = i\hbar \frac{\partial \psi}{\partial t} (\mathbf{x}, t)$$

The physicist and mathematician Palle Jorgensen noted in 1984 that:

> [Dirac] … liked to use his equation for the electron as an example stressing that he was led to it by paying attention to the beauty of the math, more than to the physics experiments.

It was because of the structure of the mathematics, in particular that there were two symmetrical parts to the equation – one representing a negatively charged particle (the electron) and the other a similar particle but with a positive charge – that scientists were led to the discovery of the positron. It seems fair to say that the mathematics did really come first here.

We shall leave the last word on this subject to Dirac himself, writing in *Scientific American* in 1963:

> I think there is a moral to this story, namely that it is more important to have beauty in one's equations than to have them fit experiment.

By any standards this is an extraordinary statement for a mathematical physicist to make.

Exercises

21 What equations in your science courses do you find beautiful?

22 What is it about them that is beautiful to you?

23 Do you ever let the beauty (or perhaps the opposite) of an equation influence you when solving a mathematical problem?

Knowledge framework: *Links to personal knowledge* – What are the implications of this area of knowledge for one's own individual perspective?

Knowledge framework: *Links to personal knowledge* – What assumptions underlie the individual's own approach to this knowledge?

Mathematics and personal intuitions

We suggested earlier that there is a two-way street between the area of shared knowledge in mathematics and our personal knowledge. In this section, we shall examine a situation that suggests that our intuitions can let us down badly when it comes to making judgements of probability. From a personal point of view we might have to correct our intuitions in the light of shared mathematical knowledge.

Mathematical intuition: The Monty Hall game

This scenario refers to a TV game show. A contestant in the show is shown three closed doors and is told (truthfully) by the game show host Monty Hall that behind one of the doors is a luxury sports car, and behind the other two doors are goats. The contestant is told he or she must pick a door and will then be allowed to take home whatever is behind the door. We assume that the contestant would prefer to win the car. When the contestant has picked a door, Monty Hall opens another door to reveal a goat (Monty Hall always chooses a door concealing a goat – he knows the location of the car). He then asks the competitor whether or not he or she wants to switch their choice to the other closed door.

What does your intuition tell you? Should the contestant stick to the original choice or switch?

Take a little time to think this through. You might want to try this game with a friend (and somewhat more modest prizes) to see experimentally what the best strategy is.

Clearly, because there is one car and two goats, the probability of picking the car if the competitor does not switch doors is $\frac{1}{3}$.

But what if the competitor does switch? What then is the probability of winning the car? Consider a related question. If the switch goes ahead, under what circumstances will the competitor not get the car? Clearly, only if the original choice was right. In other words there is a $\frac{1}{3}$ probability of missing out on the car, therefore there is a $1 - \frac{1}{3} = \frac{2}{3}$ probability of winning the car. So by switching, the probability of winning the car is doubled.

Does this make sense? After this explanation, many students and teachers at workshops are still not convinced. They argue that they cannot see how asymmetry has been introduced into the situation. The crucial point is that Monty Hall knows where the car is. He always opens a door to reveal a goat. It is this act that produces the required asymmetry. We have more information after Monty Hall has revealed the goat than we had at the beginning.

Personal qualities and mathematics

Of course, the two-way street between personal knowledge and shared knowledge means that people with special talents can contribute greatly to the production of shared knowledge. This seems to be particularly true in mathematics. There are a host of great names from the past: Pythagoras, Archimedes, Euclid, Diophantus, Galileo, Newton, Leibniz, Euler, Gauss, Riemann, Laplace, Lagrange, Weierstrass, Cauchy, Hardy, David Hilbert, John von Neumann, Alain Connes, William Thurston, Andrew Wiles, and Grigori Perelman – the list is very long. Each of these has contributed in an extraordinary way to the subject.

Although mathematics is hugely collaborative in the sense that mathematicians often build on the work of others, it is nevertheless largely a solitary pursuit. It requires great depth of thought; huge, imaginative leaps; careful and sometimes laborious computations; innovative ways of solving very hard problems; and, most of all, great persistence. Mathematicians need to develop their intuition and their nose for a profitable strategy. They are guided by emotion and by hunches – they are a far cry from the stereotype of the coldly logical thinker who is closer to computer than human.

CHALLENGE YOURSELF

Research what each of the above people has contributed to mathematics.

6.7 Evaluation of mathematics

We have seen that mathematics is really one of the crowning achievements of human civilization. Its ancient art has been responsible not only for some of the most extraordinary intellectual journeys taken by humans, but its methods have allowed the building of great cities, the production of great art, and has been the language of great science.

From a TOK perspective, mathematics, with its internal criteria for truth through mathematical proof and its underlying logic and set theory, makes a good contrast to the natural sciences with their reliance on observation of the external world and their experimental method. Furthermore, these methods provide mathematics with a certainty that is unattainable in any other AOK.

Two countering arguments should be set against this view of mathematics. The idea that the axioms, the rules of the game, are arbitrary both deprives mathematics of its status as something independent of human beings and makes it vulnerable to the charge that its results cannot ever be entirely relevant to the outside world. Moreover, Gödel's theorems cast doubt on both the consistency of mathematics and its completeness and raises questions about methods that are non-constructive, such as proofs by contradiction.

Platonists would certainly argue that mathematics is there in the universe with or without humans. They would argue that it is built into the structure of the cosmos – a fact that explains why the laws of the natural sciences lend themselves so readily to mathematical expression. A possible hybrid approach is to propose that mathematics is somehow built into human reasoning. This would explain the ubiquity of mathematics in our explanations of the world. It is a mixture of both views. While conceding that mathematics is essentially a human artifact, it would it nevertheless colour the whole of human knowledge and is therefore a structural feature of *our* world.

Both views produce challenging knowledge questions. The constructivist is a victim of the success of mathematics in fields such as the natural sciences. He or she has to account for just why mathematics is so supremely good at describing the outside world to which, according to this view, it is ultimately blind. The Platonist, on the other hand, finds it hard to identify mathematical structures embedded in the world. Moreover, he or she has a hard time explaining why they are there.

We have seen how mathematics is closely integrated into artistic thinking. Perhaps because both are abstract AOKs indirectly linked to the world and not held to account through experiment and observation. Both are open to thought experiment and leaps of imagination.

We have seen how mathematics can challenge our intuitions and how it can push our cognitive resources as individual knowers. For example, infinity is not something that the human mind can fathom in its entirety. Instead, mathematics gives us the tools to deal with it in precisely this unfathomed state. We can be challenged by results that seem counter to our intuitions, but ultimately the nature of mathematical proof is that it forces us to accept them nonetheless. In turn, individuals can, through their insight and personal perspectives, make ground-breaking contributions that change the direction of mathematics forever. The history of mathematics is a history of great thinkers building on the work of previous generations in order to do ever more powerful things, using ever more sophisticated tools.

The Greek thinkers of the 4th century BCE thought that mathematics lay at the core of human knowledge. They thought that mathematics was one of the few areas in which humans could apprehend the eternal Forms only accessible to pure unembodied intellect. They thought, in essence, that in mathematics they could glimpse the very framework on which the world and its myriad processes rested. Maybe they were right.

07 History

On previous page – What caused the collapse of the Roman Empire is one of history's greatest questions. Over 200 explanations have been put forward but the debate continues to this day.

7.1 Introduction to history

What is history?

“In our final history lesson of the year, Old Joe Hunt, who had guided his lethargic pupils through Tudors and Stuarts, Victorians and Edwardians, the Rise of Empire and its Subsequent Decline, invited us to look back over all those centuries and attempt to draw conclusions.

‘We could start, perhaps, with the seemingly simple question, What is History? Any thoughts, Webster?’

‘History is the lies of the victors’, I replied, a little too quickly.

‘Yes, I was rather afraid you'd say that. Well, as long as you remember that it is also the self-delusions of the defeated. Simpson?’

‘History is a raw onion sandwich, sir.’

‘For what reason?’

‘It just repeats, sir. It burps. We've seen it again and again this year. Same old story, same old oscillation between tyranny and rebellion, war and peace, prosperity and impoverishment.

‘Rather a lot for a sandwich to contain, wouldn't you say?’

We laughed far more than was required, with an end of term hysteria.

‘Finn?’

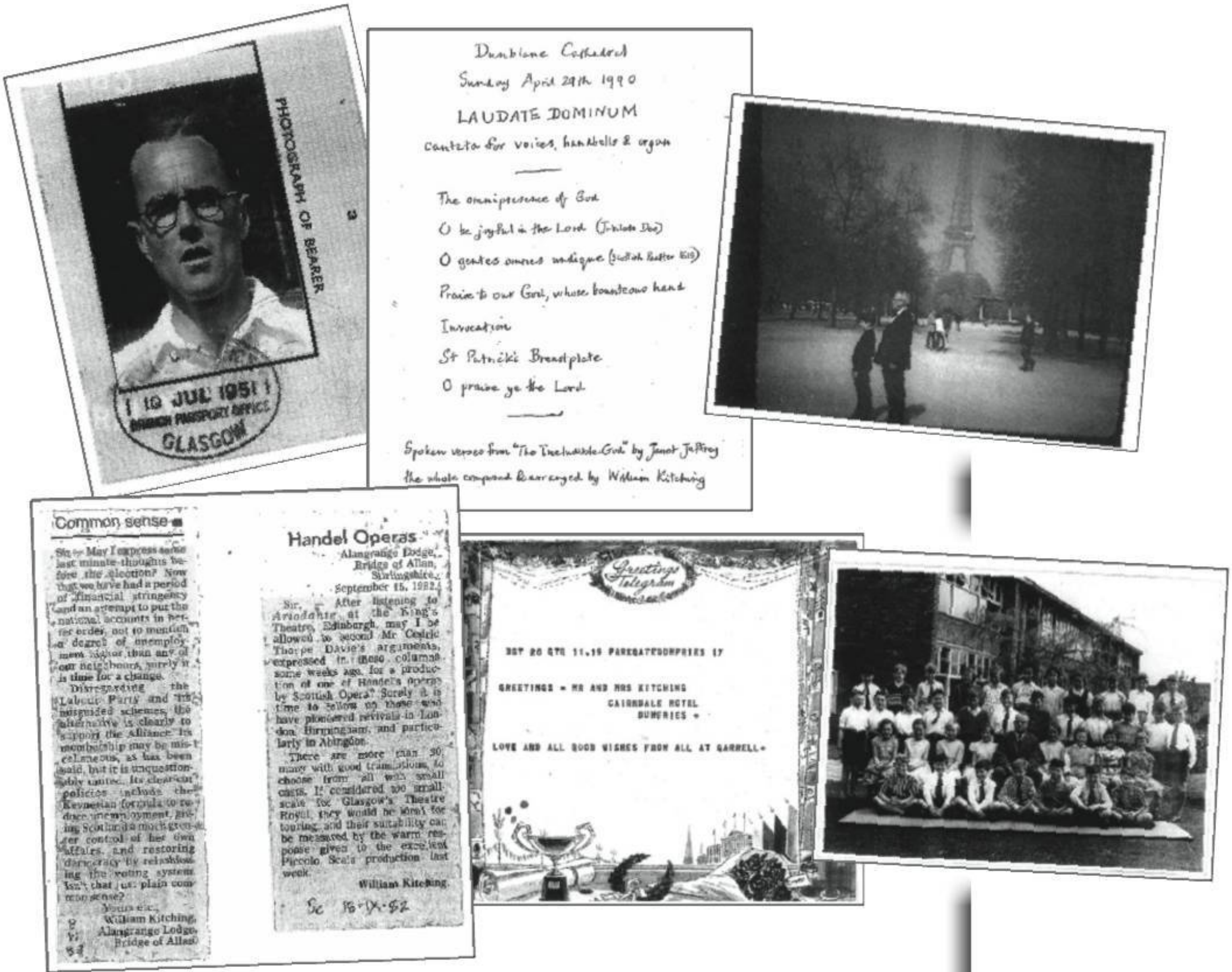
‘History is that certainty produced at the point where the imperfections of memory meet the inadequacies of documentation.’

‘Is it indeed?’”

Barnes, 2011

William Walrond Kitching, the father of one of the authors of this book, was born in 1912. What can you make of his life from the documents and illustrations opposite.

Perhaps the simplest response is to try to place the set of events in sequence. William W Kitching was born in 1912. He was issued a British passport in 1951. He seems to have worked as a teacher sometime after that (looks older). He was in Paris – when? He wrote letters to newspapers in the early 1980s. He composed (and performed?) some music in 1990.



Documents and illustrations relating to William Walrond Kitching.

This might be a good way to start piecing together his life, but it would be a struggle to write a biography of the man on this basis. Moreover, it would be a very dull book: this happened and then that happened and then another thing, and so on. We have only isolated events that have been recorded and preserved, huge gaps between them, and even the events that are documented do not have clear connections. As elsewhere, our knowledge needs to be structured and given shape – and, while useful, the simple ordering of chronology is not going to be sufficient for the job. This process will depend on what else we might be able to find out about the subject, and also on whatever broader knowledge we already possess to set our few items of data in context.

- ***What is missing?*** Many facts and events concerning the subject, and about the surrounding context.
- ***Why is it missing?*** Many facts and events are never recorded, some are lost, some are considered unimportant.

Exercise

1 Which of the following additional pieces of information would be most helpful in fleshing out the biography of William W Kitching? Why?

- **a** Mr Kitching was born in Rugby, England.
- **b** The Social Democratic Party was a political organization in the UK – founded in the early 1980s that formed an electoral alliance with the Liberal Party and merged with it a few years later to form the Liberal Democrats.
- **c** Mrs Kathleen Kitching was head of a music department in a secondary school.
- **d** Mr Kitching was a keen gardener, and gardening is a very popular pastime in the UK.
- **e** The present organ in Dunblane Cathedral was built by Flentrop of Zaandam in the Netherlands in 1990, and installed in April of that year.
- **f** Mr Kitching had a keen interest in 19th-century French music.
- **g** Mr Kitching first studied classics at Cambridge University, but then switched to music.
- **h** The tennis player Andy Murray comes from Dunblane.

While further information may well be helpful, no selection of facts is likely to be enough for our biographical task. At some point, we need to start filling in what isn't there, making inferences from what we have, and linking things together in ways that make sense on the basis of our own knowledge and experience. You have probably already done some of this – Mr Kitching played a role in the classical music community in Scotland, needed correction to his vision, probably taught either music or Latin in at least one school, held progressive or regressive economic and political views (depending on your perspective in these matters), and so on. And the outcome of this reasoning and connecting will be that some facts and events assume greater prominence in the picture, while others recede or even vanish from the canvas altogether.

Why study history?

Everything you have just read is geared to acquiring knowledge about the life of one person. While the generation of knowledge for its own sake might be a noble activity, we probably need to ask what purposes such a biography might fulfil. These could include the following.

- The person is famous and has a high profile – we are interested in knowing more because of that very fame, or we would like to know what effect this fame has wrought on the person.
- The person has made some major impact on society (positive or negative) that has touched many people in some way.
- The person is typical of members of a community, and studying the life of that person brings us insights at a broader social level about that community or some activity in which they are engaged – in which case we might look at someone representative rather than well-known.

Exercise

2 The Scottish historian and philosopher Thomas Carlyle once wrote: ***the history of the world is but the biography of great men***.

- **a** Do you think he was right?
- **b** What might be the dangers of taking this approach?
- **c** What are the alternatives?
- **d** To what extent are the processes, problems, and solutions involved in biography transferable to the research and writing of history?

7.2 Scope and applications

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

Scope of history

Consider the timelines in Figure 7.1.

Figure 7.1 Two versions of the same period.

Timeline A

- 7 October 1949: founding of DDR
- 17 June 1953: workers' uprising
- 13 August 1961: creation of Berlin Wall
- 9 November 1989: breaching of Berlin Wall
- 3 October 1990: end of DDR

Timeline B

- 7 October 1949: founding of DDR
- 17 June 1953: workers' uprising
- 14 May 1955: DDR joins Warsaw Pact
- 13 August 1961: creation of Berlin Wall
- 3 May 1971: Erich Honecker becomes leader
- 18 September 1973: DDR joins UN
- 1976–1979: "Coffee crisis"
- September 1987: Honecker visit to West
- 9 November 1989: breaching of Berlin Wall
- 3 October 1990: end of DDR

As with our previous biographical example, a simple and sparse chronology, such as timeline A, affords us a very limited window into the past. It is a useful contribution to knowledge, but much too simple. Even the more elaborate version in timeline B gives us little insight until we bring to bear what we already know. The Deutsche Demokratische Republik (DDR, colloquially East Germany, or more correctly GDR in English) was born from the Soviet occupation zone of Germany after World War II, and existed for just over 40 years until the collapse of European communism and the reunification of Germany that followed. These facts belong to common knowledge, and are the most rudimentary backdrop to the work of historians whom we expect to bring less well-known material and insightful interpretation to our attention.

But during the Cold War, historians and journalists researching the GDR and the Soviet bloc more generally had to contend with a dearth of source material as a result of the tight grip on information that was characteristic of these regimes. Accordingly, accounts of the development and state of the GDR from its formation through to the 1980s tended to be built on rather narrow foundations of personal experience and official statistics. For example, in 1987 the British journalist John Ardagh wrote:

> “... the vast majority [of East German citizens] have now come to terms with their destiny: they find that life under socialism is perfectly liveable and even has some advantages ...
>
> One undoubted achievement of the GDR, dating from the 1960s, has been its economic progress. Capitalist West Germany is of course far wealthier: but the more valuable comparisons are to be made with the East. The GDR is economically and industrially much the strongest country in the Soviet bloc [...] and by as early as 1970 it had become the world’s tenth leading industrial power. This can be attributed above all to the innate German qualities of efficiency, thoroughness, technical flair and so on.
>
> People have come to identify with the GDR and to see it as their home [...] Many people have even come to be vaguely proud of the GDR, and they resent being patronised by affluent visitors from West Germany who tell them how unfortunate they are. Such people are proud of their country’s sporting success, of its economic progress in the face of such odds, and of some cultural achievements such as the restoration of old towns. Some of them, without necessarily liking the regime, will even take some pride in the GDR as a society less violent, permissive and over-competitive than the West and one that has better preserved some of the old German values.”

Ardagh, 1988

Then, with little warning, a rapid sequence of events led to the end of the Cold War. Well within a year of the breaching of the Berlin Wall, the GDR had ceased to exist. The collapse of communist authority was accompanied by a torrent of previously classified documents – most conspicuously from the Ministry for State Security (informally known as the Stasi), which, according to the German historian Klaus-Dietmar Henke, generated a quantity of files the size of which amounted to *the equivalent of all records produced in German history since the middle ages* (Funder, 2003). The implications for historians of this massive change in circumstances, as described by Professor Mary Fulbrook in 1995, are not to be underestimated:

> “Writing a book about the GDR at this time has not been easy. I first conceived the idea for this book in the early 1980s, when – as many historians took a delight in informing me – there was too little material to do more than hypothesise. Then came an entirely unexpected reversal of the situation: with the fall of the Wall and the opening of the abundant documentation of the East German archives, there is almost too much material to do more than hypothesise.
>
> With truly Prussian zeal and efficiency, the East German communists observed, collected and collated the most extraordinary mountains of information in the interests of having total overview, total control, in a state where there was no open forum for gauging patterns of public opinion. As a result – and despite a number of

problems of interpretation – there are fascinating sediments of unexpectedly rich material for the historian to explore. It will take decades of detailed archival research before the historiography of the GDR begins to attain the well-defined contours of debate which characterise earlier periods of German history. ”

Fulbrook, 1995

As the French poet and essayist Charles Peguy once quipped, *it is impossible to write ancient history because we do not have enough sources and impossible to write modern history because we have too many*. In the case of the GDR, historians found their object of study transported from ‘ancient’ to ‘modern’ in the blink of an eye.

Erich Mielke: Stasi head 1957–89; sacks containing Stasi files.

The collapse of the GDR revealed the true extent of the grasp with which the Stasi held the whole country:

“ According to internal records, in 1988 [...] the Ministry for State Security had more than 170 000 ‘unofficial collaborators’. [...] The ministry itself had over 90 000 employees [...] Setting the total figure against the adult population in the same year, this means that about one out of fifty adult East Germans had a direct connection with the secret police. Allow one dependent per person, and you’re up to one in twenty-five. ”

Garton Ash, 1997

The tendrils of espionage threaded through workplaces and into family homes where husbands and wives, and even sometimes their children, informed on one other to the secret police and provided the content for many millions of secretly stored documents. Accounts of extra-judicial killings and incarcerations filled file after file, alongside mundane observations about everyday lives. And so as the regime disintegrated, urgent measures were taken to deal with the mountain of paper from Stasi activity:

“Stasi officers were instructed to destroy files, starting with the most incriminating [...]. They shredded the files until the shredders collapsed [...] so they had to send out agents under cover to West Berlin to buy more [...]. When the Stasi couldn't get any more machines, they started destroying the files by hand, ripping up documents and putting them into sacks. But this was done is such an orderly fashion – whole drawers of documents put in the same bag – that now [...] it is possible for the puzzle women to piece them back together.”

Funder, 2003

In 1991, the government of unified Germany decreed that everyone had the right to know if the Stasi had kept a file on them, and if so, they had the right to read it. Women (known as the puzzle women) were employed to reconstitute shredded documents, piece by piece, in a painstakingly slow task that is now being taken over by scanners and software that can match fragments on screen.

CHALLENGE YOURSELF

You may like to watch the 2006 academy award-winning film *Das Leben der Anderen (The Lives of Others)*. Set in 1980s East Berlin, the film illustrates what it was like to live in the GDR, and explores the balances and compromises that citizens needed to make in order to reconcile their lives with the demands of the regime.

Exercises

3 Bearing in mind the passages above from Garton Ash and Funder, what do you think some of the 'problems of interpretation', as mentioned by Fulbrook, might be?

4 How might historians attempt to overcome these problems?

5 What might be some of the moral dilemmas that historians face in such a situation as Fulbrook's?

This example of the GDR illustrates some basic relations between history and the past. Despite the best efforts of the Stasi, much activity went unrecorded and is consigned to the unknowable. Of those facts and events that were recorded, some were lost – such as material shredded beyond repair. But in this case, a vast quantity has been retrieved and is also now available to historians, who are of course working in the present, selecting material of interest and relevance to research, and adding their own inferences and interpretations to it (Figure 7.2).

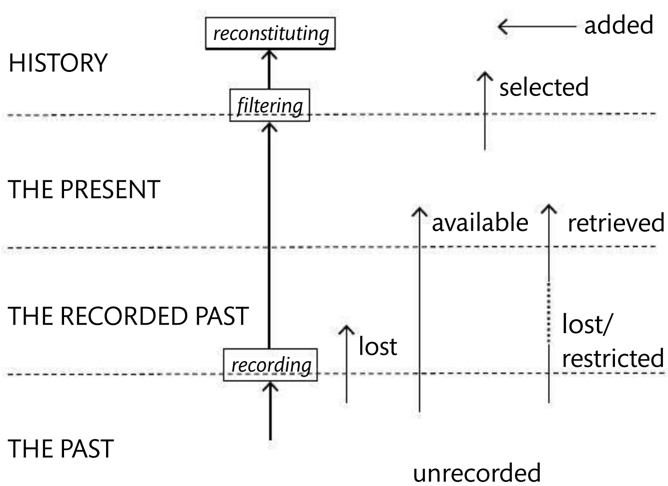


Figure 7.2 Some basic relations between the present, the past and history.

Historians are dependent on source material for their trade; without it, history fades into myth, and thence to fiction. The GDR example shows how both a dearth and a glut of source material are situations that can present serious challenges for historians: in either case, there is the further imperative of evaluating quality and reliability.

Furthermore, the example shows how historians often work in fields that are politically and morally charged – perhaps illustrating the importance of maintaining a sufficient span of time between the object of study and the study itself.

It would be easy to leave the case study of the GDR to historians with a special interest in it, but we are all living in an age in which huge amounts of data about our lives and times can be generated and stored with far less effort than was required on the part of the Stasi officers and unofficial collaborators of the 1970s and 1980s. Witness the trails of information that we produce with our mobile phones and web searches. Now we have 'Google glass', 'lifecams', and 'life-logging'. Before long, we will live in the age of what is now being referred to as the 'internet of things', with everyday devices all seamlessly networked to each other. The question of what happens to this data (now all in digital form, and therefore much easier to manipulate) touches on many moral issues, but the form of storage and the ease with which connections can be made across it will also have deep implications for the ways in which the history of the 21st century is constructed.

In English, the word *history* is often used synonymously with *the past*. For example, those no longer alive are sometimes dismissed as 'history'. The web pages you have looked for are described collectively as your search history. But the present is always wedged between history and its object of study, as Figure 7.2 tries to make clear. How might Figure 7.2 help to clarify what George Orwell meant when he said '*who controls the past controls the future; who controls the present controls the past*'?

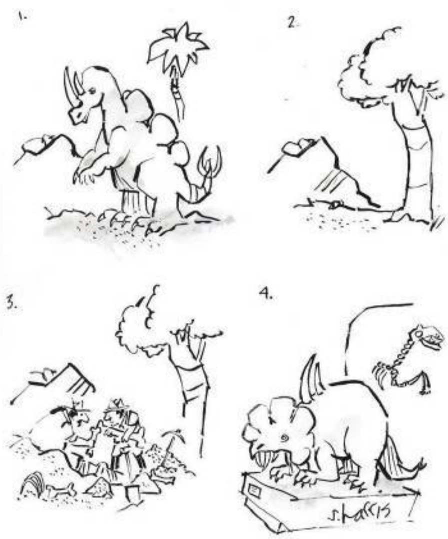
Exercises

6 What methods do you think historians might adopt in response to these changes in the form, quantity, and availability of source material?

7 Figure 7.2 can also help us to consider historical knowledge as a map – in a similar manner to that used for AOKs in preceding chapters.

Is the territory of history the past, the human past or the recorded human past? On what basis would you justify your answer?

8 Consider the answers you gave to Exercise 2 on page 98. What are the implications for disciplines such as cosmology and palaeontology?



History and pre-history.

CHALLENGE YOURSELF

- The cover of this book shows the Bibliotheca Alexandrina – built partly to commemorate the Library at Alexandria of the ancient world that was lost through fire. However, it is not certain how and when this fire consumed the building. Do a little research on this topic and compare the state of historical knowledge on it with that of the GDR. To what extent does Figure 7.2 still function well as a description of attempts to establish historical knowledge of this event?
- Given that the historian cannot know everything about the past, how far is he or she licensed to 'go beyond the facts' in producing a comprehensible account of some subject? On what does this answer depend?

The hypothesizing that Mary Fulbrook described earlier may also be affected by the nature of the target audience for whom the historian's account is directed. Compare the following two passages on Isaac Newton. Which of them do you think is 'better history' (a better map) and why? Does it matter for whom the account is written?

“Newton’s path to universal gravitation [...] began when he was a student at Trinity College, Cambridge, and he jotted down numerous remarks about gravity in his notebooks. In some, he treats gravity as if it were an impetus-like ability internal to things that caused their motion; in others, dealing with celestial motions, he considers Descartes’ explanation that gravity arose from the pressures of particles created by vortices. For a long time, he accepted the notion of a centrifugal force, one that pushed away from a body, as a swinging stone tugs on the end of a tethered string to which it is attached.

Then, about 1680, Newton’s thinking about gravitation was profoundly altered by two key events, one philosophical and the other mathematical. The philosophical event was conversion away from an impetus-like idea of force as something that impelled a body to move from within, to the view that motion is caused by a force that acts on a body from without. [...]

The other key event [...] was the correspondence with Newton’s nemesis [Robert] Hooke that began in 1679. [...] He was intrigued by Hooke’s remark that the planets travel in curved paths, not because of the combined action of centrifugal and centripetal forces acting on them, but because of the combined action of a centripetal force and the bodies’ own inertia.

This latter observation set Newton on the right track [...] It opened the door to thinking of everything – falling bodies, planets – as governed by one centre-seeking force...”

Crease, 2008

“On one particular day, the weather was so agreeable and Newton was so immersed in thought, he did not notice it was getting late. Gradually the garden around him began to glow warmly, bathed with the soft golden light only a waning summer sun could produce.

Suddenly the thud of an apple falling from a nearby three startled the young man out of his deep meditations. In the few moments it took for him to switch trains of thought, the top of a gigantic-looking full moon began to show itself above the eastern horizon.

Within minutes, young Newton’s insatiable curiosity began to nibble away at the apple and the moon. Why did apples fall straight down to the earth’s surface, rather than askance? What if the apple had started from higher up – a mile, a hundred miles, as high as the moon – would it have still fallen to the earth?

For that matter, didn’t the moon itself feel the tug of earth’s gravity? If so, would it not mean that the moon was under the sway of earthly influences, which contradicted

the common belief that the moon existed within the heavenly realm, completely aloof from our planet?

Engaged by these heretical speculations, Newton persevered into the wee hours of the night [...]

Seated beneath the steely light of the moon, Newton was engrossed in his thoughts. More than that, as crickets chirped and frogs croaked in a nearby pond, the young man began to jot down certain ideas and calculations that would one day lead him to formulate his extraordinary equation of universal gravitation...”

Guillen, 1999

We have seen how work in history extends far beyond the simple ordering of chronology into the search for more sophisticated and enlightening shaping processes which arguably characterize all forms of knowledge. But as the complexity of the historian's task becomes clearer, we are also confronted with the reality that accounts of the past can be given shape according to many different schemes.

To learn more about the shaping of different accounts of the past, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.1. Do not read the accompanying comments until you have considered the following exercises.

Exercises

9 Having read the four accounts, what can we agree on about British history?

10 Is each of these histories written from a coherent viewpoint? If so, what viewpoint can be detected in each history? Summarize it in a phrase or sentence. In what ways does each viewpoint alter the significance accorded to various historical events?

11 Can you detect what the author of each history thinks about Britain as a place?

12 Can (or should) we judge any of these histories to be in some way better than the others? If so, on what basis? If not, does this mean that all historical accounts are as good as each other?

Now go back and read Macmillan's comments and consider the extent to which her suite of passages illustrates the following approaches to history:

- *history from above:* sources pertaining to prominent and influential individuals
- *history from below:* sources pertaining to ordinary people, or grand structural forces
- *history from the outside:* sources geared to empirically verifiable events
- *history from the inside:* sources that give some insight into states of mind of historical actors.

Is it the case that we can more or less write history however we like? Can we impose whatever shape appeals to us according to whim or to whichever facts we happen to encounter first? Which of the following two analogies seems to you more convincing?

“It often seems to me as if history is like a child's box of letters, with which we can spell any word we please. We have only to pick out such letters as we want, arrange them as we like, and say nothing about those which do not suit our purpose.”

Froude* in Evans, 1997

*Froude is complaining here about the behaviour of some of his contemporary historians, not endorsing the 'letters method' as an accurate depiction of how history should be undertaken.

> “Doing historical research is rather like doing a jigsaw puzzle where the pieces are scattered all over the house in several boxes, some of which have been destroyed, and where once it is put together, a significant number of the pieces are still missing. [...] If [the existing pieces] only fit together to produce a picture of a steam engine, for instance, it is no good trying to make a suburban garden: it simply will not work.”
>
> **Evans, 1997**

Applications of history

Perhaps a fruitful way forward in this debate would be to consider the purposes for which history is constructed. So, what is history for?

The Pirahã people of Amazonia have received a lot of attention from linguists and anthropologists in recent years. Leaving aside the question of whether culture sculpts language or *vice versa* – a question you may come across elsewhere in your TOK studies – it is claimed that this ethnic group has no history beyond memory. They have no creation myths, they are reported to be uninterested in anything further in the past than what the group collectively remembers – indeed their language seems to have no past tenses. While this case appears extreme, we can try to imagine what it would be like to live in a society where very little value was placed on recording or preserving knowledge of the past. Would it matter? How would things be different if we were to agree with Henry Ford and say that *history is bunk*? This thought experiment brings us around to the question of the purposes of history.

Having considered historical knowledge as a map, we can now ask what we might want to use this map for. What functions does it fulfil? Other than the outcome of simply knowing about some aspect of the past, or the contentment to be derived from beholding the internal coherence and order that the historian has discovered in, or imposed upon, events, what problems does history solve?

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

Knowledge framework: *Scope and applications* – What makes this area of knowledge important?

Can historical knowledge be our guide to tomorrow?

The *Foundation Trilogy*, a set of three science-fiction novels by the American writer Isaac Asimov, is set in the far future at a time when humans have populated most of the galaxy. At the start of the first book, we are told of the existence of a discipline called psychohistory, which has reached a level of maturity such that the future can be foretold, to a high degree of accuracy, through the manipulation of data concerning the past and present trends of a wide range of physical and psychological phenomena. In the following extract, set on the planet Trantor, capital of the Galactic Empire, the undisputed master of the subject, Hari Seldon, is discussing important matters with a young protégé.

'Before you are done with me young man, you will learn to apply psychohistory to all problems as a matter of course. – Observe.' Seldon removed his calculator pad from the pouch at his belt. Men said he kept one beneath his pillow for use in moments of wakefulness. Its gray, glossy finish was slightly worn by use. Seldon's nimble fingers, spotted now with age, played along the files and rows of buttons that filled its surface. Red symbols glowed out from the upper tier.

He said, 'That represents the condition of the Empire at present.'

He waited.

Gaal said finally, 'Surely that is not a complete representation.'

'No, not complete,' said Seldon. 'I am glad you do not accept my word blindly. However, this is an approximation which will serve to demonstrate the proposition. Will you accept that?'

'Subject to my later verification of the derivation of the function, yes.' Gaal was carefully avoiding a possible trap.

'Good. Add to this the known probability of Imperial assassination, viceregal revolt, the contemporary recurrence of periods of economic depression, the declining rate of planetary explorations, the...'

He proceeded. As each item was mentioned, new symbols sprang to life at his touch, and melted into the basic function which expanded and changed.

Gaal stopped him only once. 'I don't see the validity of that set-transformation.'

Seldon repeated it more slowly.

Gaal said, 'But that is done by way of a forbidden socio-operation.'

'Good. You are quick, but not yet quick enough. It is not forbidden in this connection. Let me do it by expansions.'

The procedure was much longer and at its end, Gaal said, humbly, 'Yes, I see now.'

Finally, Seldon stopped. 'This is Trantor three centuries from now. How do you interpret that? Eh?' He put his head to one side and waited.

Gaal said, unbelievingly, 'Total destruction! But – but that is impossible. Trantor has never been –'

Seldon was filled with the intense excitement of a man whose body only had grown old, 'Come, come. You saw how the result was arrived at. Put it into words. Forget the symbolism for a moment.'

Gaal said, 'As Trantor becomes more specialized, it becomes more vulnerable, less able to defend itself. Further, as it becomes more and more the administrative center of Empire, it becomes a greater prize. As the Imperial succession becomes more and more uncertain, and the feuds among the great families more rampant, social responsibility disappears.'

'Enough. And what of the numerical probability of total destruction within three centuries?'

'I couldn't tell.'

'Surely you can perform a field-differentiation?'

Gaal felt himself under pressure. He was not offered the calculator pad. It was held a foot from his eyes. He calculated furiously and felt his forehead grow slick with sweat.

He said, 'About 85%?'

'Not bad,' said Seldon, thrusting out a lower lip, 'but not good. The actual figure is 92.5%.'

Gaal said, 'And so you are called Raven Seldon? I have seen none of this in the journals.'

'But of course not. This is unprintable. Do you suppose the Imperium could expose its shakiness in this manner? That is a very simple demonstration in psychohistory. But some of our results have leaked out among the aristocracy.'

'That's bad.'

'Not necessarily. All is taken into account.' ”

Asimov, 1951

Exercises

13 Do you think that a discipline with the power of psychohistory is an achievable prospect? If so, what is it that confounds us from having that power now? If not, what is it that would prevent history from ever developing in this direction?

14 Two possible applications of historical knowledge might be its use in (a) generating predictions and (b) giving us the insights necessary to make transformative interventions in the present or future. Which of these goals might be more realistic?

15 Is psychohistory more about prediction or transformation?

16 Are there other disciplines that are better equipped to predict human future? If so, which and why?

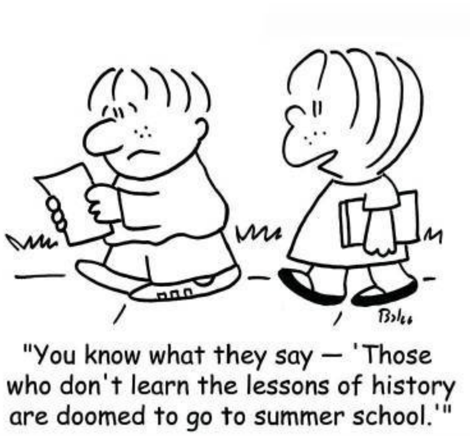
17 Is history:

- **a** just about how things were/are?
- **b** also about how things will be?
- **c** also how things ought to be?

Prescribed essay title 1: Compare and contrast our approach to knowledge about the past with our approach to knowledge about the future.

In Asimov's story, the collapse of the Galactic Empire cannot be prevented but Seldon sets out to use psychohistorical knowledge in order to shorten the period of barbarism that will precede the formation of a new civilization. To do this, he has to plan a series of interventions that will nudge events in a more favourable direction, and, for these interventions to be successful, their precise effects must not be knowable to anyone except in ways that have already been foreseen by psychohistory. As indicated in the passage above, prediction and transformation are intertwined in subtle ways in this story, but you will have to read the books to find out what happens. (The trilogy was later expanded into a longer series of interlinked novels.)

Of course, this is fiction and one must be careful with such examples as illustrations of real processes. But we can still ask whether history can furnish us with guidance for, or insights about, the future. Equally, we must be circumspect with quotations, but if we use them as springboards for thought rather than answers before we have considered the questions, we will make progress. For example, George Santayana opined that *those who cannot remember the past are condemned to repeat it*, whereas GWF Hegel claimed that *we learn from history that we do not learn from history*. Which of these two assertions do you find more convincing?



Lessons from history.

We might argue that, for historical knowledge to be applicable to the present or the future, factual accuracy is a pre-requisite. The ancient Greek historian Thucydides was perhaps one of the first scholars to emphasize the importance of a dispassionate search for facts in this domain. But for the purposes of extrapolation or application, the past has to be given a shape – and this process is central to the work of the historian. Whether this order is recognized or imposed is a theme to which we will keep returning. One of the most breathtaking attempts to bring the past into a single overarching structure was that undertaken by the British historian Arnold Toynbee. Over a period of 20 years, he published a set of 12 volumes of *The Study of History*, in which he set out his grand theoretical vision, based on the idea that history could be organized in terms of the rise and fall of civilizations, such as those he named the Egyptian, Sumerian, Mayan, Western, Far Eastern, Arabic, Hindu, Mexican, and so on, according to their record in responding to challenges of various kinds. He claimed to recognize a common pattern in these challenges and responses (Figure 7.3, overleaf).

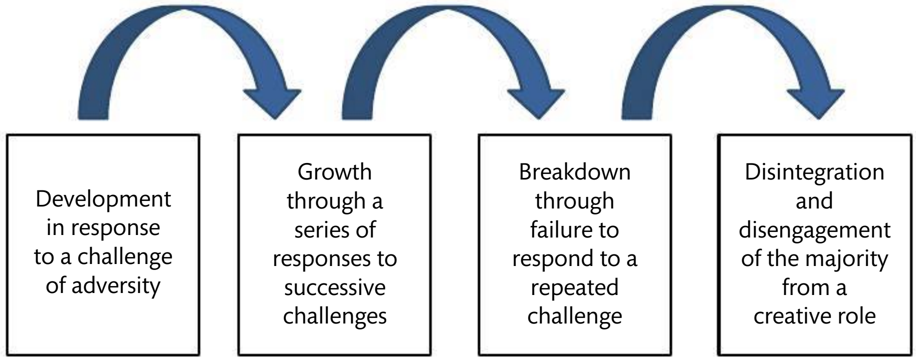
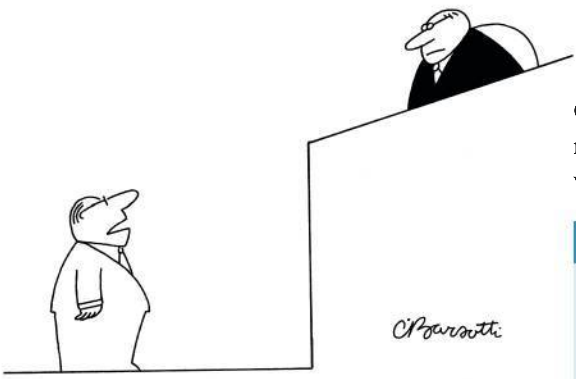


Figure 7.3 Some people see a common pattern in the rise and fall of civilizations.

Within this macro-structure, Toynbee elucidated a large number of what he called laws of history. Here are a few of them.

> “• The stimulating effect of breaking new ground is greatest when the new ground can only be reached by crossing the sea.
>
> • The instability in a balance of power varies inversely with the number of contending states.
>
> • The birth of civilisations requires creative contributions from more than one race.
>
> • Spiritual achievement and material achievement are antithetical.”
>
> Dray, 1960



"The past, Your Honor, is a foreign country, and we did things differently there."

Of the more than 20 civilizations that Toynbee identified, only a few remained in existence during the period in which he was writing, with Western civilization earmarked as the then dominant example.

Exercises

18 What is your first reaction to these examples of laws of history?

19 Do you think they can be used effectively in order to structure knowledge about the past?

20 What do you think Sir Karl Popper (Chapter 4, page 124) would have thought about Toynbee's laws and general idea about challenge and response? Do you think he would be right to take this view?

21 Assuming that these laws are accurate representations of the past, do you think they have predictive value? Or perhaps they have the more modest goal of guiding the responses we should make to challenges concerning current affairs?

22 Consider the following quotation from LP Hartley: ***The past is a foreign country: they do things differently there***. Doing things differently might be taken to refer to changes in things such as technology and the pace of globalization, or it might mean something more fundamental about human nature. What would be the implications of each of these two readings of the quotation for the usefulness of historical knowledge for prediction and transformation?

"Son, history is important because it's the story of our past that we rewrite to understand our present."

Understanding our past.

Can historical knowledge provide a useful context for today?

In his book *In Defence of History*, British historian Sir Richard Evans points out a number of 'false signals' extracted from modern history, such as the determination of the British not to appease President Gamal Nasser of Egypt during the 1956 Suez crisis in a situation thought to bear some similarity to the failure to stand up to Hitler in the 1930s. Drawing this parallel entailed ignoring important differences between Hitler and Nasser, such as attitudes to the rule of law, policies toward minority groups, and standards of education.

A similar analogy was used by British Prime Minister Tony Blair in an attempt to justify the invasion of Iraq in 2003. Thus, it might be said that the past and the present interact in a dual manner, with history employed to provide guidance for decision-making, and as justification for what has already been decided (Figure 7.4).

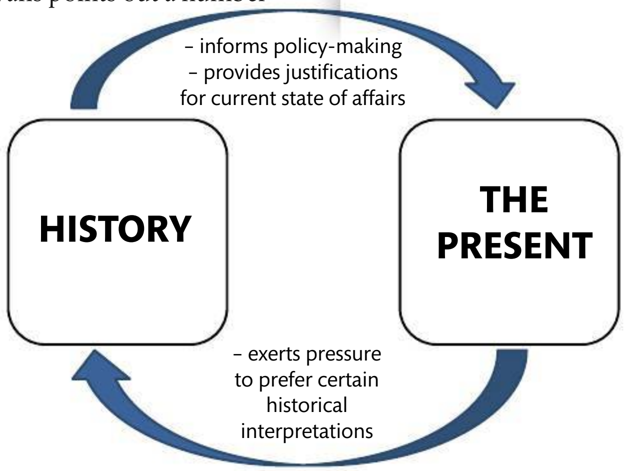


Figure 7.4 Interaction of history and the present.

Knowledge question

1 What is the role of reason with respect to the interpretations that are made in history?

Exercise

23 A distinction can be drawn between reasoning to a conclusion and rationalizing a conclusion accepted in advance – how might both be involved in the processes indicated in Figure 7.4?

The dense connections of history to the present mean that its political and ideological importance must be a prominent issue in any discussion of the applications of the discipline. History can provide maps geared to the pragmatic aims of policy and served up to citizens in ways that are intended to bolster a sense of identity, pride, and belonging to a particular state or other community. As the French philosopher Ernest Renan put it, *getting its history wrong is part of being a nation*. At its crudest, such revisionism can take the form of outright falsification, as you can see in these photographs.

Both are photos showing Lenin addressing the troops, 5 May 1920, but the one on the right shows that Leon Trotsky and Lev Kamenev have been removed by the censor.

'Whig history', in which the events of the past are viewed as an inevitable progressive march to the enlightenment of the present, can not only obscure other interpretations of the past, but also be used to put the present state of affairs on a pedestal and glorify those who wish to be seen to have established them. Marxist accounts of history have been used to justify the manifest imperfections of socialist societies by presenting them as merely a stage on a timeline ending in a glorious future. At a more general level, the end of the Cold War prompted American commentator Francis Fukuyama to declare that we had reached the 'end of history' – by which he meant that competing visions of how society should best be arranged had been vanquished by a universal consensus on the merits of liberal democracy – Western style, to which he obviously assented. Thus, there is strong pressure to see the present as culmination of the past, or a milestone on the road to salvation. This way of thinking can have a backwash effect on the construction of history itself. For example, with reference to the Cold War again:

"Every writer on 1989 wrestles with an almost unavoidable human proclivity that psychologists have christened 'hindsight bias' – the tendency, that is, to regard actual historical outcomes as more probable than alternatives that seemed real at the time (for example, a Tiananmen-style crackdown in Central Europe). What actually happened looks as if it somehow had to happen. Henri Bergson talked of 'the illusions of retrospective determinism.' Explanations are then offered for what happened. As one scholar commented a few years after 1989: no one foresaw this, but everyone could explain it afterward. Reading these books, I was again reminded of the Polish philosopher Leszek Kołakowski's 'law of the infinite cornucopia', which states that an infinite number of explanations can be found for any given event."

Garton Ash, 2009

CHALLENGE YOURSELF

There has been a vigorous debate in England recently concerning the curriculum for history that should be taught to school students. The minister for education laid out in 2013 a programme that focuses on the narrative of British history rather than activities of a more eclectic nature with an emphasis on source analysis. Prominent historians have got involved in this debate. You might like to consider the consumption of history rather than its production – what is the purpose of teaching history in schools? What should students gain from the experience?

What is your response to the Robert Jensen article at the web address below?

In 1991, American professor Martin Bernal published the first of several volumes collectively entitled *Black Athena*, in which he challenged the current historical perspective concerning the culture of ancient Greece. He pointed out that an earlier view that Egypt had exerted a strong influence over the development of Greek religion, philosophy, and mathematics had been overthrown in favour of the consensus that most of these achievements were attributable to Aryan peoples from further north. Bernal's thesis was that this shift in historical ideas came about as a result of a racist approach to historical scholarship, and he advocated a return to a revised form of the earlier theory with substantial responsibility for Greek cultural attainment from Africa and the Middle East.

Bernal's claims were flatly contradicted in an article written by American historian Mary Lefkowitz, which ignited a furious academic altercation that she describes in her subsequent book on the matter – *Not Out of Africa* – in the following terms.

"At first I was amazed that what I wrote had provoked hostility far beyond the range of ordinary scholarly disagreement. I was accused of being inspired by racist motives and later of being the leader of a Jewish 'onslaught'."

Lefkowitz, 1996

To learn more about the fears of people in power, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.2.

Exercises

24 Why do you think the contributions of Bernal and Lefkowitz provoked so much rancour? Why do the origins of the culture of an ancient civilization seem to matter so much to some people today?

25 To what extent, if at all, do you think that this example illustrates that history moves through paradigms in a similar sense to that meant by Thomas Kuhn in the sciences (Chapters 3 and 4)?

26 With reference to this example and Figure 7.2 (page 218), where would you place your view on the axis below with regard to the influence of the present on historical knowledge?

'The practical requirements which underlie every historical judgement give to all history the character of "contemporary history"' (Benedetto Croce)

'Understanding the past requires pretending that you don't know the present.' (Paul Fussell)

'History is the projection of ideology into the past.' (Anonymous)

Prescribed essay title 2: 'History is always on the move, slowly eroding today's orthodoxy and making space for yesterday's heresy.' Discuss the extent to which this claim applies to history and at least one other area of knowledge.

Exercise

27 Re-visit the excerpt by Julian Barnes on page 212. To what extent do you think that Webster's response to Hunt's question was a good one?

Can historical knowledge give us personal and shared insights into the human condition?

If prediction from history is too hard, if transformative interventions are sometimes misguided, and if history is susceptible to being hijacked from time to time by agenda-bearing outsiders, perhaps we should look for more personal applications for history (page 246).

The fact that history plays a role in the educational curriculum of almost every country in the world suggests that the applications of the discipline are considered to be real. The examples and arguments that arise from this section may provide some enlightenment as to the nature of these ways in which history can be put to use.

While it is easy to attribute to historians themselves the political purposes to which history is put, we should take care to draw a distinction, wherever it is justified, between historians on the one hand, and politicians and other leaders with self-serving agendas on the other. While undoubtedly there are historians with an axe to grind for some particular interest with which they are associated, it is unfair and inaccurate to suggest that historians are somehow inherently and irrevocably attached to perspectives that favour their countries of origin.

It is common for students in TOK to talk and write about bias in history, and claim that historians are often biased. As noted earlier, historians do have different takes on things, but to refer to these differences as *biases* is not helpful if it suggests that there has been a departure from some objective and absolute truth. The material covered in this chapter suggests that there can be no such truth – even simple timelines vary according to which events are included – so it is better to refer to perspectives, as this avoids the false implication. But at the same time, it does not follow that the existence of different perspectives implies that any perspective is acceptable or that all perspectives are of equal value.

7.3 Language and concepts

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Knowledge framework: *Methodology* – What counts as a fact in this area of knowledge?

The concept of a 'fact' seems so central to the endeavour of writing history that it is dealt with here under concepts, rather than under methodology, in this chapter.

Facts, evidence, and theory

Much of the debate about the nature of history in the middle years of the 20th century was dominated by two British figures and the interplay between their views. Sir Geoffrey Elton and Edward Hallett Carr had differences with particular respect to one of the most important concepts in the discipline – namely, a fact (Figure 7.5).

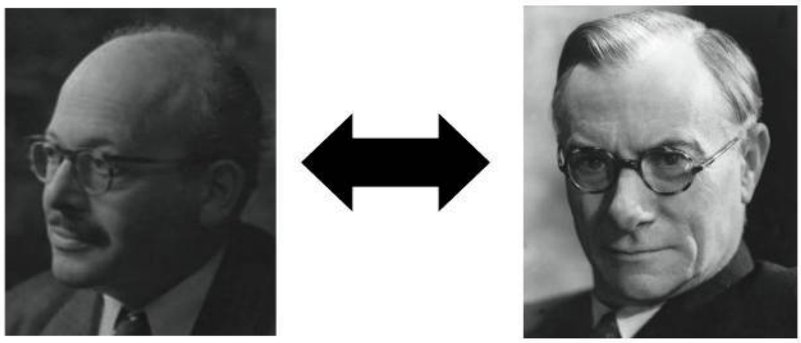


Figure 7.5 Two views on facts and history.

Sir Geoffrey Elton
'Historical method is no more than a recognised and tested way of extracting from what the past has left the true facts and events of that past, and so far as is possible their true meaning and interrelation.'

Edward Hallett (EH) Carr
'The facts of history never come to us pure since they do not and cannot exist in a pure form; they are always refracted through the mind of the recorder. [...] our first concern should not be with facts which [the work of history] contains but with the historian who wrote it. Study the historian before you begin to study the facts.'

Exercises

28 Summarize in a single sentence the difference between Elton and Carr in relation to facts. Can you give an example that could illustrate the difference?

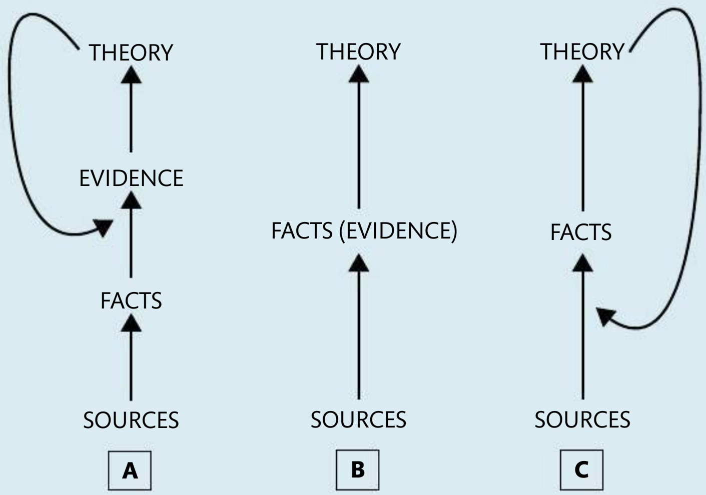
29 Can you detect any similarities between each of these views and the conceptions of science (Chapter 4) or of other AOKs (Chapter 3)?

30 Sir Richard Evans has written:

A historical fact is something that happened in history and can be verified as such through the traces history has left behind. Whether or not the historian has actually carried out the act of verification is irrelevant to its factuality. [...] Where theory and interpretation come in is where facts are converted into evidence [...] The historian formulates a thesis, goes looking for evidence and discovers facts.

Connect each of the following diagrams to the views of the three historians considered in this section (Elton, Carr, and Evans).

Exercises



31 a Decide which of the following statements to recruit in order to answer to the question: ***Who was responsible for starting the Cold War?***

- **i** From the start, Stalin had a poorer relationship with Truman than Roosevelt.
- **ii** Stalin drained his sector of Germany of supplies and machinery from 1945 on.
- **iii** The Allies failed to take Stalin fully into their confidence during WWII.
- **iv** The Americans refused to grant Stalin a much-needed loan in 1945.
- **v** Truman ordered the atomic bombing of Hiroshima without informing the Soviets.
- **vi** Churchill was a keen supporter of intervention against the Bolsheviks in 1918.
- **vii** Marshall Aid was provided to Western Europe from 1947.

Adapted from Rayner and Stapley, 2002

b Decide which of the following statements to recruit in order to answer to the question: ***When did South African apartheid start?***

- **i** In his victorious campaign in the 1948 election, Malan proposed apartheid as a means of consolidating white wealth and power.
- **ii** The Immorality Act of 1926 banned sexual relations between people of different races.
- **iii** Political power was reserved for whites from the founding of the Union of South Africa in 1910, except for black voting in the Cape and Natal.
- **iv** In the 1930s, the black franchise was diminished to allow only limited voting, and only for white candidates.
- **v** Widespread legislation was passed in 1948 to establish apartheid.
- **vi** Areas where non-whites were forbidden to live were specified by an act of parliament in 1923.

Adapted from Rayner and Stapley, 2002

Let's consider your answers to exercise 31 to be part of 'theory' (see diagram above). With regard to the process, try to decide which of the three models (A, B, or C) you followed. Which of the following were you doing?

- Arriving at your conclusion from objective facts in an inductive and balanced fashion.
- Producing facts by selecting statements and arriving at your conclusion from them.
- Recruiting some objective facts as evidence in support of your conclusion.

Did you reject some of the statements? If so, was this because:

- you didn't think they were objective facts?

- you didn't think they were relevant?
- they didn't fit in with the conclusion you had already reached?

Are there differences between the two examples that make it difficult to reach an opinion about how the historian operates? What are the implications of adhering to each of these conceptual arrangements?

The relationship between the individual facts and the theory that orders them and binds them together is an important topic in several AOKs. In addition to summarizing the issue of selection in history, Evans here captures the debate as to whether that order originates in the facts themselves or is imposed by the theory that we apply to them. Opinions on this matter are naturally connected to how we conceptualize facts themselves:

> “As I write this, I can hear the click of my fingers on the word-processor, the faint whine of the computer in the background, the dull but constantly varying roar of the traffic in the main road across the garden, the twittering of the birds outside, the light ticking of the clock on my desk, the soft padding of my cat as he comes up the stairs, the sound of my own breathing, and so on: all this in a handful of seconds, and already it is gone beyond any hope of complete or accurate reconstruction, least of all in the exact sequence in which these noises have come to my ears. So we all pull out from the seamless web of past events a tiny selection which we then present in our historical account. Nobody has ever disputed this. The dispute arises when some theorists believe that the selection is largely determined by the narratives and structures which occur in the past itself, and those who think it is imposed by the historian.”

Evans, 1997

Cause and effect

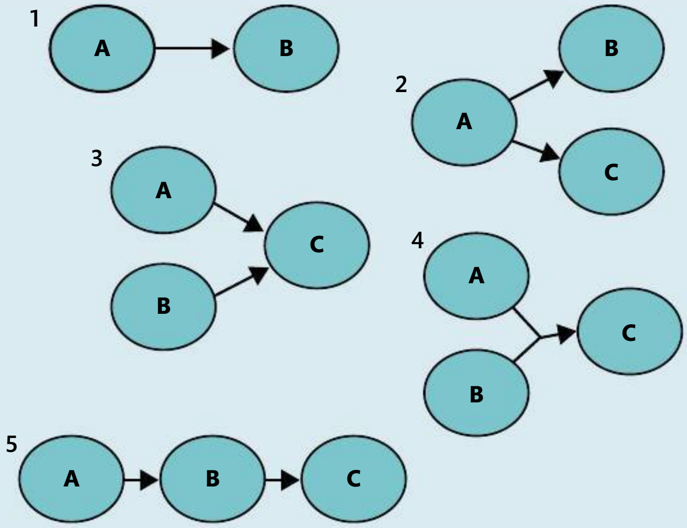
The concept of a 'cause' is more complex than it might at first appear, and much philosophy has been concerned with it. Some relationships between cause and effect are indicated below.

Exercises

32 Try to pair the descriptions (a–e) with the diagrams (1–5).

- **a** ***Multiple causes as sufficient conditions:*** each cause will bring about the effect independently
- **b** ***Remote and proximate causes:*** a chain in which each effect becomes the next cause
- **c** ***Simple cause:*** one cause for one effect
- **d** ***Multiple causes as necessary conditions:*** all causes are needed together to bring about the effect
- **e** ***Multiple effects:*** one cause for several effects

Exercises



33 Now consider each of the following questions and try to link them to a particular type of causal situation, as listed in exercise 32.

- **a** What was the cause of the fall of the Berlin Wall on 9 November 1989?
- **b** What was the cause of the Rwandan genocide in April/May 1994?
- **c** What were the effects of the destruction of the World Trade Center in New York City on 11 September 2001?

What were your conclusions from this task about the nature of historical causation? It is difficult to ascribe a particular cause to the fall of the Berlin Wall on that date, and to do so would almost certainly diminish any historical account. Admittedly, we might be justified in claiming that the wall fell precisely on 9 November because of a botched answer to a question in a press conference that evening: but there is no doubt that the Wall would have been opened on 10 November in any event. This does not seem very significant in a historical sense. For a more enlightening answer, we would have to look at changes in the leadership of the Soviet Union years earlier, consider the economic performance and military policies of West and East over an extended period. There would seem to be no clear answer to the question of cause, and no escape from the need to exercise some sort of judgement about it.

The landscape seems no more settled on the Rwandan question. Perhaps we could blame Hutu extremism and the use of radio to stir up hatred. Perhaps we would prefer to consider the role of the Belgian colonialists who much earlier sought to divide the Hutu and Tutsi communities despite their deep ethnic and linguistic commonalities. Maybe a chain of causality works better here, but it is still a matter of historical judgement. And there is the question of how far back one can go before links become so tenuous that the meaning of a 'cause' and its significance starts to be lost.

To learn more about Günther Schabowski and the fall of the Berlin Wall, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.3.

The attack on the World Trade Center is associated with so many consequences that we are once again faced with the task of deciding which of them are more important in a historical sense, and we may not be far enough divorced in time from these events in order to make a meaningful judgement about them. And it is difficult to decide if the attack was a necessary or a sufficient cause for some of these effects – possibly sufficient for the invasion of Afghanistan, or enhanced security arrangements for air travel.

In short, the historian's subject matter is intimately bound up with the idea of causes and effects, but the focus on the time dimension makes judgements about the relative significance of causes and effects particularly challenging. It is a matter of measuring the weight of evidence rather than reaching unassailable conclusions.

Progress, decline, cycles

Consider Figure 7.6.

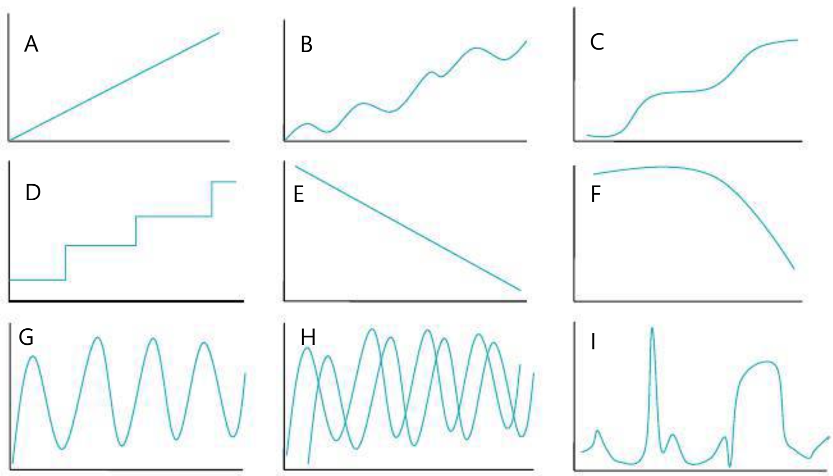


Figure 7.6 Each of these graphs is a suggested shape of the past. Try to describe each with a single word or phrase.

Suggested labels might be: progress, decline–collapse–recurrence, etc. All are concepts that we can attempt to apply to the past. It seems sensible to label the horizontal axis with time, but what variable could we put on the vertical one? We might decide to pick something quite easily defined, such as life expectancy or technology, but even here there will be difficulties in constructing a scale. To get an acceptable measure for the past as a whole at any given time would seem to be an impossible task. Nevertheless, we cannot avoid attempts to mould the past into a convenient shape as there have been so many attempts to do so. Do you think the past has a shape, or is it just 'one damn thing after another'?

Importation of concepts

In some ways, history is an eclectic discipline – it can draw from a wide range of other intellectual sources and traditions. In more recent times, this has resulted in a proliferation of different types of history – each with its roots in another subject or overarching concept.

Exercise

34 Write a 400-word history of a particular continent, based on the use of concepts from one of the following areas (some suggested concepts are given for each).

- Economics: demand, scarcity, trade
- Geography: land relief, migration, climate
- Biology: pathogens, putrefaction, immunity
- Corruption: nepotism, greed, leadership
- Colonialism: exploitation, dependence, paternalism

This essay task can give an indication of the variety of historical accounts that can be constructed on the same subject matter, while maintaining in each case an internal coherence based on a set of concepts that have well-established relations within a 'foreign' discipline.

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

There is no other AOK than history that has such a close relationship with language. Not only is historical knowledge itself almost always expressed in language, but most of the sources used in its construction are in linguistic form too. Consequently, language issues often climb high on the agenda in any discussion about the nature of history and the manner in which it should be presented.

Arguments abound as to the degree to which historians should deploy value-laden language in conveying their work, with words such as *atrocity* and *genocide*, or choices such as *leadership* or *regime*. The more scientifically minded may prefer vocabulary of this kind to be omitted in the interests of preventing emotion from overwhelming a more detached engagement with the material, but there are also those who would argue that the subject matter of history naturally evokes strong responses, and to expunge them would mean failing to do justice to the people and events under scrutiny.

You may have considered in TOK the arbitrary relationship between words and meanings – different words, or signifiers, in different languages can point to the same thing that is signified. It is also indisputable that words shift in meaning over time and across cultures, and these dynamic aspects of language are things with which we need to cope in our attempts to understand and communicate. In recent decades the development of postmodernist thinking, led by scholars such as Roland Barthes and Jacques Derrida, has promoted the view that we cannot apprehend the world itself in any meaningful sense at all – all we have is language in the form of 'texts' that refer to each other rather than mapping any reality beyond them. In this perspective, knowledge constitutes nothing more than a web of language. Words constitute texts, and texts refer only to other texts.

With respect to history, this would mean that historians may write about other historians, or about their sources, but there is no connection to the past itself in which we can have any confidence. Hence the study of history becomes the study of historians and the texts they produce, and the only tools worth employing are those literary approaches that can analyse texts.

Exercise

35 What is your reaction to this perspective on history?

Knowledge framework: *Language and concepts* – What metaphors are appropriate to this area of knowledge?

Just as in many other AOKs, metaphors are powerful tools in the attempt to create order in history. Many historians who detect some sense of recurrence in the events of the past have been attracted by the metaphor of the seasons, with cultures or civilizations following a sequence analogous to spring to winter. The German historian

Oswald Spengler employed a biological metaphor in likening history to the periods of a human life, such as childhood, youth, maturity, and old age. The title of his master work – *The Decline of the West* – indicates his view as to the stage of life now reached by what he called *culture in the ascendant phase, and civilisation in the descendent*. Both of these metaphors help to suggest that series of events recur in principle but do not repeat in detail, as sets of annual seasons and human lives are never identical.

Exercise

36 Re-visit the excerpt by Julian Barnes on page 212. To what extent do you think that Simpson's response to Hunt's question was a good one?

The Scottish historian Niall Ferguson has spiced up his perspective on world history by referring to certain historical developments, such as the scientific revolution (Chapter 4) and the so-called Protestant work ethic (Chapter 10), as peculiarly Western inventions. He refers to such Western inventions as 'killer apps' that have made the difference between Westerners and 'Resterners' as he labels everyone else. He suggests that these 'apps' may be 'downloaded' by the Resterners. Interestingly, he, like Spengler, has much to say about a possible decline of the West, but in contrast takes the view that this is an avoidable outcome.

Exercise

37 What further associations are encouraged by Ferguson's expressions? Are they helpful in gaining new insights into world history or do they entrench existing dominant opinions about it?

7.4 Methodology

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

If the subject matter of history is the recorded past of humanity, then the methods of history must in the first instance focus on those records themselves. For the modern historian, there are some general principles that are accepted as to the nature of such records and how they should be approached.

The most obvious way of classifying these records is to distinguish between original authorities (e.g. eye-witness accounts) and derivative authorities (e.g. accounts written afterwards by others). Nowadays, we call these primary and secondary sources. We could further distinguish between secondary and tertiary sources, and so on, depending on the length of the chain through which accounts have passed.

We could generalize and say that primary sources are more reliable than secondary sources, which are in turn more reliable than sources even further down the chain, but there may well be exceptions to this principle. However, the number of independent sources that offer more or less the same message about something is usually proportional to the confidence with which we should accept that message. We could also say that the difference between witting and unwitting sources is crucial – think

about who in the GDR example intended their testimony to be made public one day and those who certainly did not.

- How can we know that sources are independent? How can we tell if a source intended their contribution to be examined and incorporated into the historical record?
- Can you think of an example in which a secondary source may be more reliable than the primary sources from which the secondary source worked?

As for the content of the documentation itself, there are some guidelines for treatment. The American historian Gilbert Garraghan (1946), for example, offers the following list of guidelines for criticism of sources:

- ***Date*** – When was the source, written or unwritten, produced?
- ***Localization*** – Where was it produced?
- ***Authorship*** – By whom was it produced?
- ***Analysis*** – From what pre-existing material was it produced?
- ***Integrity*** –In what original form was it produced?
- ***Credibility*** – What is the value of its contents?

Students of IB history will be more familiar with the method in which an evaluation is made of the origins, purposes, value, and limitations of documentary sources (OPVL method). So one might ask:

- ***Origins*** – Who wrote it? Where did it come from and when?
- ***Purposes*** – What does it mean in its historical context?
- ***Value*** – Bearing in mind its origins and purpose, to what extent is it a worthwhile source?
- ***Limitations*** – What is there about its origins and purpose that limits its value?

Exercise

38 There are some differences between Garraghan's method and the OPVL method.

a How has the emphasis changed between Garraghan's advice and the standard current OPVL?

b Compare the OPVL method with methods outlined in this book for other AOKs.

In Chapter 3, we met CP Snow and his lament that intellectual life tended to fracture into the two camps of the sciences on one hand, and the humanities and arts on the other. You may by now have developed an opinion about (a) whether he was right, and (b) whether the human sciences, as Snow began to appreciate, might form a link across the divide. What about a role for history in drawing together the best of the two cultures? We have seen how processes and outcomes of history are steeped in language, and we have explored the prospects for the discipline to generate reliable and useful knowledge. The British historian George Macaulay Trevelyan claimed that history is a mixture of scientific research, imaginative interpretation and literary presentation (Figure 7.7).

SCIENCE ◀---------▶ HISTORY ◀---------▶ LITERATURE/ARTS

Figure 7.7 History bridging the two cultures – and drawing on both.

Prescribed essay title 3: 'A historian must combine the rigour of the scientist with the imagination of the artist.' To what extent, then, can the historian be confident about his or her conclusions?

Let's look at some work in history that perhaps draws from one or the other of these sources from across the spectrum of AOKs.

History as comparison: real versus real

Historians can attempt to inject rigour into their work by trying to minimize the variables involved in any kind of comparison being made. For example, in the IB history course you might try to draw some general conclusions from a study of a range of civil wars. Is it possible to extract common features from experiences in Russia around 1917, China from the 1920s onward, Spain in the 1930s, and perhaps Nigeria in the 1960s?

Exercises

39 To what extent do you think such comparisons can rank with those made in a scientific investigation?

40 There is the possibility of confirmation bias in such an exercise – perhaps the historian is pre-disposed to a theory that greed is uppermost in such conflicts, or alternatively a sense of grievance – how serious is this danger compared with similar difficulties in the sciences?

History as comparison: real *vs* imaginary

A method that is controversial among historians is the appeal to counterfactual history. What if Napoleon had triumphed in Russia in 1812? What if Archduke Franz Ferdinand had not been assassinated in Sarajevo in 1914? What if the terms of the Treaty of Versailles in 1919 had been different? What if the Japanese had not attacked Pearl Harbor in 1941? What if Hitler had won at Stalingrad? What if Kwame Nkrumah had not been overthrown by military coup in Ghana in 1966? What if British Prime Minister Margaret Thatcher had been assassinated by the bomb set by the Irish Republican Army in 1984? What if Al Gore had won the 2000 presidential election in the USA? By invoking such scenarios, we are 'running history in parallel' and attempting to elicit comparisons between a real past and one that never took place – stemming from the possible outcomes of a single event.

Exercises

41 Do you think such a method relies more on imagination or reason?

42 Is this a more reliable sort of comparison than the one in the civil war scenario?

43 Does your answer to exercise 41 tell you anything fundamental about the nature of history?

History as (mainly) geography and ecology

In keeping with some approaches in the human sciences, we might search for order and structure in history by confining ourselves to factors that are more amenable to empirical treatment. In this line of thinking, American scholar Jared Diamond finds causal explanations for the Spanish conquest of the Incas in Peru, for instance, that relate to continental topography, gradations in climate, disease epidemiology, and technological developments. These are all factors amenable to the provision of some sort of evidence. At the same time, he overlooks, to some extent, less 'visible' contributions to history, such as the more psychological aspects of different cultures and the motivations for imperial adventures that pertained at particular times. This has been dubbed the 'latitude-not-attitude' approach.

Exercises

44 Diamond has been accused of providing the 'how' but not the 'why' that is necessary in history. Do you think this might be a fair criticism arising from the method described above? Is history more about 'how' or 'why'?

45 What kinds of events from the past do you think Diamond's approach might fail to deal with satisfactorily?

Cliodynamics

Finally, let's turn to the work of Russian–American scholar Peter Turchin, who has created a high profile for what he calls cliodynamics. In his own words:

> "What caused the collapse of the Roman Empire? More than 200 explanations have been proposed, but there is no consensus about which explanations are plausible and which should be rejected. This situation is as risible as if, in physics, phlogiston theory and thermodynamics coexisted on equal terms. This state of affairs is holding us back. … [W]e need a historical social science, because processes that operate over long timescales can affect the health of societies. It is time for history to become an analytical, and even a predictive, science."
>
> **Turchin, 2008**

Turchin's vision of history as becoming a genuine human science rests on the collection and input of a huge mass of information about people and societies which is either already quantitative or is converted into this type. This data-rich approach is becoming more feasible in a digital world, and Turchin claims to have discovered historical cycles for variables such as 'political instability' that are replicated in different societies at different times (Figure 7.8, overleaf).

Knowledge question

2 In what ways would its practices need to change in order for history to be accepted as a human science? Are these changes desirable, or even possible?

Exercises

46 The cliodynamic approach to history is audacious, whether or not it yields the quality of results that advocates hope for. But what are some of the problems that immediately arise through this kind of method?

47 Do you think that Turchin and his followers will succeed in reuniting history with its partner disciplines in Group 3 of the diploma to the extent that we will be able to do away with history as a dedicated AOK?

48 Do you think the prospects for the acceptance of cliodynamics as a valid approach in history might be affected by the fact that Turchin is trained as a population ecologist rather than as a historian? If so, how?

49 In examining cliodynamics, have we basically just encountered a primitive version of psychohistory (page 222)?

50 More generally, what are your conclusions about:

- **a** the usefulness of aspects of scientific methods to the practice of history?
- **b** the prospects for history actually to become a scientific specialism itself?

Is it helpful to couch your answer in terms of the WOKs that the AOKs do and do not share?

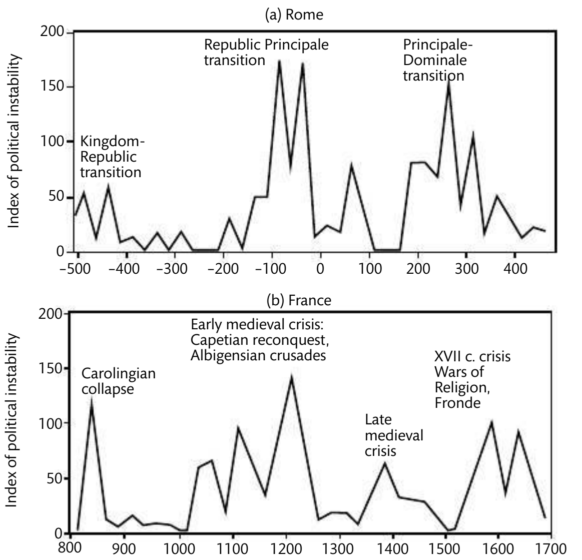


Figure 1. Long-term dynamics of sociopolitical instability in (a) Rome, 510 BCE–480 and (b) France, 800–1700
Data from Sorokin (1937). Data are plotted per 25-year interval, 'Index of Political Stability combines measures of duration, intensity, and scale of political instability events, coded by a team of professional historians (see Sorokin, 1937, for details). The Roman trajectory is based on instability events that occurred only in Italy.

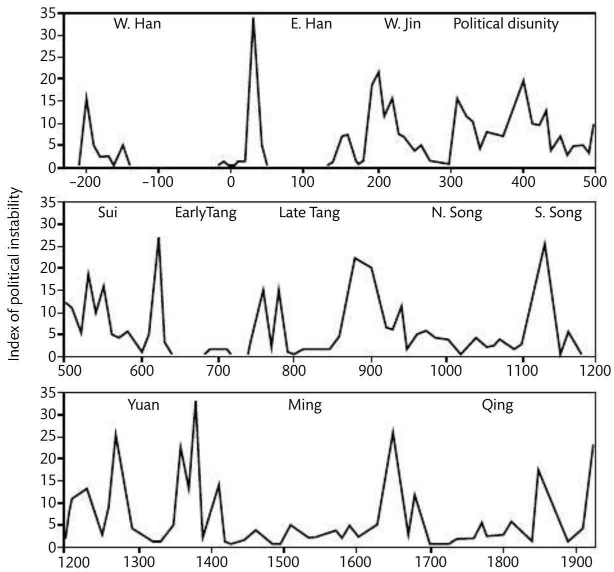


Figure 2. Long-term dynamics of sociopolitical instability in China
Data from Lee (1931). 'Index of Political Stability' refers to the number of instability events (civil wars, peasant uprising, major outbreaks of banditty, etc.) per 10-year interval. Unlike in Figure 1, where lavels area assigned to instability waves, here labels indicate internally stable period, associated with a unifying dynasty.

Figure 7.8 Examples of historical cycles as defined by Turchin (2008).

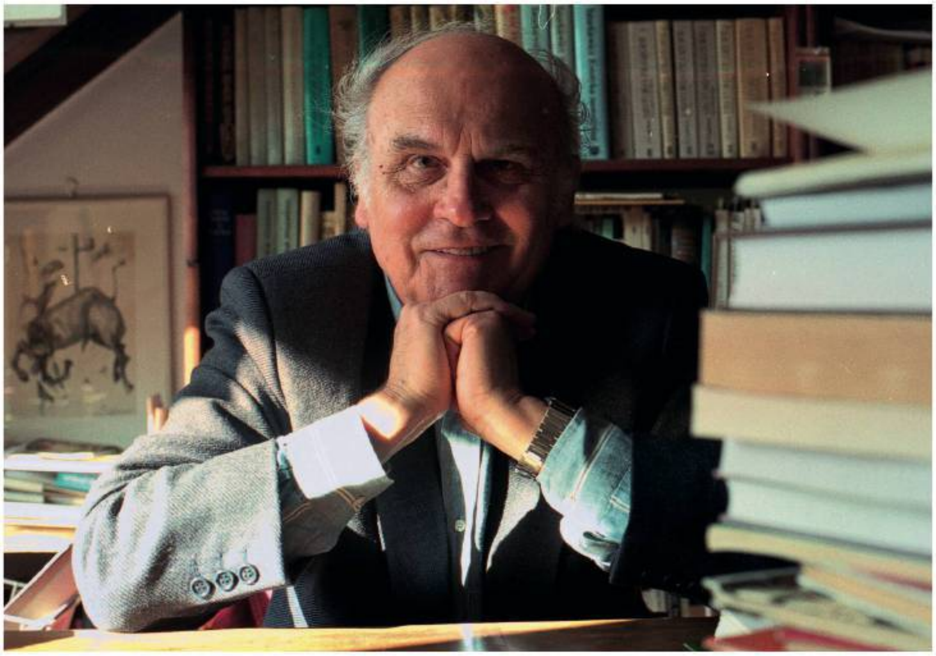
We can now turn to look in the other direction. We have already noted the nature of the materials with which historians deal, and the product they deliver. The American historian Hayden White is persuaded that the similarities between history and literature are greater than their differences.

> For Hayden White, researching and writing a history book is much the same as researching and writing a novel. Both are made up of elements of real human experience. Both have to meet the demands of correspondence to that experience and coherence in the way they present it. Both use language as their means of representing reality. Just like novelists, historians, says White, prefigure their field of inquiry by selecting and evaluating the evidence with the very linguistic and imaginative tools that will be used in the construction of the resulting narrative.

Evans, 1997

Although Ryszard Kapuściński was more of a correspondent than a historian, his journalistic output has been praised for its unique value – Kapuściński visited places and conversed with people that few other correspondents managed to do, and wrote about all of it with great style. Indeed, there was talk at one stage of Kapuściński as a candidate for the Nobel prize for literature. In one of his most famous books, *The Emperor*, he writes about his experiences in Ethiopia immediately after the fall of Emperor Haile Selassie in 1974, in conversing with some of the royal courtiers as primary witnesses.

Eulogies for Kapuściński's work have been widespread and effusive. For example, the following is from *The Wall Street Journal*.



Polish writer Ryszard Kapuściński (1932–2007).

“When our children’s children want to study the cruelties of the late 20th century; when they want to read of murderous tyrants and drunken soldiers; when they wonder why revolution after revolution betrayed its promises through greed, fear and confusions, they should read Ryszard Kapuściński.”

Here are two extracts from *The Emperor*.

“The Emperor began his day by listening to informers’ reports. The night breeds dangerous conspiracies, and Haile Selassie knew that what happens at night is more important than what happens during the day. During the day he kept his eye on everyone; at night that was impossible. For that reason, he attached great importance to the morning reports. And here I would like to make one thing clear: His Venerable Majesty was no reader. For him, neither the written nor the printed word existed; everything had to be relayed by word of mouth. His Majesty had had no schooling. His sole teacher – and that only during his childhood – was a French Jesuit, Monsignor Jerome, later Bishop of Harar and a friend of the poet Arthur Rimbaud. This cleric had no chance to inculcate the habit of reading in the Emperor, a task made all the more difficult, by the way, because Haile Selassie occupied responsible administrative positions from his boyhood and had no time for regular reading.

But I think there was more to it than a lack of time and habit. The custom of relating things by word of mouth had this advantage: if need be, the Emperor could say that a given dignitary had told him something quite different from what had really been said, and the latter could not defend himself, having no written proof. Thus the

Emperor heard from his subordinates not what they had told him, but what he thought should be said; his Venerable Highness had his ideas, and he would adjust to them all the signals that came from his surroundings. It was the same with writing, for our monarch not only never used his ability to read, but he also never wrote anything and never signed anything in his own hand. Though he ruled for half a century, not even those closest to him knew what his signature looked like. ”

Courtier YM, reported Kapuściński, 1983

“ It was a small dog, a Japanese breed. His name was Lulu. He was allowed to sleep in the Emperor's great bed. During various ceremonies, he would run away from the Emperor's lap and pee on dignitaries' shoes. The august gentlemen were not allowed to flinch or make the slightest gesture when they felt their feet getting wet. I had to walk among the dignitaries and wipe the urine from their shoes with a satin cloth. This was my job for ten years. ”

Courtier F, reported Kapuściński, 1983

Some years later, in the early 1990s, American scholar Harold Marcus protested:

“ Mr. Richard, as he is called by several raconteurs, reported that the emperor had a little dog that was permitted to urinate on the shoes of courtiers and that there was a servant whose sole duty was to wipe the offending shoes dry [...] but he never would have permitted any animal to humiliate his courtiers... Haile Sellassie was, by all reports, a sedulous reader in Amharic, French, and, later, in English. He not only perused books but also reports, newspapers, and magazines. Furthermore, he wrote instructions and orders, giving the lie to Kapuściński's absurd statement: 'Though he ruled for half a century, not even those closest to him knew what his signature looked like.' ...those of us who take Amharic and its usage seriously are insulted by the artistic license taken by Kapuściński when he ostensibly replicates conversations with informants. ”

Exercise

51 Do you think it matters what behaviour the emperor permitted his dog, or what facility the emperor enjoyed in different languages, when recording the history of 20th-century Ethiopia?

In recent years, and particularly since his death in 2007, the veracity of Kapuściński's work has come in for greater scrutiny.

“In the end, there is no floodlit wire frontier between literature and reporting. All we can insist on is that a literary text is not presented as a verbatim transcript. Kapuściński constantly wandered back and forth across that frontier, but always knew which side he was on at a given moment. Scrupulous in his journalism, in his books he was capable of inventing in order to make a truth even truer. He was a great story-teller, but not a liar.”

Ascherson, 2010

“The division between ‘literature’ and ‘reporting’ won’t hold; we believed his books because ‘reportage’ is how they were billed. Remove a fictional brick or two and the wall of ‘authenticated’ reality begins to crumble. What will remain to us is his imagination, which is already displacing in our own memory the real world he tried so artfully to describe.”

Jack, 2010

Exercises

52 Is there a distinction between ‘reporting’ and ‘history’ that would make a difference to your response to the two quotations above?

53 What does it mean to say that ***journalism is the first draft of history***?

Here is Kapuściński’s response to earlier criticisms of this nature.

“You know, sometimes the critical response to my books is amusing. There are so many complaints: Kapuściński never mentions dates, Kapuściński never gives us the name of the minister, he has forgotten the order of events. All that, of course, is exactly what I avoid. If those are the questions you want answered, you can visit your local library, where you will find everything you need: the newspapers of the time, the reference books, a dictionary.”

Kapuściński quoted by Shafer, 2007

Exercises

54 What is your view on this example? Was Kapuściński justified if he put words in courtiers’ mouths in the interests of conveying a ‘deeper literary truth’? Or was he duty-bound to report his experiences exactly as they were?

55 In your view, how successfully does White exculpate Kapuściński with the quotation from Evans (1997) on page 240?

56 How well does the map metaphor that we have been using in this book stand up in this example?

57 There are strong indications that much of Kapuściński's work was allegorical in nature – he wished to comment on the situation in his native Poland which, as a communist state at the time, would not tolerate direct dissent. Perhaps he was drawing parallels between the court of Haile Selassie and the Polish politburo of the 1970s. If so, does that make Kapuściński's rather liberal attitude to facts more or less justifiable?

CHALLENGE YOURSELF

Kapuściński’s last book was called *Travels with Herodotus.* Do some research on the approach to historical scholarship that was taken by Herodotus, and then answer the following question. What message might Kapuściński have wanted to convey about his own work at the end of his career?

Exercises

58 It would almost certainly be too harsh to regard the kind of approach that Kapuściński seems to have taken to his material as 'historical fiction'. But we might ask: ***what knowledge can be gained from the writing and the reading of historical fiction?***

59 This case study touches on many aspects of TOK. How do you see it connecting to history, the arts, ethics, indigenous knowledge, language, and others parts of the course?

Prescribed essay title 4: Can literature 'tell the truth' better than other arts or areas of knowledge?

Finally, consider the words of GM Trevelyan again.

> "The appeal of history to us all is in the last analysis poetic. But the poetry of history does not consist of imagination roaming at large, but of imagination pursuing the fact and fastening upon it. That which compels the historian to 'scorn delights and live laborious days' is the ardour of [his or her] own curiosity to know what really happened long ago in that land of mystery which we call the past. To peer into that magic mirror and see fresh figures there every day is a burning desire that consumes and satisfies [him or her] all [through] life, that carries [him or her] each morning, eager as a lover, to the library and the muniment room. It haunts […] like a passion of terrible potency, because it is poetic. The dead were and are not. Their place knows them no more, and is ours today. Yet they were once as real as we, and we shall tomorrow be shadows like them ... The poetry of history lies in the quasi-miraculous fact that once, on this earth, once, on this familiar spot of ground, walked other men and women, as actual as we are today, thinking their own thoughts, swayed by their own passions, but now all gone, one generation vanishing into another, gone as utterly as we ourselves shall shortly be gone, like ghosts at cockcrow."

Trevelyan in Evans, 1997

What are the roles played by WOKs in the making of history? We have already acknowledged the huge importance of language to history – both in its raw material and in its product – and so all aspects of the method for getting from one to the other must take cognizance of the nature of language in all its dimensions.

If all sources have their roots in empirical experience, then historians are dealing with memory and with sense perception at least one step removed. The connection between empathy and emotional involvement is also important, so historians can access a psychological inside track to events and outcomes. OPVL and other methods of analysis depend on an ability to harness the power of reason. Examine Table 7.1 and consider how the nature of each of the WOKs may influence the outcomes of a historian's work, and how they may interact according to each row in the table in the construction of historical knowledge.

WOK	Outcome	WOK	Outcome
reason	reaching conclusions based on logical progression from available facts	emotion, intuition	empathizing with historical actors and employing the common ground of human emotion
reason	asking and answering rigorous questions about the veracity of source material	imagination	filling gaps in the historical record in ways that bind events together plausibly
sense perception, memory	relying on the accounts of primary sources directly, or indirectly through the documentation that they leave behind	language	relying on language as a medium that can faithfully reflect reality, and can communicate information reliably

Table 7.1 WOKs and outcomes.

Exercises

60 Re-visit the excerpt by Julian Barnes on page 212. To what extent do you think that Finn's response to Hunt's question was a good one?

61 In the light of everything discussed in this section, what summative thoughts can you provide in relation to prescribed essay title 4 (opposite)?

7.5 Historical development

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

We have discussed in a previous section the shape of the past; and now attention turns to the shape of history, which as we have seen in this chapter is a different thing. The focus now is on how historians of different times have regarded the past from their own position within it, and how they thought it should best be studied.

Thucydides.

Although there were differences between the approaches to history of ancient Greek historians such as Thucydides and Herodotus, the dominant themes until modern times have been the role that history can play in the articulation of provenance and moral illustration. History's remit was to provide description of the influence of the divine on the Earth, and the successful defeat of evil by the forces of good. In many ways, this placed history very close to the category of literature, as discussed in the previous section.

The giant of 19th-century history was the German Leopold von Ranke, who tried to remove the prejudices of the present and insist on the study of the past *wie es eigentlich gewesen* – on its own terms – and as it actually was for those living at the time. To do this, he imported the methods of philology –

Leopold von Ranke.

careful evaluation of source text in order to establish the veracity of what was written. Thus, Ranke came to place a great emphasis on primary sources and the hard work of analysis at the expense of the more elaborate flights of imagination for which some of his predecessors were famous. History was not the same as literature or philosophy – this has been recognized as a crucial pivot point in the history of history.

Ranke's insistence on the primacy of the sources had a similar effect in some ways to the shift to an emphasis on empirical investigation in the sciences during the scientific revolution – history was now a matter of reaching inductive conclusions from data. This optimistic outlook for method and outcome was punctured to some extent in the early 20th century. The methods of history seemed to come under an intellectual cloud from the influence of troubling developments in physics (relativity and quantum physics), which seemed to undermine the prospects for straightforward empirical and inductive approach to knowledge. In this case, it is developments in the scientific field that played some part in a turning point in thinking about history.

The expansion of the domain of history in the 20th century was to some extent the outcome of the increasing availability of source material of different kinds, and it inevitably led to a certain amount of fragmentation and specialism. A growing appreciation of the two-way and somewhat blurred interaction between theory and fact – to some extent acquired from the human sciences – encouraged some historians to embark on the project of converting history into scientific discipline itself, with mixed results. So there is a tension at the heart of modern historical scholarship – between the proliferation of sub-fields and the drive to unify the discipline through established protocols from the human sciences.

7.6 Links to personal knowledge

Knowledge framework: *Links to personal knowledge –* Why is this area significant to the individual?

Knowledge framework: *Links to personal knowledge –* What are the implications of this area of knowledge for one's own individual perspective?

Knowledge framework: *Links to personal knowledge –* What is the nature of the contribution of individuals to this area?

History, as shared knowledge, impacting personal knowledge

We have seen in the section on applications how history can play an important role in creating and maintaining our individual sense of identity – as an individual and as a member of multiple groups that share provenance. We have also seen how politicians and educators value history very highly in their own ways, which indicates a powerful role for the subject in each of our lives.

The Swiss–British thinker Alain de Botton has recently popularized the idea that history in particular, and the humanities more generally, play a therapeutic (almost counselling) role in our lives – one that should be extended to formal study of these disciplines in schools and universities. History must play a part in the development of our personal identities and values, as well as shedding light on the shared human condition. The British historian Beverley Southgate has suggested that history can contribute to not only knowing ourselves, but in a sense 'creating ourselves'. These ideas hark back to earlier conceptions of history as the stage upon which moral questions are displayed and resolved – as have been endorsed by historians from Herodotus in ancient Greece, through enlightenment figures and on to even those who would impute a larger role for history such as Arnold Toynbee. Within academia, such opinions have become unpopular in modern times, and so this is an attempted renaissance of a more personal role for history in our lives. These ideas are discussed further in Chapter 10.

The Princeton historian David Cannadine has argued that the work of many historians has been directed toward emphasizing shared knowledge restricted to particular identity groups such as class, gender, nation, and civilization, and feels historical scholarship should focus more on solidarity with humankind as a whole, rather than supporting the identities that divide us.

Prominent historians making personal contributions to the shared knowledge of history

We have also looked at some prominent individual historians throughout this chapter. It is worth pointing out that the community of historians is a looser association than the corresponding one of scientists, and, to a more marked extent, the work of the historian is solitary. We should also acknowledge that, as this chapter has shown in its examples and extracts, journalists can be considered as the drafters of the first versions of history, and their contributions should not be underestimated, even though they might not be trained in the formal methods of history.

Exercise

62 How large an effect do you think these last two points bring to bear on the nature of historical knowledge?

It is also true that some historians (and others) fail to meet standards set by the academic community, and find that their assertions and arguments are given space for expression only outside the professional community itself. Such is the case of David Irving, who has devoted much of his career to the attempt to downplay the intentions behind, and the extent of, the Jewish Holocaust in the 1940s.

Ideal knower: Charles Freeman

Charles Freeman is a British historian whose specialisms are ancient Greece and the Roman Empire. He has also taught IB TOK and history, and was a TOK examiner for many years. The connections between these aspects of his career become clear in his book *The Closing of the Western Mind: The Rise of Faith and the Fall of Reason* (2003), in which he puts forward the thesis that the achievements of ancient Greek culture were undermined by the rise of a dogmatic form of Christianity in the later Roman Empire – a process characterized largely in terms of the two WOKs mentioned in the title:

"The Greeks were the first to distinguish, assess and use the distinct branch of intellectual activity we know as reasoning. By the fifth century BC, they had grasped the principle of the deductive proof which enabled them to make complex and irrefutable mathematical proofs. They also set out the principles of inductive reasoning – the formation of truths from empirical evidence. [...] These truths, however, are always provisional. [...] The Greeks recognised this as well as grasping that theories must always be the servants of facts. [...]

The argument of this book is that the Greek intellectual tradition did not simply lose vigour and disappear. [...] Rather in the fourth and fifth centuries AD, it was destroyed by the political and religious forces which made up the highly authoritarian government of the late Roman Empire. There were premonitions of this destruction in earlier Christian theology. It had been Paul who declared war on the Greek rational tradition through his attacks on 'the wisdom of the wise and the empty logic of the philosophers', words which were to be quoted and re-quoted in the centuries to come."

The relationships between WOKs and religious knowledge is examined in more detail in Chapter 10. Freeman also underlines the need for provisional interpretations of events selected for study because of their broader significance in history when he writes in 2003:

"My own feeling is that this is an important moment in European cultural history which has for all too long been neglected. Whether the explanations put forward in this book for the suppression are accepted or not, the reasons for the extinction of serious mathematical and scientific thinking in Europe for a thousand years surely deserve more attention than they have received."

Ideal knowers: Annales school

The Annales school is a French historical movement that has promoted the study of history with an emphasis on social movements rather than the influences of prominent individuals. It was founded in the late 1920s by Marc Bloch and Lucien Febvre, who developed methods that incorporated material from beyond the traditional ground of history itself – especially insights from geography and economics.

Some of the underpinning ideas of the Annales school have been picked up by more recent movements that seek a more scientific basis for historical investigation. In this sense, you might recognize the Annales school as a sort of forerunner to some of the ideas explored earlier in this chapter.

08 Arts

On previous page – How we define art?

The glass pyramid of the Louvre, made up of 673 glass segments, is as iconic as many of the art collections within the museum.

8.1 Introduction to the arts

What are the arts?

In TOK the arts are often thought of in contrast to other things. We contrast the arts with the sciences, with nature, with reality, with morality, with sport, with craft: *ars longa, vita brevis* – art is long, life is short. The arts are often used in TOK as a contrast to the natural sciences. It is tempting to let this push us into an extreme comparison between art and science as shown in Table 8.1.

Table 8.1 An extreme view of art versus science

Art	Science
subjective	objective
fictional	real
uses emotion	uses reason
individual	collective

In this chapter, we shall challenge these extreme views and explore the question of whether or not the arts, like the sciences, are just concerned with producing a representation of the world that solves problems.

Exercise

1 Discuss each of the following statements with a classmate. Which statements do you agree with and why?

- **a** The arts are purely for enjoyment.
- **b** The purpose of the arts is to make us happy.
- **c** Knowledge is a type of belief. There is no belief in the arts, therefore the arts embody no knowledge.
- **d** Anyone can appreciate art (dance, music, literature), there is no special knowledge required.
- **e** The arts are not designed to solve any particular problem.
- **f** Whether a work of art is good or not is just a matter of opinion.
- **g** There is no reason in the arts. They act purely at an emotional level.
- **h** A work of art is just the expression of the emotions of its creator.
- **i** The arts are purely the result of imagination and creativity, they tell us nothing about the world.
- **j** The arts have no effect on the development of human knowledge.

Did you find the exercise difficult? How many statements did you agree with? A good case can be made for disagreeing with all of them. That is something we shall examine in this chapter.

Prescribed essay title 1: Popular stereotypes frequently present the scientist and the artist as extreme opposites in their pursuit of understanding – the scientist being objective, disciplined and rational, and the artist being subjective, impulsive and imaginative. Yet are they really so different in the ways they look at the world? To what extent do you consider these stereotypes accurate, and to what extent do you consider them distortions of the ways in which the sciences and the arts give us their knowledge?

The following statements about art might be a little less controversial.

1 Not everything is art.
2 Artists create works of art, which reflect the skills, knowledge, and personalities of their makers.
3 Works of art can be interpreted in different ways.
4 Although there are many kinds of value that works of art may possess, their distinctive value is their value as art.
5 The character of a work of art endows it to a greater or lesser degree with this distinctive value.
6 Artworks succeed or fail in realizing their aims.
7 Artworks can be understood or misunderstood.
8 Artworks may be subjected to analysis.
9 Artworks may be praised or criticized.

How many of the above statements do you agree with?

Prescribed essay title 2: 'The knowledge contained in the arts differs from scientific knowledge in that the latter is concerned with explaining, while the former enlightens where explanations fall short.' Discuss how useful this distinction might be in differentiating these areas of knowledge.

The arts and knowledge

This chapter uses the knowledge framework to make some progress in understanding the arts as an AOK. But perhaps the biggest knowledge question underlying the arts is how they can be thought of as knowledge at all. After all, an artwork is a creation of the human imagination. It is difficult to see how such purely imaginative work can be linked to knowledge about the world. But let us take a deep breath and return to the broad notion of knowledge we started with: knowledge is a map designed to solve particular problems. So, if we are to treat the arts as an AOK, we need to pinpoint exactly what sort of problem is solved by the arts. You might want to think about this question a little. How would you answer it? We shall break it down into smaller pieces and deal with it in the next section.

Another issue to tackle early on is how to define art. This is not an easy task and our exploration could end here if we let it. But we might reflect that, on the whole, we recognize that something is a painting, a dance, a piece of theatre, a film, a ballet, a piece of music, a work of architecture, or a sculpture.

In keeping with other AOKs, we shall investigate the role that language plays in the arts. Some art forms such as poetry, novels, film, and theatre use natural language as an integral part of the work. Many, such as music, painting, and dance, do not employ words. They might, nevertheless, use language of a more general kind. It does seem to make sense to talk of the language of dance or the grammar of music.

More obviously, art forms such as music or dance employ conventions. These are practices or rules that become established through social interaction. The use of harmony in music is a good example of a convention. Conventions act as limitations on artists and, like many limitations, they serve to produce significance, meaning and, ultimately, value. Language in this broad sense is a crucial component of the arts.

The methods of the arts appear at first sight to be quite unlike those of the sciences. They seem to rely heavily upon the free imagination of the artist unconstrained by facts about the world. Nevertheless, painters seek to represent the world in some way; novelists and film-makers describe plausible human situations based on observation and experience of human psychology. Choreographers represent human interaction in a highly stylized way and musicians play on the psychology of acoustic perception in the construction of their works. There are many ways in which the arts are connected to the material world and the world of human experience. Moreover, each artwork does seem to possess some sort of inner logic; a sort of virtual reality is created in which we can play around with ideas. In this sense, the arts might be a sort of laboratory in which we can experiment with, and model, real human issues.

CHALLENGE YOURSELF

The Rothko Chapel is an institution founded in 1971. It is inspired by the work of Mark Rothko, and is open to all people of all faiths. Its aims are contemplation and action. Use the weblink below to check out the Rothko chapel and consider this question: *What sort of reality might be represented by Rothko's abstract minimalist style?*

Prescribed essay title 3: 'Art upsets; science reassures.' (Braque) Analyse and evaluate this claim.

In earlier chapters, we discovered that other AOKs are shaped by the past. This is particularly true in the arts where the meaning of an artwork is strongly tied to its location in the continuum of art history. Artworks often refer explicitly to other artworks, styles, or methods. It is possible to make *ironic* references in an artwork, for example, to past artworks or historical styles in order to create tension with current understanding. A sense of history could be said to be crucial in understanding and valuing art.

Lastly, art makes an impact on us as individuals. A good artwork can actually make us change the way we view the world. We can leave a concert hall or a theatre a slightly different person from the one who entered. The arts can inspire us to act, they can cause us to change our minds. In this sense, the arts can have a powerful effect on us as individuals.

To learn more about the Rothko chapel, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 8.1.

Each of these aspects of the knowledge framework is explored in greater detail in this chapter. But we use a number of terms that need a little explanation first.

- ***The arts / art*** – This general term covers all artistic knowledge and activity.
- ***Art form*** – This refers to an individual discipline such as painting, weaving, filmmaking, jazz, dance, and architecture.
- ***Artist*** – The producer of an artwork; a single person or a group of people.
- ***Artwork / work of art*** – The product of an artist; either material such as a painting, photograph, sculpture or film, or abstract such as a dance, or a musical composition.
- ***Audience*** – The 'consumers' of the work of art.
- ***The art world*** – All those who are closely linked to the arts such as artists, producers, museum directors, gallery owners, critics, art historians, art journalists, and patrons who support the arts.

8.2 Scope and applications

Knowledge framework: *Scope and applications* – What is the area of knowledge about?

Definition of the arts

Our first job is to define what we mean by *the arts*.

Exercise

2 Discuss with a fellow student which of the following count as art. In the course of your discussion, try to identify what criteria you use to decide whether something is art or not. Why does it matter whether or not we describe a thing as art?

- **a** The painting ***Sunflowers*** by van Gogh
- **b** A football match
- **c** A pile of bricks on a building site
- **d** A pile of bricks in the Tate Gallery, London (see photograph in margin)
- **e** A meal produced by a top restaurant in your country
- **f** The German expressionist film ***Metropolis*** (1927) by Fritz Lang (see photograph in margin)
- **g** A sunrise
- **h** A piece played by a Gamelan orchestra
- **i** A Japanese ***Noh*** play
- **j** A picture painted by a 5-year-old child

The Tate Gallery's famous 'pile of bricks' (*Equivalent VIII*, Carl André 1966).

A scene from *Metropolis*.

There are three points you might have noticed about this exercise.

- Deciding whether or not something is art is quite a different question from whether it is good art or not. It might be that a painting by the 5-year-old is art but that you decide that it is not necessarily good art.
- Art might require three basic elements: an artist, an artwork, and an audience. So art, like other AOKs discussed in this book, is a human activity.
- Clever definitions of art might include self-reference. You might decide that an artwork is something that the artist intends to be an artwork. Alternatively, that might be something that is decided by the audience.

We shall not spend much time in abstract discussion about the merits of this or that definition of art. That is a job for philosophers of art and it keeps them very busy. But some reflection on the third bullet point might be useful. There is something a little surprising about it. It includes a reference to 'artwork'. But is this not a circular definition? Are we not warned against defining something in terms of itself – that a definition should not include the word to be defined? But there is a subtlety in this case. It is saying that something is art because the artist intended it that way, which is not actually circular. We are not saying 'it is an artwork therefore it is an artwork'. What we are saying is that the intention is sufficient to make it so. This is what is called a **constitutive** definition. The artist's intentions are sufficient to magically transform an otherwise artless piece of material into art.

This property is characteristic of a larger class of things that are called **social facts**. If the right person says 'I now pronounce you man and wife' to a couple, they are magically transformed into a married couple. If enough people believe a certain sort of printed

Is it art?

paper is money, then it is money. Social facts are all around us. They are just as solid as facts about the material world. They can be true or false, but they are constituted by an intention or a belief, or by the right person using language in a certain way.

Whether a work of art is good or not might also be a social fact. But it might not be the artist who decides this. Instead, what is meant by good art and which art pieces qualify might be decided by a particular group, let us call it the *art world*, that consists of gallery curators, private collectors, art historians, art critics, and some influential artists. This is only one view of value in art. It is called the **institutional** view or theory, and we shall return to it later (Figure 8.1).

We might ask what sort of thing might be acceptable as a definition of art. Could we accept the institutional view? It is, at least a definition and a perfectly reasonable one at that. But we might be a little uneasy that it does not seem to depend on any particular characteristic of the object itself. According to this definition, anything could be art depending only on the right people thinking it is.

The philosopher William Kennick (1958) proposed a test that a definition of art should satisfy. He suggests a scenario where a warehouse is on fire. You have to rescue the artworks in the warehouse armed only with a definition of art (Figure 8.2).

Some thinkers like Berys Gaut think that the idea of art is more like a cluster of properties than a single property. Wittgenstein called this a *family likeness*. Each member of the family might have some characteristic in common with another member of the family, but there is no single characteristic that they all share (Figure 8.3).

Figure 8.1 Does the art world decide what is a work of art?

But there are some who think that art does not even have a family-likeness definition. They are called **anti-essentialists** because they think that there are no essential properties that make something a work of art. This category includes a number of feminist thinkers who are suspicious of the motives of a search for a definition. Definitions are dangerous, they say, because they make solid a set of relationships in which males dominate. For example, we make a distinction between the fine arts and the crafts. Feminists point out that the fine art category is dominated by men while women dominate the area defined as the crafts. And which category is seen by many to be artistically superior?

Figure 8.2 The warehouse test for a definition of art.

Figure 8.3 Family likenesses.

CHALLENGE YOURSELF

Do you agree that a successful definition of art is one that enables you to complete the warehouse-fire mission successfully? Is it helpful to be told that you should rescue all those works that are considered art by the art establishment?

Exercises

3 Write down 10 famous artists. How many of them are women? What do your results mean?

4 Do you agree with the feminist view that definitions are dangerous because they perpetuate male dominance?

5 Berys Gaut came up with the following definition of art. X is an artwork if and only if it satisfies some, if not all, of the following conditions.
   - **a** X is intended to be an artwork.
   - **b** X is identifiable as an artwork.
   - **c** X falls easily within an established art category.
   - **d** X possesses aesthetic, formal, expressive, or representational properties.
   - **e** X has the capacity to communicate complex meanings.
   - **f** The production of X requires skill.
   - **g** The production of X requires creative imagination.
   - **h** X invites the emotional and cognitive response of the audience.

   Try this definition out on your favourite works of art (music, literature, film, etc.). Does it work? Now try it out on something that you do not regard as art. Is your suggestion of non-art rejected by the definition?

6 To what extent might it be true that the arts are the systematic treatment of sense experiences? For example, music would be the systematic treatment of the sense of hearing – organized sound. The visual arts would be organized vision. What art forms represent the systematic treatments of taste, smell, and touch?

Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

Types of problem addressed by the arts

Our starting point is that knowledge is a map constructed by human beings to solve particular problems. We asked earlier what sort of problem might take the arts as a solution. Here we examine this question in detail and divide these problems into two distinct groups.

- ***External problems*** – Artworks might solve problems that originate outside the art world. These could be problems to do with our relation to the environment, or problems occurring in human social or political life. They could be big problems arising from the mystery of existence itself. They could be big questions about our relation to the whole cosmos.
- ***Internal problems*** – These are problems encountered within an art form itself. They can be thought of as 'engineering problems' within an art form. Just as a building, a bridge, or other structure has to overcome particular engineering problems, so an artwork also has to be constructed in such a way as to be effective as an artwork.

An analogy might help here. Consider an architect commissioned to design a new airport. There are two types of problem to solve: external and internal. The external problems are those of providing a space to house ticket desks, check-in counters, security channels, shops and gates, for example. The internal engineering problems (and in this analogy they are literally engineering problems) are how to build large vaults without the ceiling falling in, how to make the design light but strong. There are also aesthetic problems: how to make the design both unified and interesting to look at. Ultimately, the architect has to combine form and function in an effective manner.

Exercise

7 Consider a public building you know well. How did the architect solve the external and internal problems? How are form and function combined?

Knowledge framework: *Scope and applications* – What makes this area of knowledge important?

Knowledge framework: *Scope and applications* – Are there ethical considerations that limit the scope of inquiry? If so, what are they?

Some external problems that art considers

Art and human interrelationships

One set of external problems that artists grapple with is to do with the nature of our relationships with each other. Almost all plays, films, and novels deal with the evolution of human relationships under various conditions. The novel, for example, provides a perfect laboratory for exploring what happens when human relationships are put under various types of stress. The French writer Emile Zola's *Thérèse Raquin* (1867) is a perfect example of a novel that tries to answer questions about the response of human beings to extreme situations.

A reasonable objection at this point might be that the discipline of psychology does the same thing more systematically. But the novel deals with the problem in a distinctive manner. It is vivid and personal, and gives the reader an intimate insight into the emotional and psychological states of mind of the characters. The novel allows us to vicariously experience what individuals might think and do, while psychology gives us general laws of human behaviour.

Exercise

8 Can you think of a novel that functions as a laboratory for studying human relationships? In what way is the world of the novel a model or an idealization of what happens in real life?

Art and the natural world

Our relation to our natural environment is a favoured topic of visual artists. There are many who explore the characteristics of the material world that surrounds us, from painted landscapes and seascapes to sculpture in iron, bronze, plastic, and even concrete. In the 19th century, there was a panorama craze. Special buildings were constructed to house massive canvases representing the outside world on a vast scale. Again, we might detect that the arts take a different approach from the natural sciences. While chemistry and biology explore the internal structures to be found in an oak tree, the English painter John Constable (1776–1837) conducted an inquiry into the colours and textures of leaves and branches in the afternoon sunlight. There is a direct link with our own personal experiences of particular oak trees that does not have to be translated into the abstract generalities of chemistry and biology.

The Hay Wain (1821) – a painting by John Constable

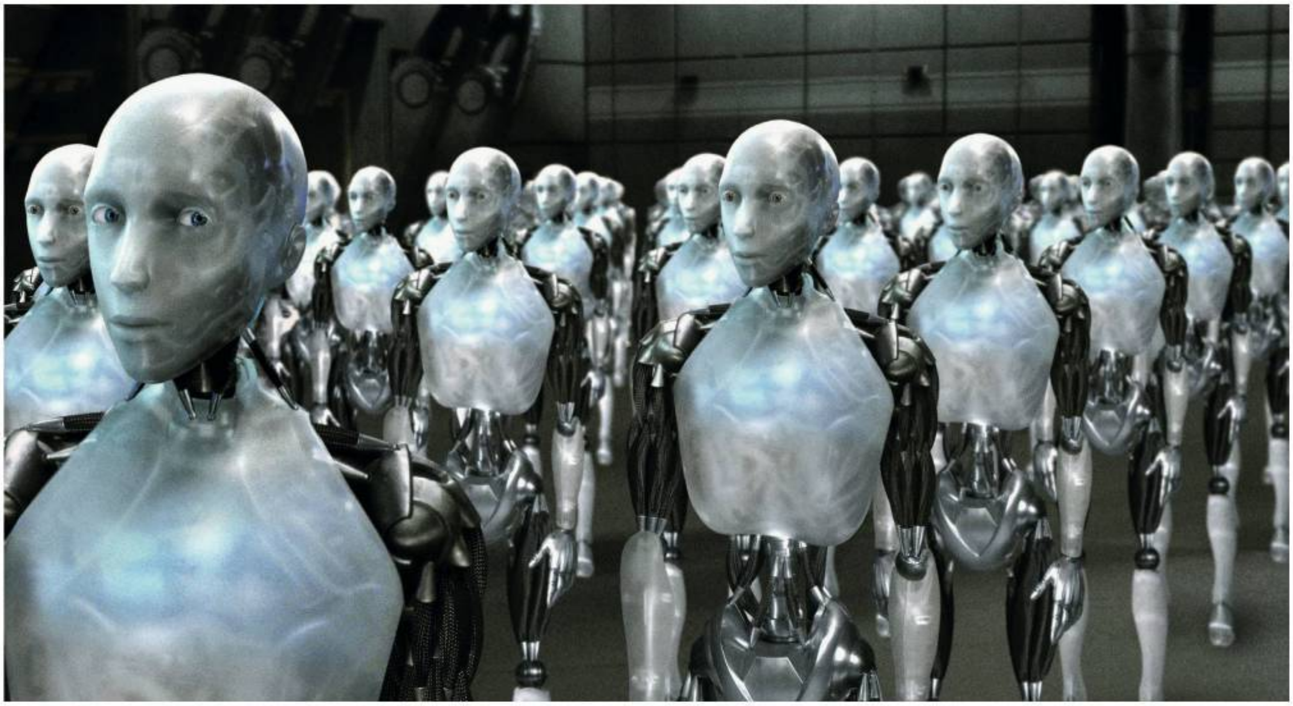
Art and politics

So far we have considered art as a representation of the world in response to contemporary questions concerning humans' place in it. But many artworks investigate aspects of the world as it was – they explore human history. This might be actual history (as in Picasso's *Guernica* (1937), a painting representing the bombing of the small town of Guernica in April 1937 during the Spanish civil war), or it could be imagined or mythological history (as in Shakespeare's *Macbeth, Anthony and Cleopatra,* or the classical mythological settings for the paintings of Claude Lorrain (c 1600–82) (known as Claude in English), and Nicolas Poussin (1594–1665). The choice of historical themes is often used as a device for exploring features of human nature that are universal. The idea is that the work of art is saying to us, 'Look, people in Julius Caesar's day behaved just the same as they do today – these characteristics are constants of human nature.'

The advantage that the arts have over the sciences is that they can refer to possible worlds as well as existing worlds. The philosopher Friedrich Nietzsche (1844–1900) felt that this made the arts a better way to measure the psychological health of a society than its morality. Morality was, according to Nietzsche, mostly concerned with saying 'no' to things that human beings wanted to do. The arts on the other hand were all about saying 'yes' to the human imagination. This power to invent other worlds is used to great effect in literary or filmic genres such as science fiction, where questions of human nature and morality are set in fictional environments with special rules. This is a powerful tool for exploring human nature.

Exercise

9 What comes to mind that might support the view that science fiction and futuristic literature usually refer to issues that concern us at present?



Scene from the Twentieth Century Fox Film Corporation production of *I, robot* (based on a book written in 1950 by Isaac Asimov).

The ability to portray possible worlds makes art an immensely powerful tool for examining human society and questions to do with political and social change. If an artwork can show the audience how the world could be better under alternative social or political arrangements, it has the possibility of producing such a change. Art then might be able to change political or social perspectives, and energize people into making social changes.

There are many examples of artworks banned by political authorities because of their potential for fomenting dissent. The Soviet composer Dmitri Shostakovich (1906–75) was taken to task for writing music perceived to threaten the stability of the state. His music was strictly monitored by the state censor, and his opera *Lady Macbeth of the Mtsensk District* was openly criticized by senior figures in the Communist Party in 1936 for what was thought to be a satirical commentary on contemporary Soviet society. The extraordinary 5th Symphony that followed was much more cautious and is sometimes subtitled 'a soviet artist's creative response to justified criticism', but some musicologists think that the use of folksongs and fragments from the Russian orthodox mass represent a cryptic act of support for the people defiant against the excesses of Stalin's regime.

Just as art might be a vehicle for bringing about social change, so it might also be used to maintain existing social structures and produce conformity to the *status quo*. This, at least, was the view of Theodor Adorno and the Frankfurt School of critical theory in the 1930s and 1940s. They were trying to find reasons why the overthrow of capitalism predicted by Marx's social and economic theory had not occurred. Instead of invoking economic or political reasons, they looked to the arts. Adorno in particular attacked Hollywood in the 1940s for producing films that gave people the impression that they were living in the best of all possible worlds. His view was that popular culture was

A fine example of Stalinist propaganda against the West.

controlled by capitalist forces which had an interest in preserving capitalism. He argued that the arts gave people a false consciousness of their own situation, they felt good after seeing a movie where the good guys win and everyone ends up being rich and happy, families are celebrated and the bad guys are locked away. People, he thought, would identify with the values being portrayed on the screen and would walk out of the cinema content with their place in life. No one would start a revolution after seeing such a film, so capitalism would be safe.

But we do not live in the best of all possible worlds and the purpose of art, according to Adorno, is to destroy the illusion and false consciousness created by what he called the popular 'culture industry'. Art can only do this by making people unhappy. Adorno and the Frankfurt School felt that the only types of art that could effectively break the spell were hard-hitting contemporary works such as the opera *Lulu* written in 1934 by Alban Berg (1885–1935).

Art has been used for maintaining the political order more explicitly through propaganda in the form of posters, films, and documentaries. Wars tend to generate vast quantities of art whose purpose is to encourage loyalty and patriotism, and to move people to contribute to the war effort. In peacetime, propaganda is used to reinforce the existing social and political structures, and to create precisely the sort of 'false consciousness' that Adorno so abhorred.

It is not just the visual arts that were used for such purposes. During Stalin's rule, artists in all media were encouraged to celebrate the fundamental values of Soviet society. This often meant a portrayal of the worker as hero in an industrial or agricultural setting. A movement known as Socialist Realism created works that were literal depictions of everyday industrial life. A particular favourite is *Zavod* (often referred to as the *Iron Foundry*) by the Socialist Realist composer Alexander Mosolov (1900–73). The piece is for large symphony orchestra and is a literal rendering of the sounds of an iron foundry.

To hear *Zavod*, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 8.2.

Zavod is four minutes long, but includes the full gamut of industrial noises associated with the production of iron. At the same time one can still identify melody, rhythm, and harmony. It is recognizably music written in the early modern tradition – it is art rather than just the incidental noise of heavy industry.

Through advertising, art plays a role in creating economic needs and desires. It is effective for some of the same reasons described above. It is direct and has an emotional appeal. Perhaps it is able to bypass our most reflective critical faculties – the last thing an advertiser wants is for us to reflect rationally on whether we really need product X.

Exercise

10 Consider this advertisement or choose one (either an image or a clip) that appeals to you. What role does art play in persuading you to spend money? Is it plausible that the artwork changes your personal desires and beliefs? Is there a sense in which the artwork produces a distorted picture of the world?

A fusion of art and advertising.

Art and religion

It is not only political and economic structures that can be maintained by the arts. For millennia, the arts have been associated with religion. Parallel to the history of Christianity is a history of church architecture, church music, church sculpture, and church painting. Similar stories can be found in Islam, Judaism, and Hinduism. In the past, art provided a direct vector into the minds of a largely illiterate population, and was a very effective means of maintaining and reinforcing the religious *status quo*. Art was present at the very core of religious practice in the rituals and ceremonies that defined membership of a particular religious group. Art was not incidental to religion, it was essential.

Exercise

11 How does the importance of the artist or the maker of art differ between ancient art and that of the present day?

Inuit art often has a quasi-religious function. For example, Inuit masks are used to reinforce Inuit mythology, to assist with the telling of history, and in religious ceremony and ritual.

Art was also significant to religion through certain sorts of absence. In Christian belief, God has forbidden humans to worship any image or sculpture. This led to conflict over statues of the Virgin. In Islam, one is forbidden to make any image of the Prophet, and no image of a person can appear in a mosque. Islamic art is therefore characterized by its use of abstract pattern and extraordinarily ornate inscription of passages from the Qu'ran, and by the absence of depictions of human beings.

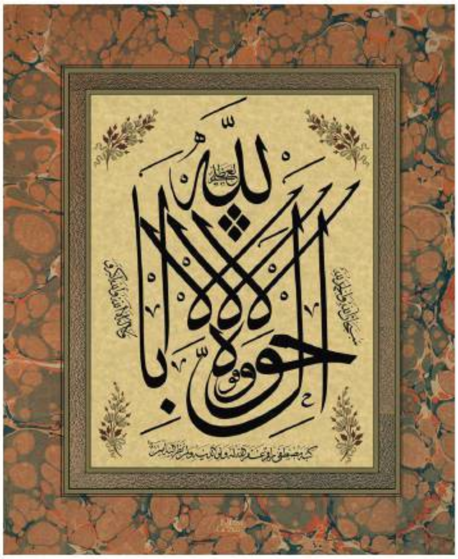
In contrast, statues of Hindu deities abound in and around temples. They are often accompanied by specific objects whose symbolic meaning helps to remind the audience of their wider significance.

CHALLENGE YOURSELF

Can you identify the historical reference in the Stalinist poster on the opposite page?

Inuit masks may be made from a variety of natural materials and are often brightly coloured.

Sculpture plays an important part in the transmission of Hindu religious knowledge.



A calligraphic panel by Mustafa Rakim (1757–1826).

Art and ethics

Morality and ethics provide a large class of questions explored by artists in many different fields over the centuries. You might ask yourself two questions:

- How many novels have you read that pose a moral question at their centre?
- What might be the advantage of exploring moral questions in a novel rather than in a philosophical treatise?

Since most novels explore questions of how to live and what choices to make, they almost invariably deal directly or indirectly with moral questions. Such situations form the core of many films, novels, operas, ballets, and short stories. By exploring the moral questions we all face as individuals, authors invite their readers to experience (vicariously) what it feels like to be facing these questions. Thus, the reader engages directly and emotionally with the issues in a way that doesn't happen when reading a philosophical treatise.

Art and human survival

Finally, the arts address our very existence and survival. A number of authors, most notably Dennis Dutton in his book *The Art Instinct,* have suggested that we all have a basic human instinct for art. This 'art instinct' is not a direct adaptation. It is not that people who have more refined artistic taste somehow have more children. Rather it is a by-product of other adaptations that enabled us to survive in the ancestral environment.

Many students in TOK essays simply assume that the purpose of an artwork is to communicate the emotions of the artist. There is possibly only one period of art history in which artists did try to do this – the period given over to what we now call *expressionism*. And novelist Leo Tolstoy is one of a small number of writers who considered that all art should transmit a feeling or an emotional response to the audience. A TOK essay on the arts that makes the same assumption without further discussion is unlikely to achieve a high score.

Much research has shown that across cultures we agree rather well about what is beautiful. For example, we show a preference for pictures that portray environments containing distant trees, animals, and water. Dutton suggests that this environment is remarkably similar to the savannah where humans took their first steps. Of course, as we saw in Chapter 5, we must be wary of a tendency to over-simplify matters in debates of this kind which purport to discuss the numerical balance of nature against nurture. Clearly, the huge diversity of art on offer in the world and its obvious cultural dependence shows that artistic taste is not just a matter of biology. Nevertheless, these arguments cast doubt over assumptions that artistic judgements are purely socially constructed.

But what about the view that the arts simply provide entertainment; that they are solutions to the problem of how to pass the time in a life which offers no meaningful activities? While many television programmes and some movies do share such aspirations, a case can generally be made that even these works are well-crafted, solve internal artistic problems (i.e. they are, on the whole, professionally made), and that they hint at deeper issues than just pure entertainment. Even the much-maligned video game might provide insights into strategy and psychology, and explore certain aspects of problem-solving in addition to being just good fun.

Exercise

12 Choose a TV show and ask yourself the following questions. In what sense is the show well-crafted? How does it solve the internal problems of providing a unified and varied TV experience? Does it borrow from other art forms such as film, theatre or literature? Can you identify any deeper knowledge questions that it raises?

In the next sections we shall explore just how the arts manage to be more than entertainment and what methods they employ.

8.3 Language and convention

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

We have seen that the arts provide the means for exploring a wide variety of questions concerning human psychology, our relation to the universe, morality, and human social arrangements. Here we come across a problem. In order to pose and answer questions we require language. But, with the exception of literature, natural languages such as French or Spanish, Japanese or Urdu do not play an essential role in the arts. Even in literature, the role of language is somewhat different from other AOKs in that the questions asked by literature are usually not posed directly but rather emerge implicitly in the work. So the puzzle is: how can art forms such as painting and music help us to answer questions and solve problems in the real world without the use of natural language?

The solution to the problem might be that the arts do employ language, but not natural language. Perhaps there is a language of painting, music, or dance. Perhaps there is even the language of a particular painting, a piece of music, or dance piece. The clue lies in the idea of convention introduced in Chapter 4.

Knowledge framework: *Language and concepts* – What is the role of convention in this area?

Defining conventions

Recall that a convention is a set of rules established by a group of people in order to solve a particular problem. In Chapter 4, we discovered that there were a number of conventions that helped scientists around the world to understand each other; for example, the international units established to measure physical quantities such as length (the metre, m), mass (the kilogram, kg), time (the second, s), and so on. There are other conventions such as driving on a particular side of the road in any given country. The purpose of this convention is to enable the free flow of traffic. The point about convention is that it is arbitrary in the sense that it does not have to be this way. We could drive on either side of the road as long as everyone does the same thing. Most of Europe drives on the right-hand side; among others, Australia, Kenya, Indonesia, and the UK drive on the left. Similarly, there is nothing about the physical world that forces us to use the metre as a measure of distance. These are examples of social facts.

Exercises

13 Choose an artwork. How is language used in your chosen work? Is natural language used in your artwork? Are there any other non-natural types of language used?

14 Choose an art form and with your classmate try to list five conventions used by it. What is the purpose of convention in your chosen art form?

Portrait of Hesire *c.* 2750 BCE in Egyptian museum, Cairo.

Convention in ancient art

There are many conventions in the arts. Ancient Egyptian art adopted a convention of portraying the head in profile, but the eye, the shoulders, and chest are shown in full frontal view, the legs are shown sideways, and both feet are shown in profile from the inside. This seems peculiar today because no person could have 'looked like' that and it is difficult (if not impossible) to twist one's body into the peculiar shape of the Egyptian picture. But the Egyptians were not trying to depict how the whole person looked.

In his book, *The Story of Art* (1995), EH Gombrich points out that Egyptian painters were more like mapmakers than artists. This fits our definition of knowledge as a map perfectly. Many painters were aiming to represent the world in a symbolic manner according to their own conventions, just like a map. Gombrich suggests that they were representing function rather than appearance. Perspective is dispensed with. What use is a man drawn with his arm foreshortened due to perspective? With such a short arm he would not be able to bring the required offerings to the dead. The painters were aiming to make their representations clear, complete, and permanent, rather than beautiful.

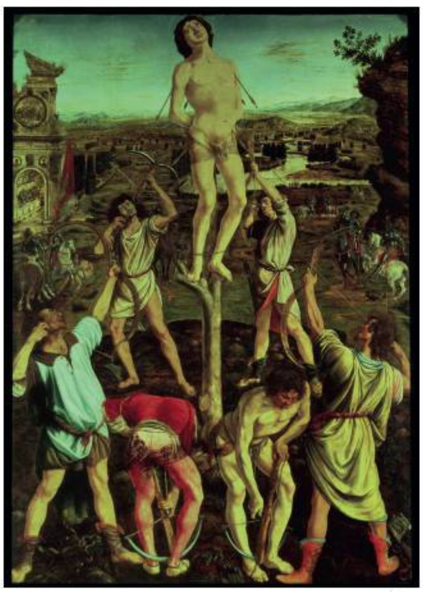
Gombrich goes on to suggest that knowledge of the significance of the people and things portrayed was just as important as that of the forms and shapes that went into the picture. For example, servants (and wives) were drawn often significantly smaller than their masters (or husbands). Understanding of these rules was necessary to understand the language of the pictures in which the life of the Egyptians is depicted.

So, the conventions adopted by the Egyptian artist were like symbols on a map that allowed the painting to be deciphered. The painting represented the temporal world including the power relations within it but also things that were to happen in the afterlife. The artwork employed a clear language with symbols and conventions or rules for combining them to solve a particular problem: that of describing the identity, and political and social status of the buried person for the purposes of passage to the afterlife.

Convention in more modern art

Conventions are just as prevalent in more recent paintings but may be harder to spot because we are so used to 'reading' them.

For example, examine these two paintings. They use quite different conventions, but what difference do you find most striking?



Martyrdom of St Sebastian (completed 1475) by Piero del Pollaiulo.

Assendelft Church, 1649, with the gravestone of the artist's father in the foreground by Pieter Jansz. Saenredam.

The most striking difference between these paintings is their handling of perspective. The older painting is flat, the figures are more or less the same size, and the background feels flat. This is not because there was no perspective in the 15th century. It is because this was not a feature that was considered important to render in a painting. The Flemish masters changed the whole convention. Through the strength of their work they persuaded others to follow their example. They showed artists how to incorporate perspective and changed the conventions leading to a different **artistic style**. A collection of corresponding artistic styles might be called an **artistic tradition**.

We might be tempted to think that when a 21st-century TOK student sketches a scene he or she does it *as it really is* without any use of convention at all. Not so! The scene is necessarily in three dimensions, the drawing in two, so it cannot be completely realistic. There have to be conventions for handling the third dimension. One of these is perspective. But you might reply that the student would represent the scene much as a camera does when it records a photograph.

Let us test this intuition. Without reading further, sketch the following scene. *You are standing in the middle of a straight railway track looking at the horizon. On the right side of the track there are poles carrying telephone cables. On the left side there is a station house in the middle distance.*

You probably drew something like Figure 8.4.

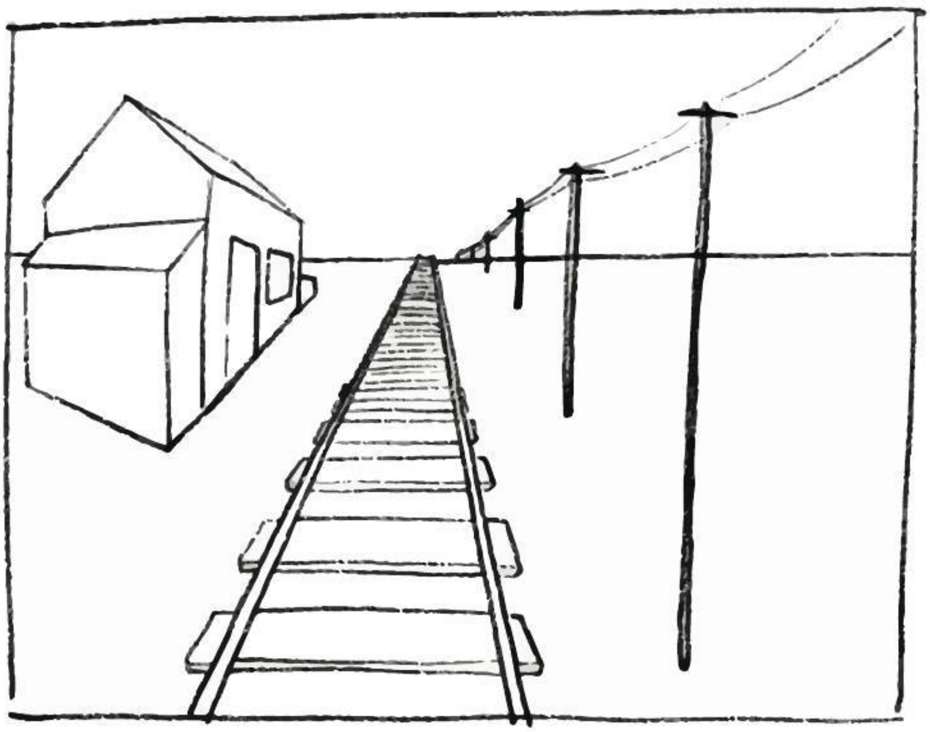


Figure 8.4 What conventions are used here?

What is interesting about Figure 8.4 is that horizontal parallel lines such as the railway lines converge to a vanishing point on the horizon. We accept this because we experience distant horizontal lines in our everyday life. But what about the vertical lines? *They should converge as they approach the top of the drawing*. But they are drawn parallel. This is not how they would appear on a photograph: the camera would record

Vertical convergence of parallel lines.

vertical convergence in the same way that it records horizontal convergence. Imagine standing at the bottom of a skyscraper with a rectangular cross-section and looking up, you would see the same sort of convergence as with the railway lines.

The conventions for drawing horizontal and vertical parallel lines are so strongly built into our consciousness that we don't even recognize them as conventions.

Prescribed essay title 4: 'Art is a lie that brings us nearer to the truth.' (Pablo Picasso) Evaluate this claim in relation to a specific art form (for example, visual arts, literature, theatre).

Controlling expectations

Convention does an important job through establishing expectations. In music, a G7 chord is usually followed by a C chord and we are surprised if the composer follows a G7 chord with an A minor chord. This type of surprise is called an *interrupted cadence*. A term which gives away the fact that it somehow frustrates our expectations.

Similarly, we might expect the sky in a nightscape such as *Starry Night* by van Gogh (1853–90) to be a uniform dark blue, not a complex of brushwork spirals. In a portrait of a human face, we usually expect the eyes and mouth to be arranged in a regular fashion, and not in a disjointed fractured collection of angular planes as in Picasso's painting of a young girl.

The fulfilling and breaking of expectations produce relaxation and tension. Fulfilling an expectation usually dissolves tension. We get an *Ah, that is what I expected* feeling; a feeling that we are on familiar ground and within our comfort zone, or that we are somehow 'home'. A frustrated expectation is when things do not turn out as convention would suggest. We get a *Strange, what is going on here?* feeling; a feeling that we are outside our comfort zone or that we are still far from 'home'.

Starry Night (1889) by Vincent van Gogh.

As we shall see, these differences in emotional temperature allow artists to structure their work and produce movement: perhaps from relaxation to tension to relaxation again. By controlling our expectations through establishing conventions, the artist can control our emotional responses and structure our artistic experience. This is useful in the project of engineering a work of art.

Exercises

15 Can you identify the setting up and fulfilling and breaking of expectations in an artwork you know? Is it true that frustrated expectations produce a different set of feelings to fulfilled expectations?

16 What expectations are set up and frustrated in Magritte's ***The Human Condition***? To what extent does surrealism rely on frustrated expectations for its effect?

The Human Condition (1933) by René Magritte (1898–1967).

Prescribed essay title 5: In areas of knowledge such as the arts and the sciences, do we learn more from work that follows or that breaks with accepted conventions?

Many students assume that the point of a work of art is to communicate a message. They state that the goal of analysis (of a novel or piece of music or film) is to uncover this hidden message. If this were the case, then there would seem to be little point in hiding the message in an elaborate and lengthy work. Moreover, in the case of music or dance, why choose a non-verbal medium to communicate the message?

A sceptical view of non-verbal communication.

8.4 Methodology

“There is a logic of colours and it is with this alone and not with the logic of the brain that the painter should conform.”

Cezanne

We've considered how a work of art might offer a solution to a number of different types of problem:

- questions about human relations with the natural world
- questions about humans and society
- questions about moral values
- questions about other types of value.

These problems we described as external because they were essentially non-artistic. If we accept that the arts are one way of answering them then it is a relatively straightforward to take the next step and suggest that the arts embody some sort of knowledge about the world.

But we also suggested that the artist has to solve another type of problem that was essentially artistic. It is this set of problems that we called internal or 'engineering' problems that a work of art has to solve. The methodology of the arts describes the strategies employed for solving these internal problems.

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Knowledge framework: *Methodology* – What are the assumptions underlying these methods?

Some internal problems to be considered

Imagine a painter sitting in front of an empty canvas, or a composer sitting in front of a blank manuscript (or more likely these days a blank computer screen), a choreographer in front of an expectant dance troupe, a film director contemplating the next film, a novelist facing a blank document. What decisions do these artists have to take in order to produce an effective work?

Clearly there are technical problems in each case that depend on the nature of the art form itself.

- The painter has to make decisions about the style and composition of the painting. Will it be abstract or representational? How large the canvas will be? What conventions will it employ? What colour palette? What type of texture?
- The composer has to think about what instruments to use, how long the piece will be, what melody, harmony, and rhythm will be used.

- The novelist has to decide on the characters and setting, how to be true to the character, the historical context, the style of the novel, and the general literary techniques that will be used.

Similar decisions have to be made in other art forms. These decisions set out the limits of the work. These limits are important for the artist because they define the 'virtual world' that the work inhabits. In an important sense, these limitations define the 'language' of the work. They set up the raw materials of the work. But there is still another group of decisions that have to be made by the artist. These are decisions that are ongoing throughout the creative process. They concern the dynamic of the work: in a film, novel, or piece of music how the work changes over time; in a painting, architecture, or sculpture how the different elements of the work combine to produce a sense of movement or of contrast. These decisions are structural. They concern the large-scale structure of the work, and explore how it links to the small-scale or surface features.

The question we need to explore here is, on what basis does the artist make these structural decisions? Are there any general principles that guide the engineering of a work of art?

Exercise

17 Think back to one of your own artistic projects. How did you reason about the design of the work? What problems were you trying to solve? What difficulties did you encounter? How effective were your solutions? Did they solve the structural problems you identified? How did your work compare to the work of a 'professional' artist? Did the professional in your field solve these problems in a different manner?

At a basic level, there might be two general structural problems the artist faces once he or she has set up the work of art – that is, decided on the basic 'language' of the work:
- how to produce a sense of unity
- how to produce interest and variation.

Most narrative artworks such as films or novels solve these problems through the story itself. A rough structure might be:

set up the virtual world → introduce a problem →
attempts to solve problem → resolution

We can represent this structure even more abstractly:

consonance → dissonance → consonance

Knowledge framework: *Methodology* – What role do models play in this area of knowledge?

Structural devices in art forms

Written work

Aristotle in his *Poetics* asserted that a well-formed plot should have a beginning, a middle, and an end. The beginning should not depend on anything that happened previously. The middle should follow in a logical manner from the beginning. The work should end in some form of closure. No further action should be needed to make sense of the story. Aristotle insists that the plot should be unified in the sense that everything that happens follows from other things in the plot. He also thinks that the work should contain rhythm and harmony in different proportions in the different sections of the work. The plot should become increasing complex until the moment of *peripeteia* at which the whole thing starts to unwind. This is usually accompanied in a tragedy by a reversal of fortune called an *anagnorisis*. The important point in all this is that there is, for Aristotle, an inevitable logic to a poetic work which follows, roughly speaking, the structure. It is significant in this regard that many courses in film script writing take Aristotle's *Poetics* as a starting point.

Exercise

18 Try to find an example of a movie plot that uses the Aristotelian devices of ***peripeteia*** and ***anagnorisis***.

We might try to look for similar structural devices in other art forms.

Music

In music of the classical period in Western Europe, we have the following structure for a piece in sonata form:

first subject → second subject → development → recapitulation

The first subject sets up the language of the work. It introduces us to the main musical 'character'. This will be a musical theme (usually a melodic line) which is repeated to make sure that the audience knows about its important structural function. The second subject is a new musical 'character' which introduces variation. Now we can see the engineering problem we have to solve: like this, the piece has variation but no unity. What the composer has to do is to show that the second subject is somehow related to the first. This is done in the third section, the development. Here the music starts with the first subject and shows (in musical terms) how this can be transformed to produce the second subject. In a sense, what we have is a musical 'argument'. Now that the second subject is linked to the first, we have achieved unity. Finally, the first subject is repeated (recapitulation) to achieve closure of the work.

What is remarkable about this musical structure is that the listener *reinterprets* the significance of the second subject after the development section has been played. At a first hearing, the second subject sounds like contrasting thematic material. But after the musical argument of the development section, in which the composer skilfully demonstrates the relationship between the two subjects, the listener understands the second subject to be merely a variation of the first. The meaning of the second subject is altered retrospectively. This seems to be a sort of musical *anagnorisis* or reversal of meaning. Composers can use these structural devices to create dissonance and consonance on a large scale to bind a long piece of music together into a whole.

Visual arts

Artists such as architects, painters, and sculptors who work in static media have to solve these problems within the static work itself. There are various techniques they can use. Different parts of a painting can have different shapes or colour schemes, but still frame the same scene. Different parts of the building could use different forms but still be unified by some stylistic element.

Prescribed essay title 6: To what extent may the subjective nature of perception be regarded as an advantage for artists but an obstacle to be overcome for scientists?

Some go quite far in precisely determining the structure of their work. For example, the painter Piet Mondrian, uses mathematical techniques in the composition of a canvas. You will recall from Chapter 6 that Mondrian (1872–1944) was copying a technique of Greek architecture by using the golden ratio to build some of the rectangles in his painting. Later architects and composers were also much concerned about proportion and some, such as the French impressionist composer Claude Debussy (1862–1918), quite consciously use the golden ratio as a compositional tool (Chapter 7).

There are other AOKs that provide rich pickings for the arts. The natural sciences have been influential across much of culture.

Consider *Nude Descending a Staircase* (1912) by Marcel Duchamp. It is a striking example of how developments in contemporary physics can feed into the visual arts. Einstein's theory of Special Relativity (1905) changed the way we think about time. Instead of something that 'flows' through space, he suggested that time was just another dimension, just like the three familiar spatial diagrams (length, breadth, height). This meant that, in a sense, the whole of time – including past and future events – could be conceived of as existing eternally. Future events existed but lie before us along the time dimension. In *Nude Descending a Staircase* Marcel Duchamp exploits this idea: every stage of the journey down the staircase is depicted simultaneously following Einstein's theory.

Nude Descending a Staircase by Marcel Duchamp (1887–1968).

Exercise

19 How does each artist solve the engineering problem of balancing unity and variation in the following paintings?

Rembrandt self-portrait (1660).

Print by Kitagawa Utamaro (1753–1806)

8.5 Historical development

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

Art is socially constructed and is rooted in its time.

We've explored the role of structure in producing effective artworks and have seen that structural elements combine to orient the audience to the artwork, help (along with convention and the language of the artwork) to produce emotional tension and relaxation (through dissonance and consonance), and allow the artwork to achieve a balance between the requirements of unity and variation. Now we'll discuss the relation of the artwork to the time in which it is situated and to the past. We start by discussing painting but the arguments can be generalized to other art forms.

There are two main ways in which an artwork reflects history:

- by depicting historical scenes
- by making references to past artworks or past styles.

Depiction of historical scenes

The Bayeux tapestry was produced to record the victory of the Norman King William the Conqueror at the battle of Hastings in 1066. The work is historical in two senses. It certainly is an attempt to represent a historical event. And although a historian would call it a contemporary record because it was produced shortly after the event, from our point of view it is historical in that it is almost 1000 years old.

The Bayeux tapestry.

The painting *Charles I (1600–49) Demanding the Five Members in the House of Commons in 1642* was produced more than 100 years after the events it portrays and was painted by an American painter. It depicts the English King Charles I demanding the surrender of five impeached members of the House of Commons. Parliament is challenging Charles' authority and refuses to surrender them. This is a significant moment in English history – the King's authority is, for the first time, trumped by that of Parliament. It heralds the English Civil War and the eventual execution of Charles I in 1649. Copley's intention was to make the painting as historically accurate as possible. But its historical significance was even greater, as noted by Gombrich (1995), when you consider that just two years before Copley portrayed this dramatic clash between the King and the representatives of the people, the then King, George III, had signed a peace with the American colonists after the War of Independence. The painting refers to an earlier historical event in order to cast light on more recent events.

Charles I (1600–49) Demanding the Five Members in the House of Commons in 1642 by John Singleton Copley (1738–1815).

The same technique can be found in Hippolyte Delaroche's 1836 painting of Charles I insulted by Cromwell's soldiers. This painting is a clear reference to the then recent revolution in France.

Yoruba man with a bicycle.

Exercise

20 Why did Copley and Delaroche portray the fall of Charles I rather than their own more recent history?

Historical references can be more subtle than a straight portrayal of a past event. Consider the sculpture *Yoruba man with a bicycle*. It strikes a dissonance between the material and the subject matter. This Nigerian sculpture is made in traditional materials with more than a nod in the direction of primitivism. Yet, as philosopher Kwame Anthony Appiah (b. 1954) notes in 1992, the depiction of a bicycle with its history in the West and its introduction into West Africa by the British and French suggests that the work is a postcolonial critique of the colonial period.

Charles I Insulted by Cromwell's Soldiers by Hippolyte Delaroche (1797–1856).

So: painting of historical subject matter can be used to cast light on current affairs, but there is no need for the historical scene to be true. Before Copley's picture, almost all references to past events in Western painting were either Biblical scenes, fictional, or mythological events. The portrayal of stories from the Bible was, of course, essential in a society in which the vast majority of the population was illiterate and painting in churches was a primary means of moral and religious education. The production of works referring to mythological events might have a similar moral purpose. The Western European painter could assume that his audience was familiar with Roman and Greek mythology and could draw on this rich tradition in order to explore quite complex ideas. The mythopoeic tradition formed a background symbolic language against which the meaning of the painting could be decoded.

Las Meninas (1656) (the maids of honour) by Diego Velázquez.

Referencing previous artwork or style

Referencing historical artworks within the work itself helps bind the work into the historical tradition. The references might be ironic in that they poke fun at the earlier work, or they might be an expression of respect or admiration. In either case, the meaning of the present work is deepened by incorporating a link to the earlier work.

Consider *Las Meninas* (1656) (The maids of honour). This famous painting by the Spanish artist Velázquez (1599–1660) was painted from the point of view of the Royal couple (visible in the mirror at the end of the room) who were themselves being painted by Velázquez whom you can see sanding by his easel on the left. It is extraordinary in many ways, not least in the reversal of the roles of audience, painter, and object of painting.

This work has inspired many references in more recent painting. Perhaps the most well known is the series of 58 paintings produced in 1957 by Picasso (1881–1973) and also called *Las Meninas*.

Las Meninas by Picasso.

The satire in the paintings reflects Picasso's assessment of contemporary Spanish politics. It is perhaps a scathing commentary on General Franco's dictatorship and his royal pretensions. The figure of the painter is distorted into a figure from the Spanish Inquisition, the ceiling roses become grotesque hooks on which torture victims can be hung. Some critics suggest there is more than a passing stylistic reference to the tradition of Philip II of Spain, the Hapsburg King.

This example is all the more striking because of the stylistic changes in painting that have taken place between the original Velázquez painting and the Picasso reworking. We are drawn to consider the revolutionary changes in artistic tradition. There is a sense in which the arts go through paradigm shifts similar to those of the natural sciences (Chapter 4). We have already discussed the move from medieval conventions to the Flemish school. But there are many such dramatic changes: 19th-century representational painting, pre-Raphaelites, impressionism, fauvism, mannerism, cubism, abstract expressionism, and so on. These developments and the fact that we can meaningfully talk of these *-isms* indicate that the production of art takes place within a historical framework in which certain coherent traditions can be identified.

Referencing in other kinds of art

It is not only in painting where we find reference to past works. Many films make conscious reference to other films. The 1905 novel *Doctor Glass* by the Swedish author Hjalmar Söderberg is the starting point for a more recent novel *Gregorius* by Bengt Ohlsson that is written from the point of view of the antagonist, Gregorius. There is also a work from 2002 by British writer Dannie Abse based on this novel.

In music, composers frequently quote each other's work or use it as a starting point for their own. Brahms based his *St Anthony Chorale* variations on a theme by Haydn; Benjamin Britten based his *Young Person's Guide to the Orchestra* on a theme of Purcell; Rachmaninov and Saint Saëns both referenced the plainchant *Dies Ira*. Elgar quoted

Mendelssohn in his *Enigma Variations*. Most spectacularly, the modern Italian composer Luciano Berio piled a truckload of quotations from other pieces on top of the Scherzo from Mahler's Second Symphony in his *Sinfonia*.

There can be cross-medium references too. The Czech composer Leos Janacek calls his first string quartet *Kreutzer Sonata*. This is a reference to a novella of Leo Tolstoy. The Tolstoy work is in turn inspired by Beethoven's violin sonata No. 9 which is dedicated to Rodolphe Kreutzer. The novel *The Big Glass* by Gabriel Josipovici is a fictional account of the making of Duchamp's sculpture *The Bride Stripped Bare By Her Bachelors, Even* (itself most often called *The Large Glass*).

Exercises

21 Write down a list of works in film, literature, music that contain references to other works. What is the function of such references in an artwork?

22 Can you identify paradigm shifts in music, literature, painting, film, dance, and theatre?

8.6 Links to personal and shared knowledge

Knowledge framework: *Links to personal knowledge* – Why is this area significant to the individual?

Knowledge framework: *Links to personal knowledge* – What is the nature of the contribution of individuals to this area?

So far we have dealt with the arts as an AOK – shared knowledge. We have discussed how the different art forms can be used to produce some sort of simplified map of certain aspects of the world in order to solve certain types of problem. So they satisfy our requirements for being knowledge. Now we can explore how artworks impact on us as individuals. Let's first consider the notion of beauty.

In his book *Beauty* (2009), philosopher Roger Scruton produces six platitudes or unsupported statements about beauty:

- beauty pleases us
- one thing can be more beautiful than another
- beauty is a judgement of taste
- judgement of beauty is a judgement about the object not the subject's state of mind
- there are no second-hand judgements of beauty
- beauty is a sufficient reason for attending to the object of beauty.

This book is not the place for a philosophical discussion of beauty or indeed of art. But what we learn from Scruton is that there is something direct about beauty that moves us and is pleasurable. The second platitude suggests that beauty of different things can be compared, and the third that it relies on the subject having a faculty of taste. The fourth suggests that the popular expression *beauty is in the eye of the beholder* is false and that beauty is actually a feature of the object not the person perceiving it. The fifth is interesting because it suggests that we cannot be persuaded by others into finding something beautiful and is a strong argument for judgements of beauty belonging to pure personal knowledge. This seems to be different to artistic value in general for which persuasive arguments can be made. The last platitude suggests that beauty is sufficient to attract our attention – we need no other reason. Indeed there are some thinkers, notably Kant and some 19th-century writers associated with the aesthetic movement, who claim that if a beautiful object is valuable because it is a means to an end, then it is not pure beauty that is being judged but something else, like usefulness or practicality.

One such writer was the art critic Clive Bell (1881–1964) who claimed that a special feature in a work of art made it beautiful: **significant form**. This produced a special emotion in the viewer that he called **aesthetic emotion**. Bell spoke to the problem of whether artistic value lay in the artwork itself, the object (an **objective** view), or in the viewer, the subject (a **subjective** view). Bell's account suggested that there was an objective origin to artistic value in the work itself but that it required a certain sensitivity in the viewer for this value to be appreciated. So Bell's significant form theory is a sort of hybrid position between an objective and subjective view of art.

This way of looking at value in art explains all six of Scruton's platitudes. But, as good TOK students, we might question some aspects of his theory. We might ask how we can acquire the sensitivity to be able to appreciate significant form. We might also ask which people, group or culture have this sensitivity. If the answer ends up being 'the art world' then we are back with the institutional theory (page 254). If the answer is 'those who are able to perceive beauty' then we have a circular argument: we are explaining beauty in terms of significant form and sensitivity to significant form in terms of beauty.

Insofar as works of art are beautiful, they can move us in the ways suggested above and can have a powerful effect on us as individuals. It is this effect that describes the transformative power of the arts. We can come out of a genuine artistic experience a different person from the one who went in. Our emotions provide the channel for this transformation.

But an emotional appreciation of the beauty of an artwork is not the only way in which we as individuals can gain knowledge from the arts. We can understand a work of art such as a novel in the context of our own particular circumstances. We can read ourselves in the novel or poem, or find our own thoughts mirrored in a piece of music. In these circumstances, reason combined with an understanding of the 'language' of the artwork helps to develop our personal picture of the world and our place in it. We gain personal knowledge through the complex interaction of these two WOKs.

The arts can also help us appreciate the immensity of things outside ourselves. The lofty vaults of Cologne Cathedral or the intricate carvings of Angkor Wat can help forge an almost physical understanding of things much bigger than ourselves and far out of reach. We gain not a scientific understanding, but rather one forged by emotion and personal acquaintance. The haunting melody of Messaien's *Quartet for the end of time* (1941) might lead us towards an understanding of eternity and the horrors of the concentration camp. Achebe's novel *Things Fall Apart* (1958) helps us understand the perspective of an oppressed nation in the grip of brutal colonial power. We gain such understanding, not through facts and figures about colonial West Africa, but rather through living in the shoes of someone who experiences these things. Again, it is a direct and emotional experience that facilitates personal reflection, not one mediated by natural language and validated by a group. This makes it personal knowledge.

As with other AOKs, the link between the arts and personal knowledge is two-way. We have explored the ways in which knowledge in the arts is built up through the work of artists. They are often individuals working, apparently, alone. They act on their experience and artistic intuition. They learn to see and hear the world in a special way. They hone their artistic skills as individuals to be able to produce the results they are after. Their own knowledge of their art is personal and is difficult to share with others. But as we have seen, they are working in a social context produced by some shared conventions, styles, languages, materials, and common problems. No artist is ever truly working alone. Artists are all located in a continuum across time and space, and are influenced by the works of the past that help define the very language of their art forms. In turn, they influence others. This is how the shared AOK is slowly built up. Not through reproducible general results as in the natural sciences, but through particular and unique works of talented individuals.

"He overreacts to everything!"

Emotional appreciation.

Exercise

23 Identify an artwork that has changed your perspective on the world. What was it about the work that affected you? What methods did the artist use to make the work effective? How did the artist solve internal and external problems? In what way did the artwork map reality?

8.7 Evaluation of art

So what have we learned in this whirlwind exploration of the arts as an AOK? Clearly, there is a case for considering the arts to be concerned with an idealized representation of the world designed to solve particular problems. In fact, we found that the arts might solve two different types of problem: external problems to do with our relations with our fellow human beings and the natural world, and internal engineering problems to do with the production of an effective artwork.

We have explored the role of language and convention in producing expectations which, in turn, load the artwork with emotional content and allow the artist to give the artwork structure. We have seen how the structure of the artwork can solve the twin problems of unity and variation. Artworks are part of cultural history and, as such, can be used as primary sources in some historical investigations.

More importantly, the arts are self-referencing and the production of art takes place against the backdrop of the canon of existing work inside and outside a particular tradition. Thus, the production of art takes place within a framework of meaning established by other existing artworks. Finally, we discussed the common phenomenon of the production of art through the sharing of the personal knowledge of the individual artist. We saw how art can affect the personal knowledge of an individual. It can change our individual perspectives. Ultimately, that might be a test for good art: its ability to make us change our minds.

09 Ethics

On previous page – Controversy in Lance Armstrong's cycling career led to him being stripped of his seven Tour de France titles.

9.1 Introduction to ethics

Why is there a chapter on ethics?

You might wonder why TOK includes ethics as an AOK when it isn't offered as an IB course. One reason is that questions of right and wrong are of great importance at the highest level and also as part of everyday life. Just think how often your parents and teachers (and the media) have told you to do this or that, or not to do this or that either in a straightforward way, or with some kind of implied lesson. Or, how often have you made judgements about people being rude, unfair, disgusting, or even horrible in their actions in contrast to your ideal world of saints and super-heros? Not only do we judge others, we judge ourselves in this ethical realm of right and wrong, good and bad. A safe conjecture is that most students your age have a variety of perspectives on ethical matters – on how people should live together and treat one another. Consequently, most of you have a great deal of experience as a basis for TOK reflection. Finally, as an organization promoting diversity and tolerance as values, it is not surprising that the IB is asking you to consider questions that define this AOK such as, 'What is the right way to live and how can I know it?'

This chapter deals with the importance of ethical and moral matters, and how we try to resolve our disputes and dilemmas, while at the same time understanding that any discussion about values may not be definitive.

Strictly speaking, ethics is the philosophical study of morality. However, the two terms are commonly interchanged. For example, we might talk about 'Einstein's ethics' or 'Einstein's morality'.This chapter uses the terms 'morals' and 'ethics' interchangeably.

Maps and the field of ethics

By now, you are used to the idea of the knowledge framework which helps us organize complex areas of study into something we can more easily understand and compare with other subjects. In the following pages, we look at the focus and language of ethics, how moral behaviour is agreed on or debated, how it has developed over time, and what it means to us as individuals. One of the ways we can begin this exploration is to think once again about knowledge as a kind of map.

9.2 Scope and applications

As the TOK knowledge framework shows us, any map has a scope and application whose boundaries help us understand the limits of the selected territory – how it stands apart from other areas – as well as what questions it can answer for us. In this case, we are talking about the territory of ethics and morality, the 'Land of the Right and the Good' and, by extension, its opposites: the multiple forms of all wrongdoing.

Knowledge framework: *Scope and applications –* What is the area of knowledge about?

While a map need not imply populations, let's go a step further and think of people as occupying the territory, either permanently or passing through, either active or passive, either passionate or indifferent. So, staying with the notion of an AOK as a territory, what are the borders of this territory and what are the people in this place doing?

Although nearly everything that can be said about this area or discipline can be contested – and often is – we could say that the two major regions of this map are meta-ethics and normative ethics. Meta-ethics asks questions such as, 'What does it mean to say something is right or wrong?' Normative ethics assumes there is a difference between right and wrong, and asks which actions are right and which are not. For example, meta-ethics states that before you can decide between telling the truth or not, or judging someone else along those lines, you have to know what 'telling the truth' means. We could break these categories down to more and more refined areas, but these are the areas and boundaries we deal with in this chapter.

If ethics is concerned with problems of human conduct, how does it differ from other disciplines? For example, psychology, sociology, and economics are each in their own way concerned with human behaviour. But ethics is different – even though the human sciences have ethical considerations themselves (Chapter 5), the concepts and judgements in the field of ethics are not the concepts and judgements of the human or social sciences. Ethics as an AOK is concerned with principles that prescribe a certain sort of conduct, while the human sciences are concerned with laws or generalities that describe or can be used to predict human behaviour.

Who does this kind of thinking and how does it help us?

Those who dwell permanently in the area of ethics and morality are usually scholars who contribute to the progress of the field through research, debate, writing, and reflection. They may address the larger knowledge questions such as:

- What is the nature of the good?
- What is the right way to live?
- How can we know?

Often universities host discussions on ethical topics.

Or, they may occupy an ethical subset of study such as justice or fairness, or more specific issues such as the morality of child labour or human trafficking. And as we've seen, where AOKs overlap, the inhabitants of the ethical and moral territory may have settled down into some border-crossing area called 'medical ethics' or 'ethical reasoning and the law'.

Many such scholars are attached to universities or religious institutions, perhaps even government agencies and think tanks exploring the common good. Conferences are organized and journals are published addressing current issues, promoting the topics and the experts of the day who have the most star power. Scholars build on the legacy of those who have gone before, such as Plato or Confucius, or the writings of contemporary thinkers such as Martha Nussbaum of the University of Chicago, or Michael Sandel of Harvard University. But for those who are simply passing through the territory, the work of the scholars in the field is a resource when we need to fill out our own thinking about matters such as:

- What is the moral issue, if any, in this or that situation, and what is the right thing to do?
- How can I justify my actions?
- Why be moral at all?

People who are 'just passing through' is a metaphor for describing those (most of us) who have no real training in moral analysis or discussion. Nor, usually, do they have familiarity with the library of works through the ages relevant to what confronts us. But that doesn't mean that our moral deliberations and judgements are trivial or less fraught with concern.

Knowledge framework: *Scope and applications –* What practical problems can be solved thorough applying this knowledge?

We are often faced with moral situations. Should we report our best friend who cheated on the exam in a way that lowered the scores of others? Should we cheat ourselves? Should we judge the man who stole the medicine for his sick wife when he had no money to buy it? What about abortion, euthanasia or gender equality? We probably have feelings about right and wrong, but they are vague or jumbled, and we don't know how to go about thinking through where we stand. Or maybe we believe there probably is a right or wrong, even an absolute right and wrong, but we can't figure it out so we just go with our gut feeling and don't think at all unless we're called on to rationalize our behaviour. Or maybe we do have firm opinions about right and wrong, good and bad, but we think these values are individual in nature or relative to our culture and there's nothing really to talk about. One view might be, 'What's right for me is right for me, and who's to say it is wrong since we are all different and have different values?' After all, it's just your opinion. And certainly it seems at first glance that there is no such a thing as an ethical fact the way there are scientific facts. All these sentiments have their place on the arc of ethical positions about moral behaviour.

Another of the central and open questions of ethics is, 'Why should I be moral?' This has a personal and high-stakes dimension to it. Reputations are gained and sometimes ruined based on morality or immorality. Laws are created to preserve the good and violators are punished. Nearly all religions have a code of conduct, most schools have written and unwritten rules – some moral, some practical – and families and couples may promote values of a highly specific nature to ensure their togetherness.

Defining your own morality

The hotlink on the right takes you to the online Morality Play and a set of 19 scenarios. Your responses – what you think is the morally right thing to do, which may not be the same as what you would actually do – are instantly calibrated to show how your moral judgements match up against those of others, and how broad a range of moral principles you use when making moral judgements. Your answers result in a moral quotient, although at no time are your responses labelled correct or incorrect.

The Morality Play is part of *The Philosophers' Magazine*, an online magazine based in the UK. It is a site serious enough to attract scholars of rank to its discussions. Exercises 1 and 2 are sample questions for discussion.

To learn more about morality, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 9.1.

Exercise

1 You pass someone in the street who is in severe need and you are able to help them at little cost to yourself. Are you morally obliged to do so?

Please select and discuss:

- **a** strongly obliged
- **b** weakly obliged
- **c** not obliged

To say you are morally obliged to do something means that in order to behave morally, you *must* do that thing. But note that the exercise distinguishes between strong and weak obligation. What do you think of this distinction of degrees of morality where things are not strictly right or wrong?

Sometimes, it is helpful to look at the same kind of question from a different, less abstract, perspective. Consider the story of a murder that occurred in New York City in 1964. It launched a subset of human science called the 'bystander effect' and is still talked about today.

A young woman named Kitty Genovese was walking home at night down a residential street in Queens when she was attacked and killed, reportedly in full view of witnesses safe in their apartment buildings, who could have called the police without further involving themselves. Certain questions still haunt thoughtful people. What would I have done? What should I have done? What was my obligation, if any? And what we ultimately ask ourselves, 'What would I have done if I had been there?'

Exercise

2 You have a brother. You know that someone has been seriously injured as a result of criminal activity undertaken by him. You live in a country where the police are generally trustworthy. Are you morally obliged to inform them about your brother's crime?

- **a** strongly obliged
- **b** weakly obliged
- **c** not obliged

The introduction of a family member changes the picture for many people. It prompts new questions. What is the extent of our responsibility to others? Does our responsibility extend to everyone or only to those closest to us? Remember the question asks us what we *ought* to do, not what we *would* do. How might your perspective change if your brother were the victim of the crime and not the accused? Is the loyalty to a brother an absolute moral demand or might there be circumstances when family loyalty might change? If you jumped to your conclusion, go back now and think again to see if you arrive at the same place.

One of the interesting features of the Morality Play is what it tells you about yourself as a moral agent. Whether or not self-knowledge is increased, the exercise is a good introduction to discussing the language of ethics and moral behaviour.

9.3 Language and concepts

As with any territory or discipline, there is a language associated with the region that differentiates it from other areas. Because studies have shown that many of the disagreements in moral disputes hang on the misunderstanding of terms and concepts as much as differences in moral principles, it is helpful to turn our attention to the language and concepts that belong to this AOK.

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Although the key words within ethics and morals are *good*, *bad*, *right*, and *wrong*, its further vocabulary includes *should*, *ought*, *principles*, *rules*, *consequences*, *sins of omission*, *sins of commission*, *virtue*, *values*, *promise,rights*, *justice*, *duty*, *obligation*, etc. Almost always these are **essentially contested concepts**, which means that they resist strict definition. Sometimes, you have to agree to disagree because there is no end of controversy about their meanings. This is the area most associated with meta-ethics.

If we are not permanent residents in the territory of meta-ethics, we are likely to be confused by such theoretical disputes. But at the same time, we may be highly concerned with ethical questions of our own. What should I do here and now? What

Is cheating a contested concept?

should I think about what is going on around me? There will always be controversy, but usually these questions place us – the ethically puzzled – in the forefront of the situation, because our *own* behaviour is involved. This involves *our* conscience, the consequences of *our* decisions, and *our* self-worth. Before we can begin to think things through, we usually have to articulate the issue and that involves language.

It's not unreasonable to suggest that many of the statements we make in daily life, apart from social niceties, are reports laden with (alleged) facts: It's raining; I'll be late; there's a test tomorrow; the game was cancelled; few women are airline pilots. Whether true or false, these statements may be about ourselves or about the external world; they may be particular or general; some are observable, others are inferences. But all are statements about *what is*, not *what ought to be*. How do you get from an *is* to an *ought*?

CHALLENGE YOURSELF

David Hume (1711–76) was a British philosopher. What do you make of his contention that you can't jump from an *is* statement to an *ought* statement? In other words, what is the connection between any particular situation and what you should do about it? This conundrum is known as Hume's gap.

Do the *ought* statements in Table 9.1 necessarily follow from the *is* statements?

is statement	*ought* statement
Some people drive when they are drunk.	People shouldn't drive when they drink.
Water-boarding is a form of torture.	Water-boarding is wrong.
He gave his winnings to the poor.	Sharing is good.

Table 9.1 Illustrating Hume's gap.

But there is another set of statements different from the descriptive or declarative ones. These are statements of value that usually fall into the realm of ethics or aesthetics. For instance, 'capital punishment should be abolished' (ethics) and 'Yo-Yo Ma played a splendid piece last night' (aesthetics). Of course, there are evaluative statements that don't belong to either class – 'this is a good idea' or 'she is a really fine student' – although it's not always easy to sort out which are which.

Consider the IB mission statement:

> “The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.
>
> To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.
>
> These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.”

The back story of the writing of this mission statement would show hours and hours of thought along with countless discussions about the right words. Read it carefully, then try to identify the values language in the passage, and within that kind of speech, the ethical values either explicit or implicit. Is there any statement that is purely descriptive? What do you make of the final phrase '*learners who understand that other people, with their differences, can also be right*'? Does the word 'right' mean correct or morally acceptable, or is there another definition?

The IB learner profile (page 10) is also written in the language of values along with the interpretation and description of those ideals.

Unfortunately, language is not always a clear indicator of ethical statements. Even phrases using the word 'good' do not always express moral judgements – a *good* driver, a *good* game of cricket, a *good* student, a *good* idea. Yet identifying a situation as being a moral one is a first step towards a discussion about the rights and wrongs of that situation.

In the 1977 Woody Allen film, *Annie Hall*, is a scene where the parents are arguing over money missing from the household. The mother screams that the housekeeper has stolen it and should be fired. The father retorts that of course she steals – she's poor, and who else is she going to steal from? Despite the wrangling, they can never agree that it is a moral issue; for the mother, it is as clear as day while the father sees it only as a matter of need and convenience. As the argument continues, the mother characterizes the housekeeper as a bad person, while the father defends her as a victim of a capitalist social order. There is no meeting of the minds, thus no rational discussion is possible.

Exercise

3 Write a dialogue for a scene in a film where two characters are arguing about whether something is a moral issue or not.

Knowledge question

1 How can we tell if an issue is a moral one?

But even if we could sort out all the ethical uses of 'good', we would still have to delve into what makes something good, or better than another good, in a particular situation. This is especially true of **moral dilemmas** where there are two competing good or bad choices. Language can only do so much.

The limitations of language and defining ethics

The problems of vagueness, ambiguity, and reference crop up in ethics and other areas all the time. Killing means taking a life but when exactly is a life being taken? If you left a person to die of exposure by just leaving them as you found them, rather than obviously killing them by shooting or poisoning, can you be said to have killed that person? Did the husband who drove his wife to suicide through psychological abuse in the 1938 British play, *Gaslight*, kill her? If a person dies because the brakes did not work in your car, is that killing? If you are a head of state and you order 20 000 troops into battle, is that killing? Is abortion killing? Is removing life support killing? Every time you think you have a foolproof rule for applying an ethical term, it may turn out not to be so.

In a similar vein, look at exercise 4 about stealing. The items suggested range from the *prime* example of taking something from someone by force (as in a bank robbery) to something as far-fetched as robbing people of their time by keeping them waiting.

There is usually more agreement about prime examples than there is about the far-fetched. Far-fetched examples are also known as *limiting-case* examples and often produce argument and dissension. The prime examples seem to hit the bullseye, whereas the limiting-case examples are stretching the point.

Exercise

4 Look at the ranking of the following examples of stealing where 'holding up a bank' is number 1 (a prime example) and 'keeping your friend waiting' is number 12 (a limiting case).

1. Holding up a bank.
2. Taking your mum's money without asking.
3. Stealing a car from the street.
4. Sneaking books from the library.
5. A doctor overcharging a patient.
6. Hiding goods from customs.
7. Underpaying workers.
8. Charging for repairs that are never made.
9. Mugging a woman for her jewellery.
10. Running away with your best friend's wife.
11. Copying answers from someone else's test.
12. Keeping your friend waiting.

Try adding five more examples across the entire range from the *prime* to *limiting case* and note the ease or difficulty of reaching consensus. Or make a list for another moral term, such as *cheating*, with the same ranking of 1–12 and discuss your agreement or disagreement with others.

These aspects of vagueness and ambiguity characterize the way in which any living language is constructed. Mathematical terms are the least given to vagueness and the natural sciences may come second in their drive for precision. But vagueness creeps in even in the natural sciences (Chapter 4). The only way to achieve utter clarity would be to create an artificial language for ethical issues, if that were possible. But that would not help in analysing problems that result from the real world and from our everyday natural language. In reality, it is often the language we live with that creates these problems and which scholars have tried to overcome insofar as possible.

Exercises

5 What could 'one word of truth can outweigh the whole world' mean as a definition of art and morality? This Russian proverb was cited in the Nobel Prize speech of Aleksandra Solzhenitsyn, 1970.

6 Of these two quotes, is one a more obvious moral injunction than the other? If so, what makes it so?

'Mighty is he who conquers himself.' (The Tao)

'Thou shalt not kill.' (King James Bible, Old Testament)

Realism and relativism

Another way of looking at ethical language is to block out some sections analogous to major cities on our map of the moral territory. **Realism** and **relativism** are two such sections for which we need to figure out what their names mean, and if they are places on the map where we stand or want to stand.

Here are brief descriptions of these hugely complex positions. But be aware that both of these positions can go by other names and that each has multiple sub-divisions.

- Realism (or objectivism) takes the view that there are objective ethical facts or truths that exist in the world independently of anyone's opinion. If murder and torture are

CHALLENGE YOURSELF

Create a similar exercise on a scale of 1–12 for the concept of lying, keeping in mind St Augustine's taxonomy of lies in *De Mendacio* from the ruthless to the relatively harmless (if indeed there is such a thing). This taxonomy can be shortened and summarised as:

- the deadly lie to be shunned since it distorts the teaching of religion
- the lie that injures someone unjustly and helps no one
- the lie that benefits one person but harms another
- the lie told solely for the pleasure of deceiving (as in jokes).

wrong, it is not because I say they are wrong. Rather, I say they are wrong *because* they are wrong.

- Relativism (or subjectivism) affirms that the individual or the culture is the source and criterion of moral judgements, thus denying any objective, external, or absolute moral values. In short, 'man is the measure of all things' and ethical statements are neither true nor false.

Exercise

7 **a** Consider the implications of the descriptions of relativism and realism – what might it mean to belong to one school of thought or the other?

b Compare relativism and realism in the light of this quotation.

'I cannot see how to refute the arguments for the subjectivity of ethical values, but I find myself incapable of believing that the only thing wrong with wanton cruelty is that I don't like it.' (Russell 1960)

The quotation from Bertrand Russell (1872–1970) directs us to think about the subjectivity or relativity of moral judgements. This is one of the most difficult areas for TOK students (and older people as well). Like Russell, we may think that everyone has the right to make his or her own moral judgements, but when we stop to think about the meaning of his words, we might find something disturbing about everything being totally subjective or individualistic. In other words, if I say that something is right or wrong, true or false, then it is right or wrong or true or false on my say so, nothing more. It is up to the subject, namely me, to make that judgement and its truth is relative to me, not to any objective standard outside of my own opinion. Would you consider it an enormous burden to have such responsibility?

Knowledge question

2 Within the relativist position, if you are sincere, is it impossible for you to be mistaken?

The consequences of moral relativism means that moral approval or disapproval is not much more than a prejudice, an attitude or an expression of feelings on the part of the speaker. And by extension, since moral statements cannot be judged true or false, they are matters of opinion, not matters of self-evident truths or matters of fact. In short, there is no one right way to act morally and you should not presume to judge others.

Of course, this sort of relativism can take different forms. While **moral relativism** in modern culture often refers to the individual's personal set of morals as being right or wrong relative to that person, ethical judgements could be relative to a society, a culture, a nation, or even the whole human race at a particular time in history. It is important to remember that *any form of ethical relativism* denies that there are universal or objective moral values that we can verify. And, if this is so, if there are no moral standards independent of human beings, then, indeed, it may be, as Shakespeare wrote in Hamlet (Act II, Scene II), *there is nothing either good or bad, but thinking makes it so.*

Exercise

8 Is the IB mission statement an expression of moral relativism?

Yet, Russell's quotation makes us think again. Could there be something real, something *objective,* in an action that gives us the 'moral shudders', a kind of moral incomprehension or disgust? Actions such as school shootings, perhaps, or burning a baby to atone for the sins of an adulterous mother – are these examples of 'wanton

CHALLENGE YOURSELF

What gives you the 'moral shudders'? Do you think your repugnance about certain kinds of behaviour is peculiar only to you, or do you think there might be something outside you that could cause your reaction and the reaction of others as well? Do you think you would have the same moral responses if your upbringing had been radically or even slightly different?

cruelty' where the actions are wrong in and of themselves? If you answer 'yes', then this means you find something *objectively immoral* in the situation and your response to these acts – the moral shudders – is a response to the inherent cruelty imposed on innocent beings. You, then, would be responding to the situation in a way that does not only depend on your feelings or opinions about it. This position of moral objectivity stands in total opposition to the boo/hooray theory of moral subjectivity or moral relativism.

The resolution to the subjective/objective debate will not be settled here, but Russell's statement points up the fact that he is not alone in his disgust for wanton cruelty despite our possible disagreement over its meaning or its examples.

Practice essay title 1: Does moral relativism oblige you to accept the moral views of everyone even if they differ from those of your own?

9.4 Methodology

If one of the distinguishing features of ethics is to be found in the kinds of problem and question it is concerned with, can we say as well that there are methods of reaching moral judgements that mark them off as especially suited to the ethical realm? Some say yes, some say not, but it seems, surprising to some students, that the way we approach ethical issues are often methods shared by thinkers in other AOKs: reason, emotion, intuition, authority, and spiritual sources. Let's see how these various WOKs play out in a real-life situation.

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

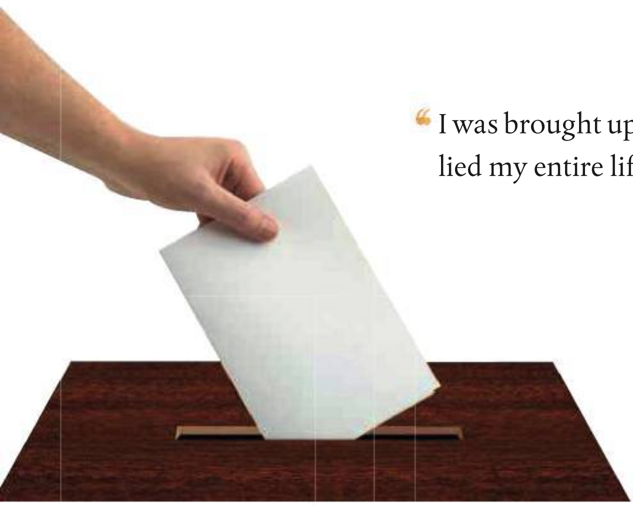
Suppose that a club you belong to (professional, social, sports, political, etc.) is having an election and your best friend is running for president against a person whom you think to be better qualified. Suppose you decide to vote for the more qualified candidate. Then your friend asks you, 'Who are you going to vote for?' Is there a moral issue here? If so, what should you do?

On the one hand, if you tell your friend you won't vote for him or her, you run the risk of alienating them. On the other hand, if you lie, you could save your friendship and no one would ever know. But suppose you are the kind of person who believes that lying is generally bad or always bad. Maybe you've been brought up that way, or your religion or society condemns lying, or perhaps you personally object to deception between friends. In fact you hate it. If you were to lie under any of these circumstances, your conscience would bother you and make you sick or depressed, or worried that someone might find out. Still, it hurts to let down your friend who is counting on you. It looks like no matter what you do, you'll feel miserable. This is the case in most moral dilemmas, but you have to do one thing or the other. And if intuition fails, you have to think through your choices.

What do you make of the contrast between the two quotations overleaf? The first is from a young woman involved in a sex scandal with the then US President, Bill Clinton, the second from an esteemed theologian.

CHALLENGE YOURSELF

Try to figure out if you are tempted to lie to make things easier for yourself in your daily life. If so, do you classify these falsehoods as 'white lies'? Do you allow the same margin of lying to others or do you get angry when you are lied to, even if it is a 'little white lie'?



Ballot papers are confidential, but what would you do if someone asked you how you voted?

> I was brought up with lies all the time … that's how you got along. I have lied my entire life.

Lewinsky reported in the *Washington Post*, (1998)

> When regard for truth has broken down or even slightly weakened, all things will remain doubtful.

St Augustine quoted in Finkbeiner, 2002

St Augustine is asking us to consider how it would be possible to survive or have peace of mind in a world where everything was doubtful, or where the personal bond between two people is destroyed by a lie. Will reason lead you to an answer?

And finally, staying with the concept of reasoning about the value of truth-telling, and linking it to the relationship between language and action, consider this piece of ancient Chinese thought from Confucius:

> If language is not correct, then what is said is not what is meant: if what is said is not what is meant, then what must be done remains undone; if what must be done remains undone, the rites and arts will deteriorate; if the rites and arts deteriorate, justice goes astray, and if justice goes astray the people will stand about in helpless confusion. Hence there must be no arbitrariness in what is said. This matters above everything.

Confucius, trs. Lau, 1979

Knowledge framework: *Methodology –* What are the assumptions underlying these methods?

Before going further, let's look at two assumptions that underlie any moral situation.

First: freedom versus fatalism. Either you are free to choose or you are not, but if it is fated that you were going to tell your friend that you could not support him or her, then strictly speaking you have no choice even though it feels like you do. Following on with this thought, if you are compelled by fate to act in a certain way and not free to do otherwise, are you responsible for whatever turns out to be the case with your friend?

More generally, if all our actions are compelled by determinism, karma, or some other natural or supernatural force, then are we to be praised or blamed, rewarded or punished for our actions? And further, would words like 'moral' and 'immoral' make any sense at all?

Second: self and others. We assume that our moral behaviour is judged within a world of others. Some say that if you were the only person in the universe, all our moral categories would dissolve and there would be nothing to consider. You might test this notion by trying to think of some action of a moral dimension that involves only yourself. Or even some action of any kind that is free of effect on at least one other person. How do you respond to the question that the presence of others in the world carries with it an implicit notion of obligation, whatever that might mean?

Going back to our example and trying to decide whether or not to tell your friend about your voting intentions, the chances are that your decision will come about from one or a mix of these methods:

- turning to authority
- responding to some kind of intuition or emotion
- reasoning along the lines of what will happen (consequentialism/utilitarianism) or what your moral obligation is (deontological).

Authority and spiritual sources

Authority takes many forms – tribal elders, therapists, family members, sacred books – but for now consider a version of the Divine Command theory. This meta-ethical theory states that the rightness or wrongness of any action derives from the will or nature of a higher being to which you should be obedient. A prime example would be the Ten Commandments in the Old Testament of the Bible, but there still is the issue of interpretation in any specific instance. Memorization of the text will not do. For example, what does it mean, exactly, to 'honour your father and your mother'?

Those who believe in the Christian source of morality as a way of life found it frightening to see 'God Is Dead' printed on the *Time* magazine cover in April 1966. Supposedly originating in Dostoevsky's *The Brothers Karamazov*, the implication here for such believers is that if God no longer exists, then everything is permitted.

Intuition and emotion

Another source of moral enlightenment goes by the name of **intuitionism**. This is an almost instantaneous certainty about what to do, in contrast to introspective deliberations or seeking counsel external to oneself. Whether intuition is due to an innate faculty of mind, lightning-fast reasoning, or social conditioning so deeply embedded in the psyche that we can't deny it, the direct perception of right and wrong via intuition appears self-evident and beyond dispute. In practice, many of us recognize the axiomatic nature of some of our judgements and find an affinity for this kind of moral experience even though it is almost impossible to explain it.

Emotion as a WOK is akin to intuitionism – and may be a modern-day version of the same thing. For example, it seems that people who have very strong emotional responses to the scenarios of the Morality Play (page 285) find it difficult to provide a justification for what they are feeling and for their choices. When they have to explain or justify their choices, they may become clumsy and tongue-tied. According to Steven Pinker (2003), this is because moral convictions are rooted in feelings, not in reason. Pinker thinks this biological basis – these gut feelings of right and wrong – arise from the neurobiological and evolutionary design of 'organs of moral emotions'.

What could be the consequences of rooting moral attitudes in emotion? Feeling strongly in a negative way about something – what Pinker calls the 'yuk factor' – might

CHALLENGE YOURSELF

What might be the sources of moral intuitions? How would you defend your intuitions to someone else? Are there self-evident moral rules?

make us condemn something solely because of powerful *feelings* when there is no good *reason* for being against it. For example, Pinker says, many issues of racism, religious hatred, or homophobia are just that, feelings of disgust toward another group of people with no good reasons to support the prejudice. The next step in this kind of situation is to turn the feeling of disgust into a moral issue.

On the other hand, emotions may have some role to play in moral judgement, since caring or indifference can lead to a wide variety of actions or no action at all. In fact, empathy (the sympathetic imagination of another person's situation) may be an essential part of a good moral framework. And, indeed, some have argued that the many atrocities committed throughout history were possible only because people's moral emotions had been switched off and they could not imagine themselves in the position of their victims. What act would you find it impossible to do because of empathy? As a TOK student, you need to think about both sides of an issue, no matter which one appeals to you.

CHALLENGE YOURSELF

You may have heard of a best-selling book called *Emotional Intelligence* by Daniel Goleman, but did you ever think that, in addition to having emotional intelligence – whatever this means – you might also have something called 'organs of moral emotions'? What could these words mean? Do they explain anything to you?

Knowledge question

3 What could be said for or against rooting moral judgements in emotions, biologically or otherwise?

Exercise

9 What does 'grounded in the logic' mean in the following quotation?

'The difference between a defensible moral position and an atavistic gut feeling is that with the former we can give reasons why our conviction is valid. We can explain why torture and murder and rape are wrong, or why we should oppose discrimination and injustice. And the good reasons for a moral position are not pulled out of thin air; they always have to do with what makes people better or worse off, and are grounded in the logic that we have to treat people in the way that we demand they treat us.' (Pinker 2008)

Reasoning

There are two widely different and powerfully attractive ethical theories that rely on reasoning to give us a method for reaching and justifying decisions. These are **deontology** and **utilitarianism.**

- Deontology deals with the principles of an action itself, the intrinsic right and wrong, and the intention or duty to act in a specified way. In short, *rules rule*.
- Utilitarianism considers the good or bad consequences of any action, especially the greatest good for the greatest number. In short, *results rule*.

CHALLENGE YOURSELF

Which of the following statements contain the premises of the deontology or of utilitarianism?

- The end justifies the means.
- Let the chips fall where they may.
- The road to hell is paved with good intentions.
- The greatest good for the greatest number.
- The Confucian principles of *Li*, *Jen*, and *Chun-Tzu*.
- Do unto others as you would have them do to you.

Exercise

10 On the basis of the two definitions above, try to analyse whether or not you would tell your friend who you intended to vote for by completing the following sentences.

a If I were a ***deontological*** person, I would ....because....................

b If I were a ***utilitarian***, I would ....because....................

Notice that one of the many differences between the two positions is that a morality based on rules looks backward, so to speak, to consult the rules about what is the right thing to do: tell the truth, don't steal, do no harm, etc. Whatever you decide is not judged by the consequences, but by the intention to follow the rightly chosen rule, which is your duty to follow.

In contrast, a morality based on consequences looks forward to what will happen in terms of the happiness or usefulness produced by the action. It involves a kind of calculation about how many people will be helped (or not harmed) or made happier by the decision.

Note that both these positions take for granted that reasoning (about the rules or results) is central to the judgement about behaviour (yours or someone else's). The person acting from intuition or emotion would have no time for such deliberations, nor any reason to promote such justifications.

Consider another example. A young man is doing poorly in school. He has the opportunity to *borrow* the work of another student and does so. Only he knows. His marks improve. He is happy. So are his teachers, his parents, his girlfriend, and the football coach because he will be able to stay on the team. Test your understanding of the deontologist and the utilitarian frameworks by explaining from each perspective what, if anything, is wrong with this situation. To help you, Table 9.2 shows in the simplest form, the differences between the two theories.

Deontological	Utilitarian
rules	results
principles	consequences
the *right* thing to do	the greatest *good*
duties and motives	outcomes

Table 9.2 Deontological ethics and utilitarianism summarized.

This framework suggests that within the deontological theory, the student is wrong regardless of the good or bad consequences if he violates, or intends to violate, such moral codes as doing his own work and not taking what does not belong to him. In the same vein, he is wrong if he has violated the written or honour code of his school, or an agreement among peers. As you will often hear, 'it is the principle of the thing'. Yet, in contrast, according to a moral position based on consequences, if nothing bad has happened, and happiness for all concerned has increased, the utilitarian judgement might be much less harsh.

Although it is not the goal of TOK to master philosophers' thoughts, it is appropriate to look briefly at two of the major thinkers, associated with these two classical theories of ethical judgement. Below is a brief summary of their positions.

Immanuel Kant

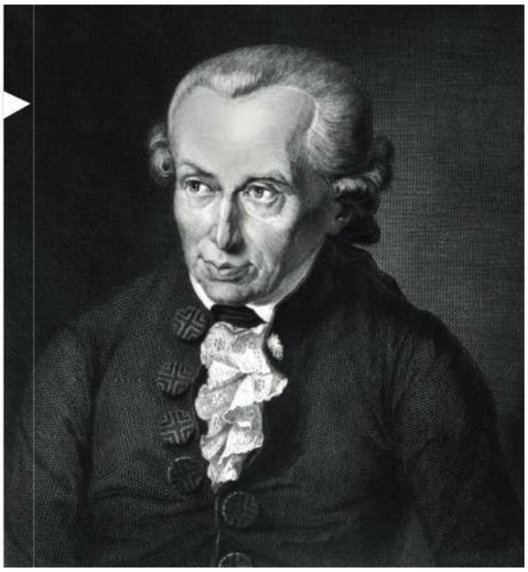
Kant, a deontological thinker, claimed that a free will and a rational mind (not feelings) are assumed in all moral judgements, and that all genuine moral behaviour comes from the concept of **duty**. If any moral agent wanted to commit an act from feeling or inclination, then the moral element could not be identified because he or she wanted to do it anyway. Kant also claimed that duty, the **categorical imperative**, is without exception binding on all people. The method by which we come to know our duties – what we should or should not do – is not easy to understand but it is worth mulling over. First, apply the **universal principle** by asking yourself, 'What kind of world would it be if everyone did this or that?' Kant does not mean *how many people would your action*

CHALLENGE YOURSELF

Do you think the IB learner profile (page 10) is an example of student or teacher qualities that could or should be universalized to everyone?

help, or, *would the world be a better or worse place in terms of happiness or chaos*. Rather, he means *use your head and think it through*. Is it even a possible world?

Again, consider lying, cheating, stealing, or killing as an example and ask, what if everyone did this? If everyone lied, there would be no truth; thus it is an incoherent notion and not a possible world. The same with killing – if everyone killed, then there would be no one left to kill or be killed. And so with cheating, if everyone borrowed everyone else's homework, there would be no homework to borrow. You would have created a logically incomprehensible world, thus the immorality of cheating is revealed and should be avoided at all costs. At a simpler level, take jumping the queue. What if everyone did it? This action would destroy the queue, the thing you are morally concerned about. So the rationality involved in discovering our moral duties should be clear – moral actions are those that can and should be universalized as categorical imperatives.



Immanuel Kant (1724–1804).

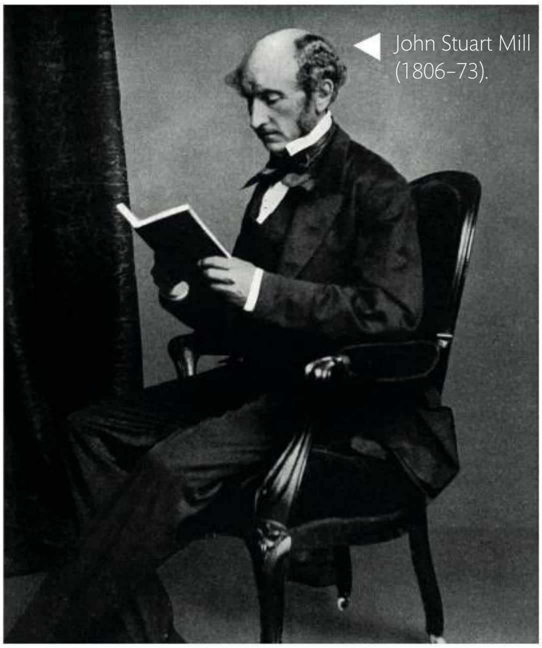
Why does Kant emphasize logic and reason? He might answer that if a person is to know the good, it would be through some human quality but he ruled out the gut, the heart, and all feelings as too unreliable and indefensible. Thus, reason, being the defining feature of the human species, gained pride of place. So, if right and wrong were to be revealed to us, it would be through the light of reason and the power of logical thought.

In addition to the universal principle of 'What if everyone did it?', Kant also believed in the maxim that you should always act in such a way that you never treat people simply as a means, but always as an end. In other words, *don't use people*. Can you even imagine what kind of world this would be if this maxim were the only ethical duty that everyone, including governments, abided by?

John Stuart Mill

John Stuart Mill is most closely linked to the utilitarian maxim 'the greatest good for the greatest number'. This maxim is to be used when judging whether any action is right or wrong. At a common-sense level, it seems that this kind of thinking (the ability to look ahead and consider the results of our actions) is what many people want from their government, from their family, from their friends, even from their own behaviour. They ask, what if I do this or that? What will happen? How many people will be harmed or helped? However, the problem is what is meant by 'the greatest good' and how it can be measured. Furthermore, even if the greatest good is defined as happiness, how do we protect the minority from something that benefits most people?

For many people, these are questions to be subjected to reasoning. Yet for some people, it is a moral intuition that the minority should *not* be sacrificed for the greater good when one person's happiness involves someone else's unhappiness. This can be seen in the situation described in Ursula Le Guin's *The Ones Who Walk Away From Omelas*. In this modern fable, the improbable situation is that a prosperous and happy group comes to realize that their good fortune depends absolutely on a child being kept deep underground in a dark cell. The title of the story refers to those who walk away after seeing the pitiful creature. But what is the moral status of those who refuse the condition of their well being and walk away? Utilitarianism does not seem to be able to address this **conundrum**, because there is no other moral scale available than 'the greatest good for the greatest number'. Does this mean that the people who stay are better than the ones who walk away?



John Stuart Mill (1806–73).

If you wish to delve more deeply into the utilitarian ethic and to evaluate its strengths and weaknesses, it is good to remember that in the global society of modern times, the greatest number might imply the entire world. Or, perhaps, everyone but yourself.

For instance, a Pakistani journalist at the United Nations once criticized the Japanese government for dumping rice into the ocean instead of sharing it with the world's needy. The journalist's position was that if we moved our thinking to a higher level, we could see that human benevolence should not stop at geo-political borders. The question then arises, do you really mean the greatest good for the greatest number of people or only the greatest good for the greatest number of people like us? In short, if utilitarianism depends on how many people are affected by any action, how can anyone ever assign moral worth to the consequences, if no one knows how many heads there are to be counted?

9.5 Historical development

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

Even without anthropologists to tell you how different people are, you know just by looking around your family, your school, your neighbourhood, or your town that differences abound. Yet, throughout human history there is an amazing similarity in some of what might be called the 'great maps about the right way to live' – in other words, the *Code of Hammarabi*, the Confucian *Analects*, the Holy Bible, the Holy Qur'an, and others up to the UN Declaration of Human Rights. If you had all these documents in front of you and underlined the similarities in red and the differences in blue, would you be surprised if the reds of similarity outnumbered the blues of difference?

Exercises

11 Consider the list of vices that Pope Gregory the Great drew up in the 6th century. These are often referred to as 'the seven deadly sins'. Try to list the corresponding virtues and think about whether they are good in and of themselves, or is their main value to hold society together?

Vices	Virtues
lust	
anger	
envy	
gluttony	
sloth	
pride	
greed	

12 If you could design a society, name three types of virtuous behaviour that would be regarded as central to the flourishing of the community (not necessarily the individual) and three vices that would be regarded as serious offences.

The ancient world

The *Code of Hammurabi*

The original stones showing the Code of Hammurabi.

The clay tablets in cuneiform writing of the *Code of Hammurabi* (1770 BCE) were discovered in Iran around 1900. They are mainly a list of do's and don'ts about contracts and relationships in Babylon. Yet despite the differences of costume and song, of foodstuff and manners, of time and place, there are surprising similarities to the way some communities behave today. Thus, we see the beginning of normative and virtue ethics – what to do to secure the common good (at least for those who counted as citizens).

The Confuciuan *Analects*

In China, Confucius (551–479 BCE) never stated whether man was born good or evil, but nevertheless held that '*by nature men are similar; by practice men are wide apart*', implying that men should be '*conditioned by society towards the virtues of the saint, scholar and gentlemen*'. Or in today's vernacular – getting men to do the same thing will give you a stable society. (There is no reason to suppose that Confucius included women in the progress toward perfection.) These norms, like the *Code of Hammurabi,* were dogmatic and dictatorial unlike the use of reason and the dialectic that appeared with Socrates and the ancient Greek thinkers much later, around 350 BCE. But the older codes were on to something about shared values.

The ancient Greeks

When we begin to look at the thinkers of Greece in and around 350 BCE and read the dialogues of Plato, we see some of the rational methods used by scholars (and even ourselves) today: the dialectic back and forth of argument and the analysis of values – what are justice, love, beauty, and the nature of the good?

But back in 350 BCE, in Plato's dialogues we can almost see and hear the wise men of antiquity thrashing out one view after another. This teaching style is now called the Socratic method. And with Plato, the position of realism comes to the fore. The Platonic view is that there truly are moral values outside of ourselves: ideal forms that cannot be realized fully in this life, that are absolute, timeless, and unchanging.

The cast of characters in Plato's dialogues represent much that is the same in our time. We have only to think of news stories, novels, films, and our own experience: the moral **nihilist**, the **sceptic**, the relativism of the **Sophists**, the **hedonist**, and with Glaucon in *The Republic*, the individualist who is only 'looking out for number one'. And Thrasymachis of *The Republic* proclaims that 'might is right' 2000 years before the voice of Neitzsche in Germany echoed the same notions about his Superman in the 19th century.

In ancient Greece, ideas were a kind of intoxication stemming from the freedom of throwing off the shackles of polytheism and tradition. This is somewhat analogous to any child reaching maturity and finding that his or her parents and teachers are hopelessly flawed, so the best course is to figure out things for yourself! It was against this background of intellectual excitement that Socrates and Plato hoped to persuade men that lying, cheating, stealing, and other vices do more harm to the villain than to the victim and certainly are pernicious to the community. And that the best rulers are the philosopher-kings who know 'The Right' and, therefore, know right from wrong and desire only the right. Are there any philosopoher-kings today in the world of politics?

CHALLENGE YOURSELF

How can we ever know these ideal forms?

Knowledge questions

4 Do you agree that all sin comes from ignorance and reason is our only salvation?

5 If not, how could a community survive unless human intelligence becomes the virtue that maintains social order?

Practice essay title 2: Do you have to know 'The Right' or the right thing to do in order to do the right thing?

Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Although **virtue ethics** is less fashionable today, it deserves a mention in any history of ethics, however briefly, because the approach of virtue ethics de-emphasizes rules, consequences and particular acts, and places the focus on the person. The issue is not primarily whether or not an intention is right, though that is important; nor is it primarily whether or not one is following the correct rule; nor is it primarily whether or not the consequences of action are good, though these factors are not irrelevant. What is primary is whether or not the person acting is expressing good character (moral virtues). See if this passage from Aristotle's Book II of the *Nichomacean Ethics* makes any sense to you. It certainly has seeds of the nature versus nurture debate still current in psychology today.

CHALLENGE YOURSELF

Chances are if you pass a magazine stand in a train station or airport, you will find any number of headlines on how to take control of your life from the Alcoholics Anonymous 12-step programme to weight loss and exercise routines meant to implant the habits of the relevant physical or moral virtue. In what ways would a 'practice makes perfect' philosophy lead to success in school, professional, or social relationships?

> Moral virtue comes about as a result of habit … a slight variation from the word ethos (habit). From this it is also plain that none of the moral virtues arise in us by nature; for nothing that exists by nature can form a habit contrary to its nature. For instance the stone which by nature moves downwards cannot be habituated to move upwards, not

even if one tries to train it by throwing it up ten thousand times; nor can fire be habituated to move downwards, nor can anything else that by nature behaves in one way be trained to behave in another. Neither by nature, then, nor contrary to nature do the virtues arise in us; rather we are adapted by nature to receive them, and are made perfect by habit. ”

Aristotle, trs. Ross, 2009

So our dispositions or habit-like tendencies are engrained as a product of our own behaviour and become our 'second-nature', so to speak. Morally speaking, we are born a blank slate – a *tabula rasa* –and our character is formed by our repeated behaviour freely chosen. To paraphrase the last line from *Invictus* (William Ernest Henley, 1849–1903), you are 'the captain of your soul'. That is, if you are not morally virtuous, then you are in the grip of appetites and passions that get in the way of doing the right and reasonable things.

In Aristotle's study of character, a frequent theme is the fact that a virtue lies between two vices. The virtue of courage, for example, lies between the vices of rashness and cowardice. The coward has too much fear. The rash person has too little fear and excessive confidence. The courageous person has the right amount. See if you can add to Table 9.3.

Table 9.3 Aristotelian vices and virtues.

Emotion/action	Vice: deficiency	Virtue: mean (middle)	Vice: excess
giving money	stinginess	generosity	prodigality
fear	rashness	courage	cowardice
seeking pleasure	insensibility	moderation	self-indulgence

In the Middle Ages, we find Thomas Aquinas in the Christian tradition, Maimonides in the Jewish tradition, and Avenenna and Avarroes of the Muslim faith to whom modern readers owe a debt of gratitude for reviving the spirit and works of Plato and Aristotle, as well as giving us original views of their own. While TOK is not a course in history, even a small understanding of these impressive scholars helps in our appreciation for what we have inherited over the years.

Religious teaching as a basis of morality

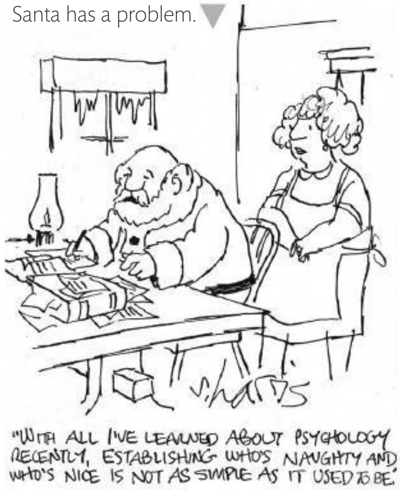
A complete timeline of the development of ethical and moral thought is too lengthy to go into here. However, we can make reference to the establishment of Christianity, from which God's will eventually became the dominant theistic foundation for morality in the West, and the example of the life of Jesus as the model for right behaviour. The same pattern is true for the centrality to moral thought and conduct of the Holy Qur'an and the life of the Prophet Mohammed. These are just two of many religions whose followers abide daily by tenets of a practical and moral nature. A comparison chart might be in order here to gauge the notions of the good life as promoted by Hindu, Muslim, Christian, Buddhist, Jain, and other religions.

Contemporary thinking

The ethics of care – Carol Gilligan

There is no doubt that advances in brain research will stimulate new thinking about right and wrong, good and bad, and how we make and justify those decisions. In addition, new perspectives in gender studies have tried to show that women tend to follow a different path of moral development from that of men. Rather than thinking through moral dilemmas in terms of justice and rights, or interpreting moral behaviour within the deontological or utilitarian framework, Carol Gilligan, a psychologist and author of *In a Different Voice: Psychological Theory and Women's Development*, has tried to build a theory about what she calls *ethics of care*. While Gilligan's thinking certainly has affinity with other cultures where relationships are central rather than the individual, her way of looking at morality claims that women tend towards an outlook that emphasizes tending to the needs of others, not to abstract principles of right and wrong. Not surprisingly, her views about gender differences in moral reasoning have not gained widespread acceptance within or outside the academy, except in the medical field. But for TOK students, her writing offers an alternative that can be explored for presentations or for greater substance in their TOK essays.

Santa has a problem.



The question still remains, how do we know right from wrong, and how can we make the best judgements about good and bad people?

Jonathan Haidt and Steven Pinker

Jonathan Haidt (2010) uses the map metaphor when talking about the excitement of his neighbourhood, meaning his discipline of psychology, and how people are moving in all over the place: developmental psychologists, cognitive neuroscientists, experimental philosophers, and economists – they are all talking about morality. Perhaps it's the dawn of an age of consilience.

Haidt goes on to say that until recently there have been only two restaurants in the neighbourhood, *'the utilitarian grill and the deontological diner'*, but he wants to expand our ideas of the moral domain and how it should or does drive our actions by calling on the biological and neurosciences who stake out as their province the dissection of our moral intuitions – taking intuition as a kind of cognition. Yet, Haidt is not the only voice in this territory; we have seen Steven Pinker's remarks about the tension between emotion and reason in moral judgements, and there's the work of Marc Hauser at Harvard and others. It is a territory brimming with enthusiasm and creativity.

Suppose, then, that we look at what the 'moral sciences' today can tell us. It goes something like this: the reality is that we as human beings are innately wired down through the evolutionary ages with a *moral sense*, but we use different ways to express or connect our actions with these senses or receptors. And what might these senses be? Well, suggests Haidt, let's think of ourselves – everyone in the world (universality) – with moral concerns about a limited number of ideas (say, harm, fairness, community, authority, and purity) that *'keep reappearing in cross-cultural surveys as the primary colours of our moral sense'*.

> People everywhere at least in some circumstances and with certain other folks in mind, think it's bad to harm others and good to help them. They have a sense of fairness that one should reciprocate favors, reward benefactors and punish cheaters. They value loyalty to a group, sharing and solidarity among its members and conformity to its norms. They believe that it is right to defer to legitimate authorities and to respect people with high status. And they exalt purity, cleanliness and sanctity while loathing defilement, contamination and carnality.
>
> **Pinker, 2003**

Would it be surprising to you to read an article called 'The weirdest people in the world' and have it put to you that perhaps for generations WEIRD – Western, Educated, Industrialized, Rich, Democratic – people have been used as the representative for generalizing about the whole human population by those referred to as 'Western thinkers'? This group focuses on categories and laws, rights and justice rather than a more holistic reality emphasizing relationships and context. But it needs to be said most emphatically, that moral psychology here is descriptive and in no way implies that the morality of this group, or any group, is right, wrong, or superior.

To listen to a talk on the science of morality, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 9.2.

Accepting this data, does it lead you to conclude that we have a species commonality within the diversity of cultural groupings? Does it satisfy you that in the moral sphere values can be universal and variable at the same time?

What do you make of these additional thoughts from Professor Haidt?

> “Morality is like the Matrix from the movie, *The Matrix*. … But there are lots and lots of other matrices out there. We happen to live in a matrix that places extraordinary value on reason and logic. So the question arises, is our faith justified? Maybe ours is right and the others wrong. What if reasoning really is the royal road to truth? … Maybe … morality, with this emphasis on individual rights and welfare, maybe it's right because we are the better reasoners. We had The Enlightenment. We are the heirs of The Enlightenment. Everyone else is sitting in darkness, giving credence to religion, superstition and tradition. So maybe our matrix is the right one.”

Haidt, 2010

9.6 Links to personal knowledge

Knowledge framework: Links with personal and shared knowledge – Why is this area significant to the individual?

It is not easy to know where to draw the line between one's self and the groups we identify with, the more so since every person belongs to many different groups. Yet there is an existential experience of being unique like no other person on the face of the Earth. It is in this sense that we recognize that while there are multiple views on nearly all issues of importance – morality being central to our thoughts just now – no one can decide for you what is right and what is wrong no matter how tight the community bonds.

At the very least, we can give our best thinking to important issues and one way to do this is to continue to ask questions of ourselves, thereby revising, rejecting, or reaffirming our own moral views.

Exercise

13 The following survey was designed by TOK students to combine the techniques of the human sciences with the content of morality, and to think about their school as a moral community and their place in it. The outward purpose was to try to gauge shared knowledge about morality in their school community without reference to philosophers or academic writings.

1	Is there a written rule in school against cheating?	Y	N
2	Is there an unwritten rule in school that accepts cheating as long as you don't get caught?	Y	N
3	Is there an unwritten rule in school against stealing?	Y	N
4	Is there a written rule in school against stealing?	Y	N
5	If you saw someone doing something wrong, would you report that person to someone in authority?	Y	N
6	Does your answer to question 5 depend on the action?	Y	N

7	Does your answer to question 5 depend on the person?	Y	N
8	Is there an unwritten rule in school against snitching on friends?	Y	N
9	Would your answer to questions 5 and 8 depend on whether anyone knew that you reported someone?	Y	N
10	If you lived alone on Earth, would it be possible for you to do anything wrong?	Y	N
11	Do you have a set of ethical principles or an ethical code?	Y	N
12	Can you explain them to someone else clearly?	Y	N
13	Do they guide your behaviour?	Y	N
14	If you answered 'yes' to question 3, are these principles the same or similar to your parents'?	Y	N
15	If you answered 'yes' to question 3, are these principles the same or similar to your best friends'?	Y	N
16	Could you be friends with someone who did not share your ethical values?	Y	N
17	Could you marry someone who did not share your ethical values?	Y	N
18	Does it matter if you are a good person?	Y	N
19	Does it matter if others think of you as a good person?	Y	N
20	Can you define what it means to be a good person?	Y	N
21	Do you know anyone who is a really good person?	Y	N
22	Do you think that most people would agree on the meanings of all the words in this survey?	Y	N

a Circle the appropriate answers for *you*, then match your responses with others and discuss your differences.

b By way of an extension, answer the following:

- **i** How important is it that the school community agrees on what is right and wrong, and what are the consequences of observing (or not) a moral code?
- **ii** How important is it that your personal moral code is aligned or shared with those in your immediate school community?

Finally, to understand how a young person can reflect on his or her own moral development – their personal understanding of the moral realm and their development within this context – consider this interview with a 25-year-old law student at Harvard University.

Q: Is there really some correct solution to moral problems or is everybody's opinion equally right?

A: No, I don't think everybody's opinion is equally right. I think that in some situations there may be opinions that are equally valid and someone could conscientiously adopt one of several courses of action. But there are other situations to which I think there are right and wrong answers that sort of belong to the nature of existence, of all individuals here who need to live with each other. A person's life is enriched by cooperating with other people and striving to live in harmony with everybody else, and to that end, there are right and wrong, there are things which promote that end and that move away from it, and in that way, it is possible to choose in certain cases among different courses of action, that obviously promote or harm that goal.

Q: Is there a time in the past when you would have thought about these things differently?

A: Oh, yeah. I think that I went through a time when I thought that things were pretty relative, that I can't tell you what to do and you can't tell me what to do, because you've got your conscience and I've got mine …

Q: When was that?

A: When I was in high school, I guess it just sort of dawned on me that my own ideas changed, I felt I couldn't judge another person's judgement, but now I think even when it is only the person herself who is going to be affected, I say it is wrong to the extent it doesn't cohere with what I know about human nature and what I know about you, and just from what I think is true about the operation of the universe, I could say I think you are making a mistake.

Q: What led you to change, do you think?

A: Just seeing more of life, just recognizing that there are an awful lot of things that are common among people. There are certain things that you come to learn that promote a better life and better relationships and more personal fulfilment than other things that tend to do the opposite, and the things that promote these things, you would call morally right. ”

Gilligan, 1990

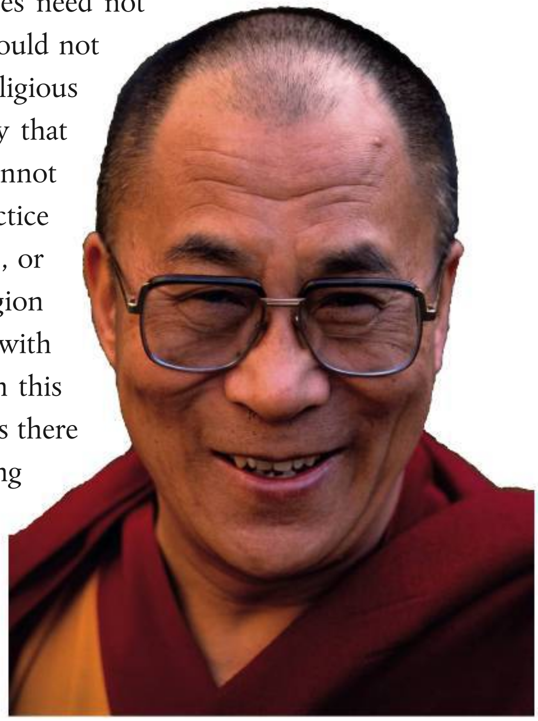
Knowledge framework: *Links to personal knowledge –* What assumptions underlie the individual's own approach to this knowledge?

Ideal knower: Dalai Lama

“ Of course, both as a Tibetan and a monk, I have been brought up according to, and educated in, the principles, the precepts, and the practice of Buddhism. I cannot, therefore, deny that my whole thinking is shaped by my understanding of what it means to be a follower of the Buddha. However, my concern in this book is to try to reach beyond the formal boundaries of my faith. I want to show that there are indeed some universal ethical principles which could help everyone to achieve the happiness we all aspire to.

I believe there is an important distinction to be made between religion and spirituality. Religion I take to be concerned with faith in the claims to salvation of one faith tradition or another, an aspect of which is acceptance of some form of metaphysical or supernatural reality, including perhaps an idea of heaven or nirvana. Connected with this are religious teachings or dogmas, ritual and so on. Spirituality I take to be concerned with those qualities of the human spirit – such as love and compassion, patience, tolerance, forgiveness, contentment, a sense of responsibility, a sense of harmony – which bring happiness to both self and others.

Dalai Lama XIV.



While ritual and prayer, along with the questions of nirvana and salvation, are directly connected to religious faith, these inner qualities need not be, however. There is thus no reason why the individual should not develop them, even to a high degree, without recourse to any religious or metaphysical belief system. This is why I sometimes say that religion is something we can perhaps do without. What we cannot do without are these basic spiritual qualities. Those who practice religion would, of course, be right to say that such qualities, or virtues, are fruits of genuine religious endeavor and that religion therefore has everything to do with developing them and with what may be called spiritual practice. But let us be clear on this point. Religious faith demands spiritual practice. Yet it seems there is much confusion, as often among religious believers or among nonbelievers, concerning what this actually consists in. The unifying characteristic of the qualities I have described as 'spiritual' may be said to be some level of concern for others' well being. In Tibetan we speak of *shen pen kyi sem* meaning 'the thought to be of help to others'. And when we think about them, we see that each of the qualities noted is defined by an implicit concern for others' well being.

Moreover, the one who is compassionate, loving, patient, tolerant, forgiving and so on to some extent recognizes the potential impact of their actions on others and orders their conduct accordingly. Thus spiritual practice according to this description involves, on the one hand, acting out of concern for others' well being. On the other, it entails transforming ourselves so that we become more readily disposed to do so. To speak of spiritual practice in any terms other than these is meaningless.

My call for spiritual revolution is thus not a call for a religious revolution. Nor is it a reference to a way of life that is somehow otherworldly, still less to something magical or mysterious. Rather it is a call for a radical reorientation away from our habitual preoccupation with self. It is a call to turn toward the wider community of being with whom we are connected, and for conduct, which recognizes others' interests alongside our own. ”

Dalai Lama XIV, 1999

Practice essay title 3: Ethics is concerned with knowledge questions in much the same way as other pursuits of truth. Discuss.

10 Religious knowledge systems

On previous page – Torii gates at the Fushimi Inari Taisha shrine in Kyoto, Japan.

Some estimates suggest there are approximately 4200 religions in the world but how do we define what constitutes a religion?

10.1 Introduction to religious knowledge systems

What is religion?

Manuism

Manuism has millions of adherents around the world. While in principle it can take place anywhere, tradition dictates that large numbers congregate on a fortnightly basis, wearing red, and singing songs of tribute. These occasions can be used by adults to induct the next generation into similar devotions. Many hope to find the means to visit the home ground some day. Gifted performers display their allegiance through a combination of ritual and innovative practices in front of the congregation (although, from time to time, some go astray and are lost). Nowadays, the spectacle is relayed around the world allowing participation on a global scale. Years ago, when many devotees had lost faith, a charismatic leader arrived from the north and gained the trust of the multitude. A powerful and renewed belief grew from repeated positive experiences. To this day, this leader remains a figurehead and object of sustained reverence, to an extent unmatched within rival groups.

The Cult of Reason

The Cult of Reason was a movement dedicated to the pursuit of truth and liberty through the exercise of Reason. Acts of congregational worship were encouraged, with devotional displays to the ideal of Reason. At the Festival of Reason – celebrated in every Temple of Reason – inscriptions were laid, proclaiming 'Death is an Eternal Sleep', and 'To Philosophy'. In each temple, an altar was erected 'To Liberty', and the ideal of Reason was personified in the form of a living Goddess.

Before you read on, consider whether or not either of the descriptions above could be about a religion. Why or why not? Are there any described features that seem familiar in the context of religion? There are some concepts that appear to connect to religion – congregations and rituals, devotion and belief, charisma and reverence, temples and goddesses – but are they sufficient?

Many of you will quickly recognize that Manuism is an invented term to describe the activities and beliefs of supporters of Manchester United Football Club. Perhaps less well known is the Cult of Reason, a real movement that emerged but quickly disappeared during the French Revolution of the 1790s. Accordingly, many people would dismiss the claim that Manuism is a religion on the grounds that it is about following a football team, and not about finding answers to the questions and issues normally associated with religion. A subset of these people might even be offended by the notion. And some would also be unimpressed with the Cult of Reason as a religion – isn't religion supposed to be concerned with faith rather than reason? Having faith in reason as an object of devotion seems to twist categories and distort our expectations beyond acceptable limits.

Whatever our responses to Manuism and the Cult of Reason, the fact is that religion plays an important role in the lives of most people on Earth. Most reliable sources put the combined population of Christians and Muslims well in excess of 3.5 billion – more than 50% of the entire human population. Adding Hindus and Buddhists may bring the total up to 90% or more, and there are many more than just these four religions. And this proportion is almost certainly not decreasing. As a prime influence on what and how people think and know, it would seem foolhardy to ignore the impact of religion in TOK studies.

The Stretford End, Old Trafford, Manchester, UK

Religious knowledge and TOK

The remit of this chapter goes further than an acknowledgement that religion colours many of our lives in ways that affect knowledge. We will explore and assess the claim that religions *produce* knowledge themselves. In order to develop this idea, we will try to find answers to some key questions that are parallel in many ways to the questions that we have posed in earlier chapters.

What is religion for?

The preponderance of religion in the world suggests that it addresses issues that other AOKs somehow fail to resolve. If religion is the solution to some problem, what is the problem that it addresses? In other words, what is the scope of religion, and what are its applications? If knowledge is a kind of map or representation, what is the territory that religion represents? If we reject the idea that supporting a sports team is a religious activity on the grounds that it does not concern itself with the right kinds of question, then what kinds of question do count as appropriate for religion to tackle?

Festival of the Cult of Reason

How does religion go about its business?

Is there anything like a 'religious method' that corresponds to the methods employed in the sciences or history? What might be the concepts central to the pursuit of religious knowledge, and how can they be tested? More loosely, how does religion avail itself of various WOKs? Would we be correct in assuming that there is a close connection between religion and faith, and what do we mean by faith in the first place?

On what basis should knowledge in religion be assessed?

If we accept that knowledge is a product of religion, how can we evaluate its quality? We need some sort of benchmark for deciding how successful religions might be in generating knowledge, just as we have ways of judging the quality of knowledge produced in other AOKs. It will be difficult for some people to accept the idea of religious knowledge unless we can plausibly address this question.

CHALLENGE YOURSELF

Is the relationship between religion and faith the origin of any unease that we might feel with the idea of the worship of reason, as promoted by the Cult of Reason?

It is easy to generalize and assume that all religions require the existence of one or more gods. This is not the case. Which religions contradict this assumption?

So, in a nutshell:

- What are the questions and issues to which religion provides solutions or answers?
- What concepts, methods, and activities are employed in religion in order to reach these solutions or answers?
- By what means can we evaluate the solutions or answers that religions provide?

It will take the rest of this chapter to suggest answers to these questions.

10.2 Scope and applications

Knowledge framework: *Scope and applications –* What is the area of knowledge about?

What is religion about?

Let's start with the first question, 'What are the issues that religions address?' Regardless of whether you are a religious person or not, select three of the following ten issues that you think religion addresses. It may be interesting to compare your answers with other students. Remember to focus on identifying the issues religion addresses, not on whether or not you think the outcomes are successful – that would be the third question above, which will come later.

1. The world is a frightening place.
2. Nothing in the world seems permanent.
3. Humans make mistakes.
4. Terrible things sometimes happen without warning.
5. Many people live lives of material poverty.
6. Everyone dies.
7. The complexity and beauty of the world need explaining.
8. Left to themselves, people lack discipline, self-control, and become self-centred.
9. Comfort is to be found in a like-minded community with established routines.
10. It is often difficult to work out what is the morally right thing to do.

Are there any systematic explanations for the differences you may have with your fellow students in this exercise? To what extent is there common agreement about subject matter of religion? If we cannot agree as to what issues or questions religion is addressing or answering, it will be difficult for our exploration to move forward, as it will be hard to appreciate the value of whatever solutions are offered. So let's look at three different viewpoints concerning the nature of religion.

> “What I've found is that, across the board, religion is about behaving differently. Instead of deciding whether or not you believe in God, first you do something, you behave in a committed way, and then you begin to understand the truths of religion. And religious doctrines are meant to be summons to action: you only understand them when you put them into practice. Now, pride of place in this practice is given to compassion. And it is an arresting fact that right across the board, in every single one of the major world faiths, compassion — the ability to

feel with the other, [...] is not only the test of any true religiosity, it is also what will bring us into the presence of what Jews, Christians and Muslims call 'God' or the 'Divine'. It is compassion, says the Buddha, which brings you to Nirvana. Why? Because in compassion, when we feel with the other, we dethrone ourselves from the center of our world and we put another person there. And once we get rid of ego, then we're ready to see the Divine. And, in particular, every single one of the major traditions has highlighted — has said — has put at the core of their tradition — what's become known as the Golden Rule. First propounded by Confucius five centuries before Christ, 'Do not do unto others what you would not like them to do to you.' ”

Armstrong, 2008

“ It is time we admitted [...] that there is no evidence that any of our books was authored by the Creator of the universe. The Bible, it seems certain, was the work of sand-strewn men and women who thought that the earth was flat and for whom a wheelbarrow would have been a breathtaking example of emerging technology. To rely on such a document as the basis for our worldview [...] is to repudiate two thousand years of civilising insights that the human mind has only just begun to inscribe upon itself through secular politics and scientific culture. [...] the greatest problem confronting civilisation is not merely religious extremism: rather, it is the larger set of cultural and intellectual accommodations we have made to faith itself. ”

Harris, 2004

“ Which of the following – baseball, basketball, tennis and golf – is best at scoring runs? The answer of course is baseball, because 'runs' is a term foreign to basketball, tennis and golf alike. Different sports have different goals[... and] just as hitting home runs is the monopoly of one sport, salvation is the monopoly of one religion. If you see sin as the human predicament and salvation as the solution, then it makes sense to come to Christ. But that will not settle as much as you might think, because the real question is not which religion is best at carrying us into the end zone of salvation but which of the many religious goals on offer we should be seeking. [...] One of the most common misconceptions about the world's religions is that they plumb the same depths, ask the same questions. They do not. ”

Prothero, 2010

Exercises

1 Try to summarize the key differences between the claims of each of these three thinkers.
2 Can you detect any similarities peeping through the disagreements?
3 Which, if any, of these three excerpts seems most convincing to you, and why?

CHALLENGE YOURSELF

In his book *God is not One*, Stephen Prothero includes Confucianism and the Yoruba religion that originated in Nigeria as two of his 'eight rival religions that run the world'. The IB World Religions programme excludes these examples, preferring to insert Sikhism, Jainism, and the Baha'i faith, which Prothero ignores. If you are following this IB programme, or at least if your school offers it, you might be able to investigate why this is the case.

CHALLENGE YOURSELF

We have already met Stephen Jay Gould's idea of 'non-overlapping magisteria' in Chapter 3 (page 93), as propounded in his book *Rocks of Ages*. To which of the three views on religion presented above do you think Gould would be sympathetic?

Religion is about participation in order to foster compassion …

The British writer and former nun, Karen Armstrong, depicts engagement with religion as an openness to participation in the ritual and doctrinal dimensions of religion which will, regardless of the specifics of the particular religion, lead to a heightened sense of empathy and compassion for others – an emotional bond with the larger human community that loosens the drive for selfish motives and egotistical behaviour. She is claiming that participation in certain actions can change attitudes. In this sense, all religions are addressing the same issue and aiming for the same outcome, despite the different journeys that may be experienced along the way.

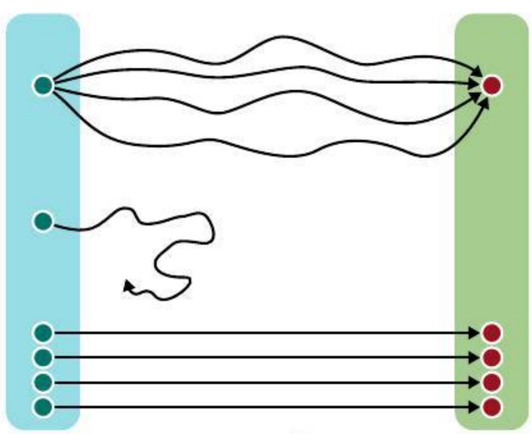
Religion is a primitive attempt at explanation riddled with false beliefs …

The American neuroscientist Sam Harris regards religions as failed disciplines – attempts to explain aspects of our experience in the world that are out-dated and have been largely shown to be false as a result of advances in other Areas of Knowledge – particularly the sciences. These religions survive as shadows of their former selves – explaining ever-diminishing regions of reality as the natural and human sciences march forward. By tolerating the failures of religion, Harris believes that we open the door to more extreme versions, which are dangerous because beliefs are usually followed by actions for which the prior beliefs are cited as justifications. If these beliefs are false, any actions based on them are unlikely to be positive.

Religions are individual and several attempts to resolve different human problems …

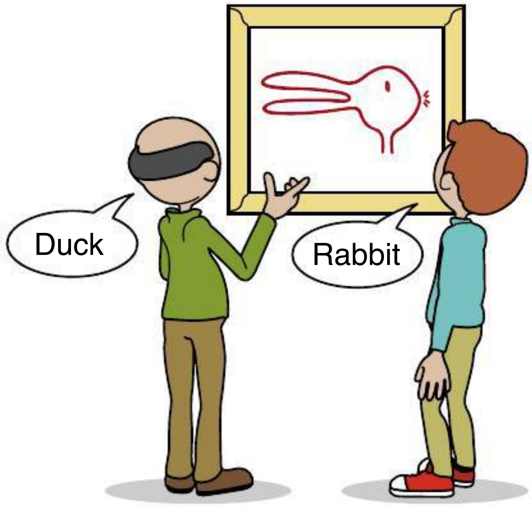
The American professor of religious studies, Stephen Prothero, maintains that the importance of the differences between religions has been systematically underestimated. Although he agrees with those like Armstrong who emphasize the practices of religion, he thinks they overlook the premise that such practices are actually rooted in clearly distinguishable attempts to resolve different problems with solutions tailored to each. Those with views similar to Harris also indiscriminately lump religions together – but this time on the basis of their collective inability to produce true answers to empirical problems. It is better to take each religion on its own terms – to characterize Christianity as advocating salvation as the solution to the problem of sin, Islam as advancing submission as a corrective to pride and self-importance, Buddhism as a route to awakening from suffering, Confucianism as a pathway to social harmony, and so on.

Figure 10.1 A summary of three approaches to religion: Armstrong, Harris and Prothero.



Take a few moments to appraise Figure 10.1. To what extent do you think it is an accurate synopsis of what you've read so far? Are there any weaknesses in the diagram and do you have any suggestions for improving it?

Now consider the cartoon below. Identify one way in which it supports Prothero's view, and one way in which it doesn't. Does it add anything interesting to Harris's view?



And the answer is ...

Exercises

4 In each of the three scenarios, what are the prospects for religious knowledge? Does any one of them look more promising than the others? You might like to consider:

- **a** What kind of knowledge is privileged in Armstrong's view? How might we test this knowledge? If all religions have the same goal, might some of them offer more efficient routes to it than others?
- **b** Is it possible to subscribe to Harris's view and still maintain that there is such a thing as religious knowledge? By what procedures might we test the idea that religious claims are false?
- **c** Does Prothero's view imply that each religion should be regarded as a discipline in its own right? How could we test the solutions to different problems that each religion offers? Does this view make it impossible to compare religions?

5 Can you connect Harris's opinions with those of Ed Wilson about consilience in Chapter 3?

6 Before you read further, return to the list of issues on page 310. Which of them seem to be addressed by each of the three views of religion? Can you detect any pattern?

Here are some points to consider and compare with your own thoughts.

- **a** Armstrong might support points 8 and 9 as worthy goals of participation in religious practices.
- **b** Harris is likely to say that point 1 is less true today than in the past because of our advances in scientific knowledge, so it is not as pressing an issue for religion to tackle. He might add that there are material explanations for point 7 that render religious treatment superfluous and misleading.
- **c** Prothero would probably point to specific statements as being more in line with particular religions – for instance, point 8 to Islam, point 3 to Christianity, point 2 to Buddhism, point 10 to Judaism.

Knowledge framework: *Scope and applications –* What practical problems can be solved through applying this knowledge? What makes this area of knowledge important?

What practical problems can knowledge gained through religion solve?

Almost all the issues on page 310 are concerned with some aspect of the core experiences of being a human being (i.e. the 'human condition'), and we might ask whether such issues have been addressed elsewhere in the field of shared knowledge. There are, after all, several other AOKs that are focused on the nature of being human – human sciences, ethics, literature and other arts, and history all come to mind. So why do we need religion in order to deal with such issues? Hasn't this territory been mapped elsewhere?

Knowledge question

1 To what extent is the knowledge offered by religions also available from other AOKs? Does your answer make religious knowledge systems redundant?

It could be argued that the human sciences, as sciences, take a rather dispassionate view of their subject matter. Ethics, as a branch of philosophy that attempts to ground knowledge claims about right and wrong in a rational basis, might be similar. Next, consider the great novels and dramas of literature, and the grand narratives of history. Don't these disciplines provide answers to deep questions of human nature and life? If so, why haven't they made religion obsolete? For some people, perhaps they have – atheists have no need for the map that religions provide and would deny that religion should have exclusive rights to any territory.

We come into this world without asking to, we struggle, strive to learn, try to realize our potential, or just fulfil some of our desires. We try to do good, perhaps to leave a legacy, and then sooner or later we die. Many people are struck by the apparent absurdity in this narrative when taken at face value, and seek a larger purpose or meaning for their lives. It could be argued that the AOKs discussed above are successful in describing the human condition and sometimes in providing guidance as to how we should respond to the situations in which we find ourselves. But they are not equipped to provide the larger sense of purpose. It could be that the need for purpose is the reason that religion survives and prospers. Then again, others would claim that it is sheer hubris to maintain that we humans should think there is some special purpose or meaning to our lives. They might point to the fact that we have populated an ordinary planet for a tiny fraction of its history in a universe of staggering magnitude (and which is now shown to be teeming with planets orbiting other stars). Hence the belief that we have some privileged role in the cosmos is untenable.

Defining religion

While the three perspectives we've analysed are useful in helping us to explore what religion is for – why we seem to need it and what knowledge we might acquire from it – they do not seem to converge easily on a definitive answer as to what counts as a religion. Indeed, the differences between religions seem to render it hard to make overarching claims that encompass all of them. It is as if the closer one looks at religion, the fuzzier it appears.

There have been several attempts to deal with this apparent fuzziness by putting forward clusters of attributes or dimensions that describe religion in a general way. For example, we might claim that religions comprise:

- a creed – a set of beliefs
- a cultus – a set of practices
- a code – a set of ethical values or precepts
- a community – a set of people who subscribe to the religion.

Much of the previous discussion can be framed in a way that is consistent with this list. Do ritual practices, as Armstrong suggests, lead to the adoption of an ethical stance, or perhaps at least promote an attitude that encourages upstanding moral thinking? Do religious beliefs, as Harris would emphasize, routinely bring about public practices, rather than being merely private allegiances, as some others prefer to claim? What is the relationship between **propositional** and **procedural** knowledge here? In this scheme, how well does Manuism hold up as a religion?

10.3 Language and concepts

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

The key concepts of religious knowledge

Just as knowledge in other areas is organized around critical concepts, so it is with religions. It might be instructive to examine these key concepts in different religions to look for patterns or individual distinctiveness. So consider the following array of key concepts from different religions:

• jannah	• nirvana	• heaven
• grace	• karma	• kripa
• anatta	• soul	• atman
• moksha	• salvation	• ren
• jihad	• li	• mitzvot
• dukkha	• shirk	• sin.

Exercises

7 In which religion is each of these key concepts embedded?

8 Do some of these concepts extend across more than one religion?

9 To what extent can you see any basic similarities between the concepts in each row? Even if they are different, could it be said that they perform similar functions in some way?

10 How easy or difficult is it to get an understanding of what they mean? Do you think their origins in different languages or cultures provide a formidable challenge in this respect?

11 Do you think each of these concepts is open to examination or testing of some kind?

12 Do the results of your research give more support to the views of Armstrong or Prothero?

There have been many attempts to 'boil down' the concepts inherent in different religions into a common 'essence'. A distinguished example is that of the Romanian–American scholar Mircea Eliade, who maintained that all religion hinged on a clear distinction between the concepts of the sacred and the profane.

Concepts are of course expressed in language, and it is worth exploring how successful words can be in conveying the kind of complex and sometimes slippery concepts at the heart of religion. For example, in Chapter 9, the Dalai Lama is quoted speaking of 'salvation' – a word many would reserve exclusively for Christianity. To what extent does 'salvation' capture religious aims across the spectrum?

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

The role of language in religion

The role of language in religion clearly goes further than merely providing names for concepts. For example, Scottish scholar of religion Ninian Smart identifies the importance of narrative as a vehicle for expressing and explaining those key concepts.

CHALLENGE YOURSELF

You might like to explore the work of Ninian Smart and his seven dimensions of religion, of which narrative is one. There is the possibility of comparison with the 4Cs on the opposite page.

Knowledge framework: *Language and concepts* – What metaphors are appropriate to this area of knowledge?

Metaphors in religious knowledge systems

Although some religions rely more heavily on it than others, the power of storytelling as a method of communication is clear. Sometimes the point of the story is unambiguous, but often there are various layers of meaning that can be extracted. For example, what should we make of the following?

Expressing concepts can be tricky

> “15 Then the Lord said to Moses, ‘Why are you crying out to
> me? Tell the Israelites to move on.
> 16 Raise your staff and
> stretch out your hand over the sea to divide the water so
> that the Israelites can go through the sea on dry ground.’
>
> 21 Then Moses stretched out his hand over the sea, and all
> that night the Lord drove the sea back with a strong east
> wind and turned it into dry land. The waters were divided,
> 22 and the Israelites went through the sea on dry ground, with
> a wall of water on their right and on their left.
>
> 26 Then the Lord said to Moses, ‘Stretch out your hand over
> the sea so that the waters may flow back over the Egyptians
> and their chariots and horsemen.’
> 27 Moses stretched out his
> hand over the sea, and at daybreak the sea went back to its
> place. The Egyptians were fleeing toward it, and the LORD
> swept them into the sea.
> 28 The water flowed back and
> covered the chariots and horsemen—the entire army of
> Pharaoh that had followed the Israelites into the sea. Not
> one of them survived.”
>
> **The Holy Bible. Exodus 14, New International Version**

Are we to believe that the waters of the Red Sea actually parted in this fashion – that this is a historically accurate account? Even in some of the most scientifically advanced countries of the world, some people are willing to accept this. But this event undermines much of what we know about the physical world – it is obviously at odds with the findings of science. Some people well versed in religious matters might point out that this story appears in the Qur'an as well as the Old Testament, which strengthens the case for accepting it at face value. Alternatively, some would adopt a definitional approach to this problem of knowledge by declaring that a miracle is an event not fully explained by natural processes. Others would object by saying that we can make up any words we want and define them any way we like, but this does not mean that they describe anything real in the world. Here, we run the danger of becoming trapped in a circularity. We accept the accuracy of scripture as a justification for whatever scripture says. It may be that the reluctance of some religious adherents to depart from a literal interpretation of scripture is related to the desire for permanency in an ever-changing world (mentioned earlier as a potential motivation for religion). Retreating slightly from this position, some claim that the original meaning of 'Red Sea' was 'reed sea', a meaning lost in the multiple re-telling and myriad translations of the story. They can then rationalize the account in terms of what is possible in a marshland environment as opposed to open water.

Unconvinced, we may withdraw further from a literal interpretation and seek a more metaphorical or veiled meaning for it. For example, the story might serve as a message about the power of God or as a warning to the wicked. Christians might appropriate it as a foreshadowing of the life of Christ – a physical salvation as compared to the spiritual salvation to come. You might like to consider here the connections between the accepted methods of interpretation of scripture (for example, exegesis in Christianity; tafsir in Islam) and the challenges facing historians and art critics when faced with source material.

Religious languages

While language is universally important for the transmission and storage of religious knowledge, the status of individual languages is not always the same. Sanskrit, Hebrew, and Arabic occupy exalted positions with respect to the religions they help to convey. In the case of Islam, it is only the Arabic text that is sacred – the Qur'an in another language is regarded as a mundane translation. The upshot is that non-Arabic-speaking Muslims recite rather than read the Qur'an in Arabic, which suggests that the important properties of the text extend beyond simple meanings of words. In contrast, lacking this restriction, the translation of the Bible into hundreds of different languages has clearly facilitated the spread of Christianity across vast regions of the world.

While entry into a community of religious adherents is, in principle, an easy matter of uttering statements of belief, such as the Nicene Creed or the Shahadah, it is common to hear both adherents and new converts claim that the power of language cannot describe or encompass their religious experience – meaning that the fullest understanding is possible only through the direct participation in religious practice. This inability to bring personal knowledge to the shared table, so to speak, can be one reason for disagreements among people with differing perspectives about the status of knowledge in religion.

> “*La ilaha ila Allah; Muhammadur-rasul Allah*. There is no god but Allah; Muhammad is the Messenger of Allah.”
>
> **Shahadah**

> “I believe in one God, the Father Almighty, Maker of heaven and earth, and of all things visible and invisible. And in one Lord Jesus Christ, the only-begotten Son of God, […] And I believe in the Holy Ghost, the Lord and Giver of Life; who proceeds from the Father and the Son; […]”
>
> **Nicene Creed**

CHALLENGE YOURSELF

As an interesting digression, you might wish to explore the unusual views of the 19th-century German scholar Friedrich Max Müller, who suggested that the origins of religion lay in the structure of language itself.

Because attitudes regarding religious texts and concepts are shaped by the nature of language, the way religious people use language provides some insight into their personal relationship with their religion. Liberal and fundamentalist stances may be examined in this light.

10.4 Methodology

Knowledge framework: *Language and concepts* – What is the role of convention in this area?

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

The role of convention

Some scholars say that **orthopraxy** (conformation to tradition) trumps **orthodoxy** (correct belief). For example, in the Christian traditions, sacraments play a vital part in the community of believers. Whatever else one might think about religious knowledge, there is no doubt about the importance of procedural knowledge in this area. This practical dimension of religion should contribute to any discussion about methods. You might compare Robert Merton's norms about what is expected of the behaviour of scientists with the rituals of the religious adherent (Chapter 3, page 87).

But we need to look at methods in religion in a way that includes both thought and practice – matters of doctrine as well as ritual, creed and cultus in the terminology of the analysis on page 314. Is there any obvious, broadly employed method of generating religious knowledge as there is in other AOKs, such as deductive logic in mathematics, inductive procedures in the sciences, and source analysis in history? Can you think of a parallel candidate for religion? It looks hard.

However, it is common to hear people speak about the roles of some of the WOKs in religious experience and practice – roles that perhaps are transgressed in the example of the Cult of Reason and thus lead us to find this example bizarre. It might be instructive to proceed by examining these WOKs because they could turn out to be components of a methodology for religion. This may contribute to a convincing response to the second question on page 309 (How does religion go about its business?) and pave the way for an attempt to deal with the final question (about evaluation). In examining WOKs, we may find that there are interesting tensions or synergies between them. A good starting point could be the following (modified) prescribed essay title.

Prescribed essay title 1: Analyse the strengths and weaknesses of using faith as a basis for knowledge in religion and in one [other] area of knowledge.

Faith

Knowledge question

2 To what extent is faith a requirement for knowledge to be gained from religion? Can we plausibly claim to acquire knowledge through faith alone?

The vocabulary that is sometimes used in TOK to describe religious thinking and activity needs some scrutiny. It is common to hear it said that religious people have 'faith', and that this means believing something is true when there is scant evidence to support it. It was this conception of religion that prompted the British–American writer Christopher Hitchens to claim, rather contemptuously, 'that which can be asserted without evidence can be dismissed without evidence'. Seen from this angle, faith seems unreasonable, injudicious – a lazy and ineffective approach to knowing. But this formulation certainly makes some sense when we speak of the faith that scientists need to have in their inductive conclusions, and in assuming that the universe has fixed laws and a comprehensible nature. More broadly, this concept of faith makes sense in all AOKs in which the gathering of evidence plays a key role, because there are always limitations as to the evidence that can be collected. But, in a religious context, faith is sometimes thought of as more an attitude of openness to ideas or practices, or a trusting disposition, rather than an assent to a particular knowledge claim that lacks convincing support.

The profile of faith in religion was bolstered by the rise of Protestantism in the Reformation of 16th-century Europe. In one of the most important historical developments in organized religion, Martin Luther and his supporters sought to break what they believed to be the stranglehold of the Roman Catholic Church by allowing ordinary people to establish the foundation of a direct relationship with God not mediated by the clergy or priesthood. The success of Protestantism, coupled with the rise of science in the 17th century with its emphasis on empirical evidence, cemented a respectable place for faith in the quest for knowledge – and changed its meaning to some extent in the process. Karen Armstrong claims that clerics were so impressed with the achievements of the pious scientists of the time that they became intoxicated with the idea that religious tenets could be established using scientific methods. This would remedy once and for all the perceived weaknesses of faith as a method for justification. But some religions – particularly those not associated with these historical developments – do not seem to be very concerned with the concept of faith at all, and it would be wise to avoid hasty generalizations from particular cultural standpoints when attempting to respond to prescribed essay title 2.

Reason

Whether or not religious leaders sought to engage with reason in the context of science in order to buttress the claims of religion, there is no doubt that reason as a WOK has its place in religious knowledge systems. Many attempts have been made to prove the existence of God through the application of reason – witness the ontological and cosmological arguments.

Religious ambivalence about reason as a WOK is strikingly illustrated by the following example. Early in the 4th century CE, the Roman emperor Constantine converted to Christianity and sought to clarify the basis of his newly adopted religion – especially with regard to relations between Father, Son, and the Holy Spirit as elements of the Holy Trinity. At the Council of Nicaea (in modern Turkey), arguments were heard

CHALLENGE YOURSELF

Try translating the English terms *belief* and *faith* into other languages known to you. Is the meaning consistent across the languages?

For example, in German:

ich glaube... can be *I believe...* or *I think...* or *I suppose...*

ich glaube an jemanden... can be *I trust someone ...*

[der] Glaube as a noun can be translated as either *faith* or *belief.*

There is a tendency among people in some parts of the world to assume that all religions are about having faith in certain core propositions, and that having faith means accepting them without evidence.

CHALLENGE YOURSELF

Research the cosmological and ontological arguments for God.

Do you find them convincing? Why or why not? Do you think they would convince any believers or atheists to change their minds? Why or why not? Does this tell us more about the specific arguments or about the power of reason in general when related to religion? What is the difference between reasoning and rationalization, and do these have roles in religious knowledge that are different from those that they have in other AOKs?

for and against the notion that Jesus was divine, together with arguments pertaining to the status of the Holy Spirit. Despite an agreement being reached by the end of the meeting, the convolutions of reasoning that had been spun prompted some to conclude that the very difficulties in establishing the logical relations of the Trinity provided support for the idea that God operated in a place beyond the reach of reason – here was rational evidence for the limitations of reason itself. In a way, this assertion of the insufficiency of reason as a WOK parallels the claims examined earlier about the weaknesses of language to describe religious experience. Is it the case that the WOKs that we have identified in TOK are not capable of servicing religious knowledge? If this is the case, we may run into trouble in our attempts to support the idea of such knowledge.

This example might be an interesting starting point for thinking about the following (modified) prescribed essay title.

Prescribed essay title 2: Some people say that religious beliefs can be neither justified nor refuted by reason. However, while sometimes this claim is used as a [justification] for rejecting religious beliefs, at other times it is used to conclude that these beliefs are established by faith. To what extent is faith a legitimate basis for knowledge claims, in religion and [other] areas of knowledge?

It might also be added here that Constantine's original intention was to adopt a formulation of the creed that would be inclusive, while later versions overseen by his successors sought to exclude groups increasingly seen as heretic. Perhaps these developments provide an insight into the propensity for religions initially to establish a common community and then refine and 'purify' their own doctrine.

Emotion

Adherents of religions talk of powerful emotions that lie at the heart of religious experiences. They speak of such things as love, awe, joy, and fear. Some have marked out a complementarity between the role of learning propositional 'exoteric' truths (creed and perhaps code) and the personal experience of religion, which may or may not be mediated through the group (community) and ritual (cultus). In the European tradition, the Romantic movement championed emotions as the key element in religious participation. And Karen Armstrong places the emotion-connected dispositions of empathy and compassion as important goals of religion. There seems no doubt that we have to deal with deep emotional experience and commitment in any attempt to characterize religious knowledge.

Sense perception

Any account of the world in which we live needs to deal with what our senses tell us about it. We need no special training or education in order to see the complexity of nature and how components of it interact in ways that seem to follow certain principles. As an empirical endeavour, science uses reason in order to build a reliable and coherent body of knowledge founded on observation through sense perception. Religions have a long history of wrestling with the insights of science in different ways, but many do also emphasize the importance of directly observable phenomena. Buddhists, for example, have often emphasized that the Four Noble Truths at the heart of their religion are empirically verifiable.

> “[N]o credible understanding of the natural world or our human existence [...] can ignore the basic insights of theories as key as evolution, relativity and quantum physics. It may be that science will learn from an engagement with spirituality, especially in its interface with wider human issues, from ethics to society, but certainly some aspects of Buddhist thought – such as its old cosmological theories and its rudimentary physics – will have to be modified in the light of new scientific insights.”
>
> **Dalai Lama XIV, 2005**

At a more fundamental level, religions have used empirical data to support key tenets, such as the existence of gods (relate to point 7 in the list on page 310). In 1802, English philosopher William Paley put forward the most famous formulation of what became known as the argument from design (or teleological argument). In contrast to the cosmological and ontological attempts to prove the existence of a supernatural creator of the universe more or less through the use of reason alone, the argument from design took as its key premise the incontrovertible complexity of the world we sense all around us. Paley postulated that just as a timekeeping watch, with all its perfectly interacting components, must have a designer (creator) because it could never undergo self-assembly or any other form of self-construction, so the world, in all its complexity and workings, must have a designer. Therefore, God must exist.

The fundamental flaw in this argument is that a designer must logically be more complex than his or her design – a proposition which also needs explaining. Despite this, this line of thinking survives in what is known as ‘intelligent design’– proposed as an alternative explanation to evolution. Unfortunately for the ‘theory’, intelligent design amounts to little more than an admission of ignorance when faced with a phenomenon that is not understood. Most of the favourite examples (e.g. blood clotting mechanisms, the structure of the bacterial flagellum, the functionality of the eye) used by the advocates of intelligent design have been shown to have credible origins and developmental pathways through evolutionary processes.

Imagination, intuition, revelation

All religions that speculate on the existence of the supernatural rely on the human power of imagination. In his analysis, Ninian Smart went further and suggested that all religions deal fundamentally with some conception of an invisible world. Although other AOKs clearly make use of imagination in different ways, if Smart is right, this feature of religion might to some extent set religious knowledge apart. There are persistent criticisms of religion on the basis that it deals with intangible entities whose existence cannot be verified, and accepts knowledge claims arrived at through intuition. Furthermore, to many people the very concept of revelation is inadmissible as a source of knowledge. Those of a religious persuasion counter that these objections are predicated on the scientific expectation that evidence be based on sense perception, and conclusions reached through reasoning. This model of justification for knowledge might need to be modified for religion. We will explore this shortly.

Memory

Many religious texts are committed to memory. There are those who have memorized the entire Qur'an – even those who do not understand Arabic. This is quite a feat. Those religions, such as Judaism, that are tightly associated with a particular ethnic group, may be considered to reinforce collective memory. The role of memory as a WOK may have more to do with *transmission* of religious knowledge rather than its *creation*.

Having taken a tour through WOKs with religion in mind, is it possible to bring these threads together into some general pattern of activity that represents accurately how religious knowledge is produced, developed, and evaluated on an ongoing basis?

10.5 Historical development

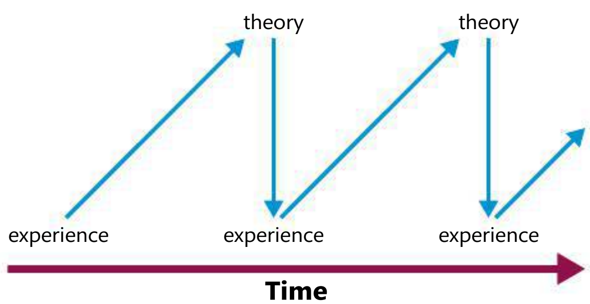
Knowledge framework: *Historical development* – What is the significance of the key points in the historical development of this area of knowledge?

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

In this book, we emphasize the idea that knowledge is a sort of map or representation of some aspect of the world. This knowledge takes the form of 'theory', understood in a broad generic sense, which is informed by some sort of experience of that aspect of the world. The knowledge that arises from this experience can then be tested against some new or carefully selected experience, and so the process continues (Figure 10.2).

The sciences aspire to limit the input of experience to sense perception – used in the most dispassionate and objective manner possible. The knowledge produced by this process can then be tested in a rational manner according to accepted scientific protocols. Faith is restricted to unavoidable assumptions of a fundamental nature, such as the existence of unchanging laws of nature, and the limitations of logic, such as the problem of induction. Although we have seen that this process is not perfect, it has nevertheless been hugely successful in the production of knowledge of a scientific nature. Elements of this model can be detected in the practices of historians and scholars in other disciplines.

Figure 10.2 How experience and theory work together to produce knowledge.



How much of this scenario is shared by religion? Can we regard religious knowledge as a representation that is tested in some similar way? The apparent 'invisibility' of much of the territory addressed seems to militate against the idea of religion providing effective tests for knowledge. The one thing that we can count on is the existence of the experiences of religious adherents. If religion is about testing doctrine against these experiences, then perhaps we have a working model to think about. But we will need to be much more inclusive than the scientist as to what aspects of experience are permitted to play a part in this testing process. We have seen that emotion, intuition, imagination, revelation, and sense perception can all contribute toward religious experience, and to exclude them would be to undermine the nature of such experiences. We need a much more holistic interpretation. It might be claimed that faith offers an atmosphere of trust and openness in which knowledge can be examined, and that reason can be employed in the process of testing this knowledge against experience.

Exercises

13 Would you agree that all of these WOKs are a part of religious experience?

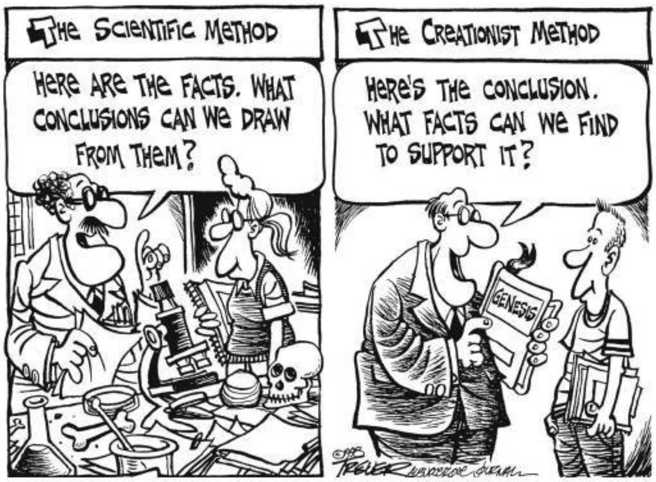
14 What might be the difficulties in assessing religious experience in a rigorous way?

15 Do you think the cartoon below offers a fair comparison between the methods of science and religion?

16 Do you think that religious knowledge can exhibit steady progress according to the sort of model offered in the diagram in Figure 10.2?

17 On a longer timescale, do you think that Thomas Kuhn's paradigm and paradigm shift model (see Chapters 3 and 4) could describe what has happened with religions?

A modern schism.



The model examined above demands a somewhat sceptical approach to knowledge in that claims need to be regarded as provisional. There needs to be a tolerance to disagreement. But history shows that dispute about fundamental religious tenets or creeds tends to lead to schism rather than resolution. Hence the emergence of Roman Catholicism, Orthodox Christianity, Protestantism, and many other denominations through to the rise of Pentecostalism in many parts of the world today. It might explain the early split in Islam between Sunnis and Shias, and the varieties of Buddhism from Mahayana to Theravada.

At the same time, some religions, such as Hinduism and Christianity, seem particularly adept in accommodating outside influences from a wide variety of different cultures. This may well be one reason why Christianity is the world's number one religion today in terms of numbers.

Throughout this discussion, we should remember that even denominations within religions are not monolithic; there is great variety of belief and practice at more local levels. Thus, sweeping statements about religion as a whole are almost always unjustified.

We have seen that techniques from other AOKs might be brought to bear in the construction of religious knowledge (the repertoire of historians and art critics, for example). But due to the ubiquity of religion in human societies in the past, it would also be worth considering the likelihood that some particularities of religions may have had a key influence on some fundamental assumptions in other AOKs. For instance, Judaism and Christianity project a very clear timeline onto human history, whereas the concept of reincarnation found in Buddhism and Hinduism encourage a cyclical view of time. It is easy to see how this difference could have deep ramifications for thought and the construction of knowledge in many different fields.

CHALLENGE YOURSELF

The current battle being fought between liberal and conservative forces within the Anglican Church over the acceptability of homosexuality is a striking case study of some of the difficulties that religious institutions face in responding to changes in public morality and the deep divisions between cultures. By studying this example we might grasp the achievements of some religions in the first place in acquiring adherents in wide regions of the world.

10.6 Links to personal knowledge

Knowledge framework: *Links to personal knowledge –* What is the nature of the contribution of individuals to this area?

What are the origins of religions? Did religions develop primarily as exploratory exercises by individuals trying to understand how the world works, and then broaden out into communities of like-minded thinkers, following standardized codes of behaviour? We could think of this as a general movement from personal to shared knowledge. Or were religions responses to social needs that subsequently developed beliefs and practices that bound their communities together? In this scenario, some kind of shared knowledge might be prior to any personal intellectual quest.

The relationship between shared and personal knowledge in religion is crucial. Shared knowledge is publicly available in religious texts, and found in the minds of individuals in the form of memorized material and familiarity with procedural forms such as traditions and rituals; on the other hand, the essence of being a devotee to a religion encompasses more than the acquisition of the shared knowledge available to the religious community. As we have seen, key to the lives of religious people is the kind of personal experience that may be difficult for the non-religious to understand. It is from these different perspectives that wide disparities of opinion emerge about the questions that religion raises. While the adherent may hold that his or her religion has generated convincing and effective answers, it may be impossible for the outsider to agree because such agreement might well require membership in the community of adherents. As a result, what counts as an open question in a religion may depend on whether or not one has a commitment to that religion in the first place. Validation of knowledge claims depends on a kind of knowledge available only within the system, so to speak. Many would assert that this undermines the strength of its justification.

That said, it is often difficult to separate personal and shared knowledge in the field of religion. Many experiences contribute simultaneously to both. The Hajj in Saudi Arabia is an example of a shared experience that has a profound effect on the individual Muslim. A Pentecostalist service in Nigeria can be a colossal communal event involving many thousands of people, yet it touches every individual within it in a way that private worship might not achieve. There are many other examples. But there have been conflicts and differences of view over the role of the individual adherent – witness the motivation for the Reformation in Europe, and the contrasts between Mahayana and Theravada varieties of Buddhism.

Many religious denominations have taken different perspectives on the self. As a rough guide, in the West this has focused on asceticism and the attempt to discipline the self; in the East, we see a more mystical approach that stresses withdrawal from normal life.

Religious experience involves shared knowledge.

Finally, it takes little research to appreciate the contributions that individuals have made to various religions – from founder figures such as Jesus, Muhammad, the Buddha, Confucius, and Laozi, to other individuals who have found a prominent place in the history of religion, such as Martin Luther.

10.7 Evaluation of religious knowledge

We can now turn to the third question on page 309. If religion is a response to certain issues or questions, on what basis can we decide if the answers that religion provides are good ones? If religion is a kind of map, how can we know if the map is accurate in some sense?

Inside *vs* outside

As we have seen, there are important and rather obvious differences in the attitude to religion of religious adherents (the inside, as it were) and of detached observers or non-religious people (the outside). These different perspectives carry through to the ways in which the knowledge produced by religion might be appraised. On the one hand, those of a religious disposition would want to conduct evaluation using the concepts and distinctions that inform religious experience. We met this kind of approach earlier in the work of Mircea Eliade and his emphasis on the distinctions that religious adherents draw between the profane and the sacred; between the everyday imperfect world in which we live and the realm of the eternal or supernatural.

On the other hand, the religious outsider may have difficulties in accepting categories such as the sacred and will look to external means for verification. Such means are likely to rely on other AOKs (Table 10.1).

Perspective	Approach to religion	Method of evaluation
inside – intrinsic value, substantive theory	focus on its own concepts and distinctions	on its own terms
outside – instrumental value, functional theory	regard it as the cause of, an effect of, or a parallel explanation of phenomena in other AOKs	with reference to other AOKs or disciplines

Table 10.1 Implications of differences in perspective on religious knowledge

If religions comprise sets of practices and doctrines that lead us to an emotional destination in which empathy and compassion for others are enhanced, then we might see religion as an adjunct to ethics. We might agree that compassion will lead to better moral judgements and actions in the world, and thus religion could take some of the credit. How then might we measure the impact of religion and thus the value of the knowledge it produces? What might our conclusions be?

If, on the other hand, we regard religions as attempts to explain empirical phenomena in the world, we would have to turn away from ethics and try to evaluate the contribution of religion in comparison with other AOKs that address these kinds of issue. We would have to ask how successful religion is in providing explanations and predictions about the world. In practical terms, how might we go about this task? What might our conclusions be here?

CHALLENGE YOURSELF

You might like to research the views of Englishman Edward Tylor and the Scottish anthropologist James Frazer on one hand, and the French sociologist Emile Durkheim on the other, as to the origins and development of religion. Tylor and Frazer subscribed to the 'intellectual quest' theory; Durkheim employed the concept of social religious institutions as part of his development of the discipline of sociology. To some extent, we are indebted to Durkheim for the concept of shared knowledge. Can you connect what Armstrong and Harris have to say about religion with these earlier thinkers?

! A surprising number of people reinforce the link between religion and ethics to the point where they claim that religion is the only source of moral authority. 'Atheists can have no moral compass', they assert. While it is clearly possible to derive a moral code from religion, it is a fallacy to claim that a secular basis for morality is impossible.

If religions are distinct responses to different issues, then perhaps each religion will need a different benchmark for evaluating the knowledge it produces. On the surface, this would seem to be a difficult task, although arguably less so for those religions that focus more on this world, such as Confucianism and some forms of Buddhism.

The Weber thesis

The work of the German sociologist Max Weber provides a specific example of how a particular religious system might be evaluated indirectly through its effects. Weber claimed that adherence to Protestant Christianity seemed to be strongly correlated with individual success in a capitalist economic environment – and this was not the case with Catholicism. For Weber, it is the religion that is at least partly responsible for economic success – religion as a cause of some other phenomenon. This is in contrast to some other prominent thinkers, such as Durkheim and Marx, who viewed religion mainly as a response, or effect.

The Weber thesis, as it has come to be known, is based on the history of post-Reformation Europe, and as such might not be applicable to other cultures or areas of the world. Accordingly, because different religions developed in different parts of the world, we might be reduced to evaluating them only in the context of specific cultures, or even just on the basis of what they do for individual people. Prothero's view of religion does raise the question of whether there are any systematic reasons why different religions, with the different problems and solutions ascribed to them, developed in particular cultures and locations, and at the times that they did in fact arise.

Table 10.2 summarizes suggestions for an 'outside' approach to evaluating religious knowledge.

Table 10.2 Outside approaches

Nature of religion	Related AOK or discipline	Evaluative question
a contributor to a compassionate worldview	ethics	Has religion made the world, taken as a whole, a more morally upright place?
a generator of systematic knowledge about the world	range of sciences	Has religion contributed to an understanding of the natural and social worlds in which we live?
a response to a particular human problem	economics	Is a particular religion responsible for facilitating economic growth and material well-being?

Ideal knower: Archbishop Desmond Tutu

Archbishop Desmond Tutu was the first black South African Archbishop of Cape Town and achieved international renown during the apartheid regime in his country for his unflinching opposition and untiring activism. He has won numerous prizes and been awarded many honorary degrees in recognition of his work in the fields of democracy and human rights. The following passage is taken from a speech he gave in England in 1989. As you read it, consider how to summarize Tutu's position with regard to religious knowledge.

“They tell the story of a drunk who crossed the street and accosted a pedestrian, asking him, ‘I shay, which ish the other shide of the shtreet?’ The pedestrian, somewhat nonplussed, replied, ‘That side, of course!’ The drunk said, ‘Shtrange. When I wash on that shide, they shaid it wash thish shide.’ Where the other side of the street is depends on where we are. Our perspective differs with our context, the things that have helped to form us; and religion is one of the most potent of these formative influences, helping to determine how and what we apprehend of reality and how we operate in our own specific context.

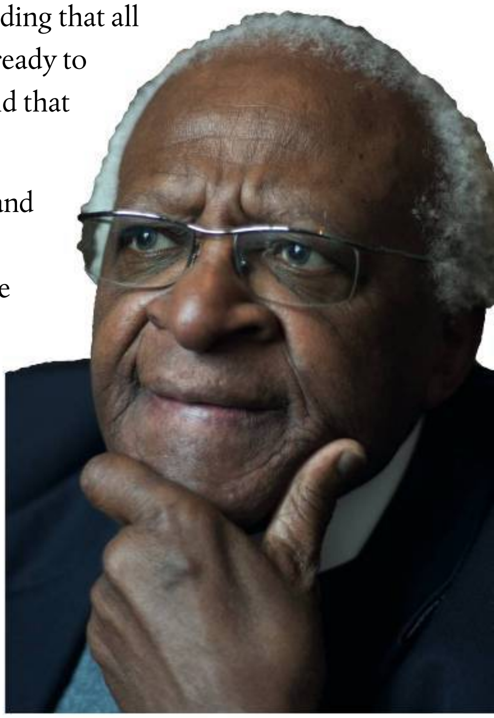
My first point seems overwhelmingly simple: that the accidents of birth and geography determine to a very large extent to what faith we belong. The chances are very great that if you were born in Pakistan you are a Muslim, or a Hindu if you happened to be born in India, or a Shintoist if it is Japan, and a Christian if you were born in Italy. I don’t know what significant fact can be drawn from this – perhaps that we should not succumb too easily to the temptation to exclusiveness and dogmatic claims to a monopoly of the truth of our particular faith. You could so easily have been an adherent of the faith that you are now denigrating, but for the fact that you were born here rather than there.

My second point is this: not to insult the adherents of other faiths by suggesting, as sometimes has happened, that for instance when you are a Christian the adherents of other faiths are really Christians without knowing it. We must acknowledge them for who they are in all their integrity, with their conscientiously held beliefs; we must welcome them and respect them as who they are and walk reverently on what is their holy ground, taking off our shoes, metaphorically and literally. We must hold to our particular and peculiar beliefs tenaciously, not pretending that all religions are the same, for they are patently not the same. We must be ready to learn from one another, not claiming that we alone possess all truth and that somehow we have a corner on God.

We should in humility and joyfulness acknowledge that the supernatural and divine reality we all worship in some form or other transcends all our particular categories of thought and imagining, and that because the divine – however named, however apprehended or conceived – is infinite and we are forever finite, we shall never comprehend the divine completely. So we should seek to share all insights we can and be ready to learn, for instance, from the techniques of the spiritual life that are available in religions other than our own. [...] When we read the classics of the various religions in matters of prayer, meditation, and mysticism, we find substantial convergence, and that is something to rejoice at. We have enough that conspires to separate us; let us celebrate that which unites us, that which we share in common.”

Tutu, 2011

Desmond Tutu, the first black South African Archbishop of Cape Town.



Ideal knowers: Sufists

It is a risky business to identify ideal knowers in the field of religion. For every candidate group there will be supporters and those who demur and offer criticism. This is an unavoidable function of the diversity of religion in so many dimensions as we have discussed – in terms of what each religion and group is about, how they proceed, what impact they have had, their attitude to others, and so on.

Sufists provide a contrast to Desmond Tutu as an activist and someone who has used his position to influence the world. Sufism represents a very different strand of religion. Sufists maintain that they practise an original form of Islam that involves an emphasis on purity and an avoidance of worldly engagement. As the following quotation from the famous 13th-century Sufi poet Jalaluddin Rumi suggests, contentment might require the reigning-in of the self. Once again, we are confronted by the diversity of religions as responses to questions of existence, meaning, and purpose.

> “Essence is emptiness.
> Everything else, accidental.
> Emptiness brings peace to your loving.
> Everything else, disease.
> In this world of trickery,
> Emptiness is what your soul wants.”

Rumi

11 Indigenous knowledge systems

11 Indigenous knowledge systems

On previous page – Over 3000 years ago the indigenous people of the Pacific travelled between islands by canoe. They navigated using knowledge passed on from ancestral navigators. They learnt to guide their vessels by the stars, changes in wind and wave direction, the passage of birds and cloud formation.

11.1 Introduction to indigenous knowledge systems

A striking example

Across the vastness of the largest ocean on Earth lie thousands of irregularly scattered islands, together called Polynesia and Micronesia. Many of these tips of submerged mountains of the Pacific had been inhabited long before the arrival of explorers intent on territorial expansion. But because the newcomers had the finest technological instruments of navigation available at the time, and were keenly aware of their absence in the indigenous cultures, the explorers erroneously assumed that the islands must have been originally found as a result of passive drift – a viewpoint held by some Western historians and adventurers until quite recently. Indeed it was only the construction in the 1970s of a computer simulation of the Pacific Ocean environment that invalidated the drift model once and for all. Outsiders were forced to accept the reality of purposeful long-distance ocean travel by people without the aid of compasses, sextants, or other technological paraphernalia.

The Pacific Islands cover an enormous area of the Pacific Ocean.

It is now understood that Micronesians used a battery of different sources of data to construct a sophisticated and accurate knowledge of the geography of the Pacific, and of how to navigate on it. Here is a description from the Canadian anthropologist Wade Davis.

> Clouds [...] provide clues to the wayfinder – their shape, colour, character, and place in the sky. Brown clouds bring strong winds; high clouds no wind but lots of rain. [...] Light alone can be read, the rainbow colours at the edge of stars, the way they twinkle and dim with an impending storm, the tone of the sky over an island, always darker than over open ocean. [...] A halo around the moon foreshadows rain, for it is caused by light shining through ice crystals of clouds laden with moisture. [...] Dolphins and porpoises swimming towards sheltered waters herald a storm, while the flight of a frigate bird heading out to sea anticipates calm. [...] A sighting of the white tern indicates that land is within 200 km; the brown tern reaches out as far as 65 km, the boobies rarely more than 40. Phosphorescence and the debris of plants in the sea, the salinity and taste and temperature of the water, the manner in which a swordfish swims, all these become revelatory in the senses of the navigator.

[The navigator] could name and follow some 220 stars in the night sky. [...][A]s long as one is able to commit to memory all the stars and their unique positions, the time at which each is to appear on a particular night, and their bearings as they break the horizon or slip beneath it, one can envision a 360-degree compass ... [...] When clouds or mist obliterate the horizon, the navigator must orient the vessel by the feel of the water, distinguishing waves created by local weather systems [...] from the swells generated by pressure systems far beyond the horizon [...] from the deep ocean currents that run through the Pacific ... [...] Expert navigators [...] can sense and distinguish as many as five distinct swells moving through the vessel at any given time. Local wave action is chaotic and disruptive. But the distant swells are consistent, deep and resonant pulses that move across the ocean ...

Even more remarkable is the navigator's ability to pull islands out of the sea. [They] can identify the presence of distant atolls of islands beyond the visible horizon simply by watching the reverberations of waves across the hull of the canoe, knowing full well that every island group in the Pacific has its own refractive pattern [...] ”

Davis, 2009

A point of particular interest here is that the navigator on a Micronesian vessel would not sleep throughout the voyage, nor did such experts think of their knowledge as compartmentalized into subject areas, as those with a Western education might.

Before you read on, think about what you have learned about different kinds of knowledge in your TOK course. Consider also the kind of knowledge that you learn in your various diploma subjects. Bearing this in mind, how does the knowledge that Micronesians gained about navigation compare? Can you identify some distinctive features of their knowledge?

Some suggested features of indigenous knowledge systems

There are some preliminary comments that can be made while keeping the TOK knowledge framework in mind. A key point to grasp is that all of the data used by the Micronesians was integrated in the service of a particular type of activity – in this case, navigation on the high seas. But the scope of this knowledge, while drawing on many sources, was applied to a specific environment – namely the Pacific Ocean. The methods used to construct this knowledge were clearly empirical in nature – consisting of observations of diverse aspects of the environment. European navigators would probably have filtered out some of it as having limited value, yet the sheer breadth of data shows the degree to which the selectivity of sense perception can vary. For most of their history, the Polynesians and Micronesians had no written language, and so the retention of navigational concepts and techniques relied on powers of memory that many cultures have allowed to fall into disuse. However, it appears that much of this indigenous knowledge was lost as a consequence of the general drive during colonial rule to suppress local practices. It is only in recent decades that a concerted effort has been made to reconstruct the methods of traditional navigation and put them once again to use.

CHALLENGE YOURSELF

Although the claims that Polynesians and Micronesians populated the islands of the Pacific by purposeful exploration are now accepted, this view was disputed in the past. It was said that they might have come from the east rather than the west due to the direction of the prevailing trade winds, and that they reached unplanned destinations by accidental drift. By learning about the voyage made by the Norwegian adventurer Thor Heyerdahl, and the work of the New Zealand historian Andrew Sharp, you may discover why their assertions on this matter are no longer given credence.

Indigenous knowledge systems as an area of knowledge

Let us take the Micronesian example as a case study and use it to test other instances of indigenous knowledge systems from around the world. In this way, we might be able to determine if there are general characteristics that will allow us to speak of indigenous knowledge systems as a coherent AOK. Returning to our map metaphor, can indigenous knowledge provide us with a knowledge map which is recognizable and distinctive? If so, what might be the features of that map? If not, might this mean that we would have to accept that each culture has its own map? Or that there is no such thing that deserves the name of an 'indigenous knowledge map' at all? At this stage, we should be tentative and regard the ideas as hypotheses rather than established facts.

Micronesian knowledge of navigation has the following characteristics that might be applicable to all indigenous knowldege.

- Local – At least some parts of it will not work in other parts of the world.
- Holistic – It draws on knowledge that we would place in different disciplines and uses it seamlessly.
- Flexible – Knowers are able to switch from one set of concepts or method to another depending on circumstances.
- Empirical – Taking into account a wide range of phenomena available to sense perception.
- Concrete – Knowledge is processed to reach conclusions without extensive theorizing.
- Oral – Stored and transmitted without recourse to written form.

These features can be connected to aspects of the knowledge framework (Figure 11.1). The arm concerning historical development will be addressed later (page 343).

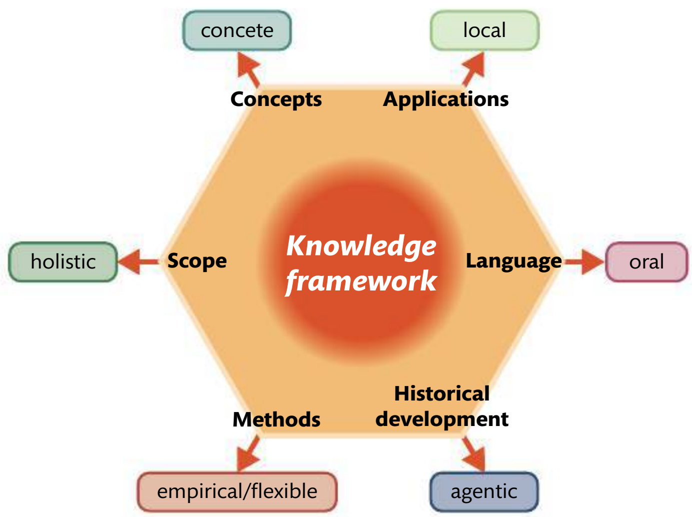


Figure 11.1 Characteristics of indigenous knowledge and the knowledge framework.

Who has indigenous knowledge?

The word 'indigenous' suffers from a certain amount of vagueness. Indigenous peoples can be the descendants of the first inhabitants of a geographical area – such as those humans who reached Australia around 50 000 years ago, and the Americas much later. For those continents, the distinction with the later arrivals from Europe is clear. What's more, the new arrivals soon dwarfed the sizes of the original populations, either through the actual migration or decimation of indigenes by conquest or disease. This double-migration pattern is not accurate for the continents of Africa and Asia, and thus the meaning of the term 'indigenous' in these cases is more blurred or even inappropriate. It also needs to be pointed out that, according to this description, most of the inhabitants of Europe are indigenous too. So in order to avoid becoming overwhelmed by the scope of what might legitimately be included in this category, we need to make a decision as to the limits of what we are going to discuss.

We will focus here on cultures that produce knowledge that might share some of the general characteristics of the knowledge systems of the 'first nations' (such as those in modern-day Polynesia, Micronesia, and Melanesia). In the spirit of TOK, the questions of where indigenous knowledge ends and some other kind of knowledge begins, and whether there is a viable distinction between them at all, are open ones for you to discuss.

There has been much discussion as to the most useful or accurate term to use for what we are calling 'indigenous knowledge' in this book. Why do you think this is? Some alternatives are:

- native knowledge
- community knowledge
- endogenous knowledge
- traditional knowledge
- ethnic knowledge
- sustainable knowledge
- folk knowledge
- cultural knowledge
- experiential knowledge

Adapted from Antweiler, 1998

Exercises

1. At this stage in your work, do you think that any of these alternatives might be better? How do they help you to pin down your pre-conceptions about such people and their knowledge?
2. What might be some of the objections to each of them? What objections do you have?
3. Would it be contradictory to use some of these terms alongside the suggested characteristics of indigenous knowledge (page 332)?
4. What is the best course of action when there is no linguistic label for something on which everyone can agree?

Indigenous knowledge systems: example or examples?

In this chapter we will look at a range of examples of indigenous knowledge from around the world (Figure 11.2). If you are studying indigenous knowledge systems in depth as an AOK in your TOK course, you might be taking a similar approach. Alternatively, your school might be located in a place or country where access to a particular indigenous culture is dominant, in which case you may want to examine that particular culture to see the extent to which the knowledge system conforms to the ideas presented here.

Figure 11.2 Our destinations in the search for understanding of indigenous knowledge.

11.2 Scope and applications

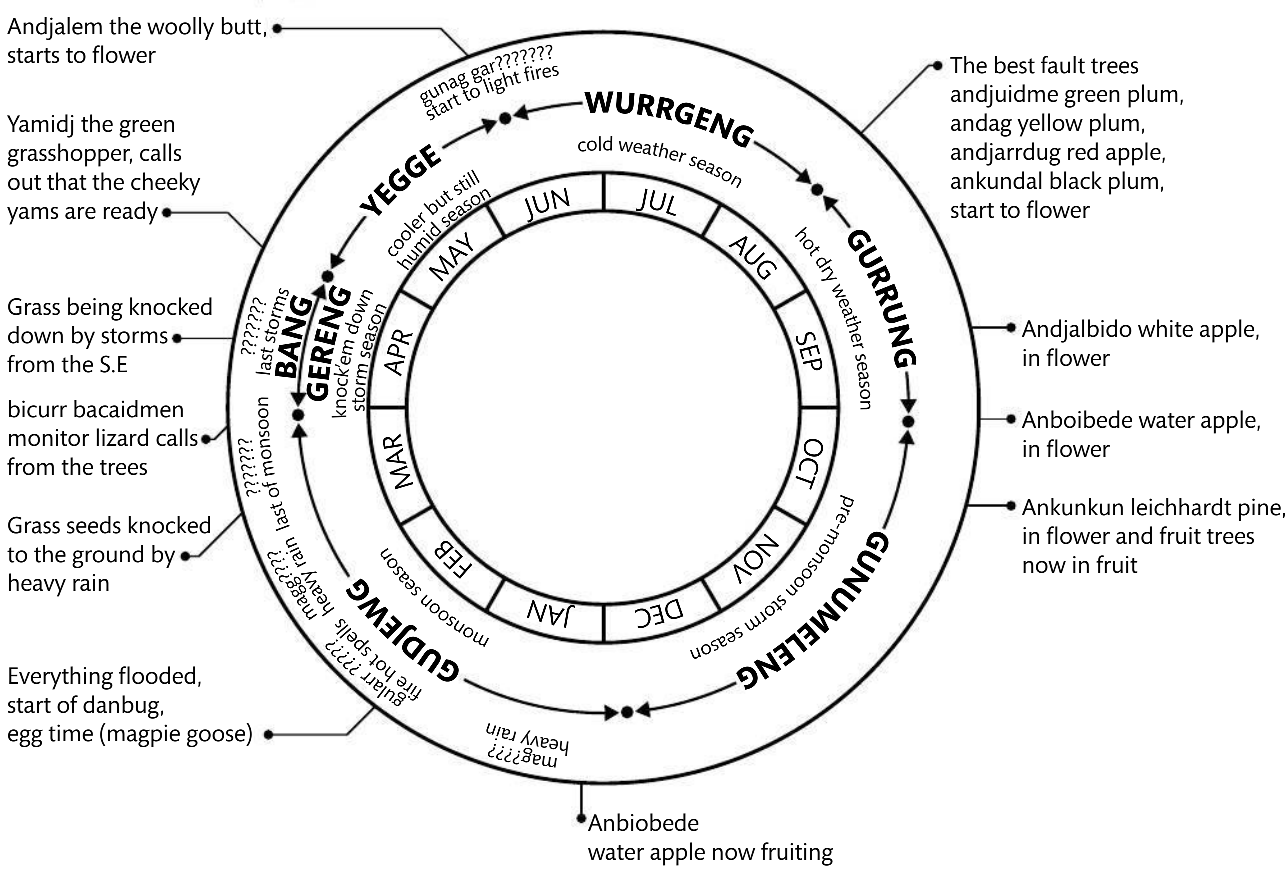
Knowledge framework: *Scope and applications* – What practical problems can be solved through applying this knowledge?

Additional framework question: What is the structure of this type of knowledge?

Indigenous knowledge is local and holistic

While the Polynesian and Micronesian exploration of the Pacific Ocean stretches the definition of local to its extreme, other examples make the point more strenuously. The aboriginal people of Kakadu (or Gagudju) in Northern Australia and the Krahô people of Brazil are two groups whose knowledge of fire management is crucial to how they interact with their environments. Controlled use of fire allows the production of food that attracts game animals that can be hunted, as well as preventing spontaneous fires from spreading to catastrophic effect. This procedural knowledge is adapted to the particularities of the flora in that region. For example, in Australia, this knowledge has been recognized as so effective that it has become part of park ranger policy in the management of Kakadu National Park. In fact, the timings of fire use are codified in the local calendar (Figure 11.3).

Figure 11.3 Seasonal calendar for the Kakadu Region in the local language.



- Fire in the Wurrgeng (cold dry season) produces 'green pick' for game hunting.
- Fire in the Gurrung (hot dry season) is used to produce a mosaic pattern that encourages ecological diversity and prevents catastrophic spread of unplanned fires.

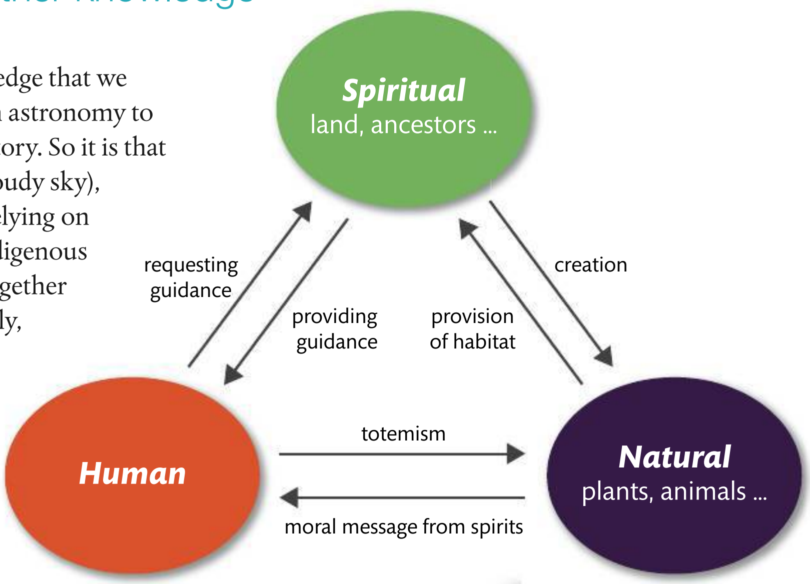
The Krahô people of Brazil also cite the effectiveness of fire in 'cleaning' the land for crop cultivation – especially for the production of honey which plays an important part in their culture – but also for the collection of fruit and various roots. Cleared land is considered to have enhanced aesthetic qualities as well as affording increased visibility. Pests can be eliminated by fire, and the resultant ash can be distributed as a fertilizer. It is clear that there are many advantages of the use of fire, but the power of this method rests on its systematic use according to established knowledge acquired over a long period, with a large element of trial and error.

The application of this knowledge is to some extent contextual – restricted to the features of a specific environment such as flora, fauna and topography. Nevertheless, it would seem likely that some general principles of fire use could be drawn from the activities of these communities, and so it might mean that such knowledge is not entirely local in character.

Indigenous knowledge and other knowledge systems

Micronesian navigation encompasses knowledge that we might locate in a variety of disciplines – from astronomy to meteorology to oceanography to natural history. So it is that when astronomical data are not available (cloudy sky), the knowledge system remains effective by relying on swells and ocean currents. In many cases, indigenous knowledge systems can be shown to bring together an even broader scope of knowledge. Typically, such systems offer representations of the natural, human, and spiritual worlds in a sort of continuous canvas, allowing for a web of interactions to be described and explored. Consider Figure 11.4 and observe the interactivity between the three domains of knowledge for the Shona people of Zimbabwe.

Figure 11.4 Traditional worldview of the Shona people of Zimbabwe.



> “For the Shona, the human world, the natural world and the spiritual world are linked. The natural world provides the habitat for the spirits and sends messages from the spiritual world to the human world. The spiritual world provides guidance, punishment and blessing to the human world. People therefore have to relate to both the natural and the spiritual world.”

Haverkort, *et al.* 2011

Exercises

5 If the situation as described by Haverkort *et al.* is typical of indigenous knowledge systems, to what extent do they differ from other AOKs in the TOK programme?

6 What comparisons can be made between indigenous and religious knowledge systems? What is the connection between them?

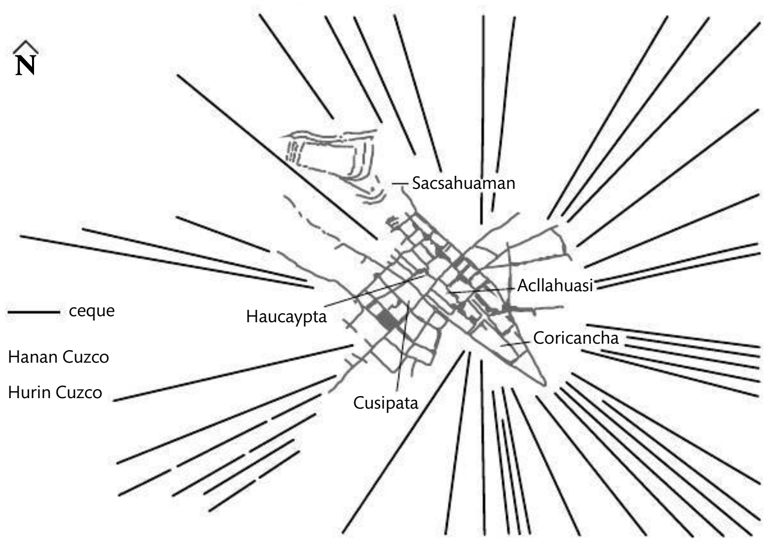
7 Note how other AOKs tend to establish territories with boundaries – what is the function of these boundaries? What is gained and what is lost by erecting them?

There are many examples of interlocking systems of knowledge that are elaborate responses to local environment. For instance, the Samburu live in the dry conditions of northern Kenya where drought can be frequent. Consequently, they keep large populations of cattle to ensure the survival of at least some of the herd, which in turn creates the need for larger numbers of people for herding. Because this task is allocated to children, the Samburu society operates on polygamous lines in order to supply the numbers of herders required. But this results in many young men without wives, so, to prevent upheaval in the community, such men are dispatched to remote outposts of the region after a circumcision ritual that is given the highest prestige. Thus, procedural and propositional knowledge is bound into a set of cultural practices that dovetail with local circumstances.

With reference again to our list of suggested features of indigenous knowledge (page 332), we might speculate as to how flexible such a system can be in practice, as there may be some tension between knowledge that is designed for specific local conditions and its ability to adapt to change. This is an area of particular interest to those involved in development issues, which we will touch on later.

Although it is important to focus on present cultures and communities in this work, we can look briefly at the Inca civilization that flourished before the Spanish conquest of Peru in the 16th century cast it into sudden decline. Because the Incas considered their environment to be sacred, they constructed a worldview based on a set of lines, called *ceques*, which radiated from their capital of Cuzco in 41 directions (Figure 11.5). Each *ceque* connected a number of shrines, or *huacas*, which could be natural formations or human constructions. The entire arrangement was divided at a higher level into four segments of the circle of *ceques* which corresponded to the parts of the Inca empire. This system of sacred geography acted to bring various aspects of civilization into alignment, as it represented the social and political divisions of society, events from history, and marked significant celestial occurrences related to the calendar.

Figure 11.5 Part of the world view of the Incas.



As with previous examples, the Inca *ceque* system seems to bring together knowledge from what we might regard as distinct disciplines, and rationalize them into a holistic and ordered conceptual scheme that has wide-ranging applicability within the confines of the culture that created it.

The limitations of knowledge application

In Chapter 3, we discussed various possibilities for knowledge to become increasingly fragmented. The drive for this specialization in knowledge is partly a result of the sheer volume of shared knowledge now at our disposal as a species, and hence of the inability of individuals or even communities to master all of it. But specialization is also motivated by a desire to produce knowledge that is applicable to all similar situations within the scope of the discipline. The physicist would be unlikely to be so enthusiastic about his or her subject if there turned out to be a different set of laws and principles for each planet in the solar system. The economist would like to think that at least some of his or her knowledge could be useful to policymakers in faraway lands. The price for this extended applicability is a degree of abstraction that necessitates the ignoring of some aspects of local situations. There is an argument that indigenous knowledge systems tend to place a higher value on the peculiarities of the local context and are less concerned with the applicability of knowledge beyond the boundaries of the culture that produced it.

However, there exist examples that arguably indicate a desire to transcend such limitations. Political alliances, such as the confederacy created by the Iroquois peoples – originally inhabiting parts of New York State in the USA – may satisfy the clamour for knowledge over a broader area of applicability. The League of Five (and later Six) Nations established between the 16th and 18th centuries was a triumph of political organization – there are some who claim that it influenced American ideas of federal democracy in general during the early years of independence.

Exercises

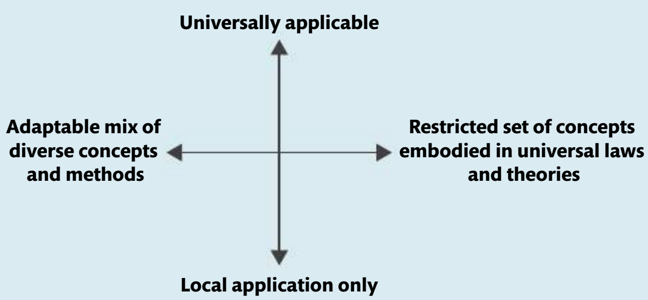
8 Which aspects of the knowledge involved in Micronesian navigation and in the Inca ***ceque*** system could be described as:

- **a** entirely local
- **b** applicable in different places?

9 How many disciplines from the modern curriculum seem to be integrated into the knowledge in each of these two examples?

10 Could it be persuasively argued that the holistic nature of indigenous knowledge brings with it a certain degree of flexibility in the way it is conceived and applied?

11 Consider the graph axes below.



- **a** Where would you locate on the graph the knowledge systems that have been described in this chapter so far?
- **b** Can you add any other indigenous system known to you?
- **c** Now where would you place the following disciplines?
  - **i** physics
  - **ii** economics
  - **iii** mathematics
  - **iv** literature
  - **v** history

The French sociologist Bruno Latour has created a very similar conceptual scheme – here described with reference to our graph axes on the previous page.

- 'Immutable mobile' – This is knowledge arising from strictly tried-and-tested methods and findings that can be universally applied; such knowledge would be located in the upper right quadrant.
- 'Mutable immobile' – This is knowledge arising from a diverse mixture of adaptable methods and findings that are applicable only in unique local environments; this knowledge is to be found in the lower left quadrant.

Exercises

12 What are the advantages and drawbacks associated with 'immutable mobile' and 'mutable immobile' knowledge?

13 Have you placed any knowledge in the bottom right or the top left quadrants? If so, why? Can you describe it? Might there be different problems with such knowledge?

11.3 Concepts and methodology

Knowledge framework: *Language and concepts* – What are the roles of the key concepts and key terms that provide the building blocks for knowledge in this area?

Knowledge framework: *Methodology* – What are the methods or procedures used in this area and what is it about these methods that generates knowledge?

Indigenous knowledge is 'concrete' and empirical

In the 1960s, the French anthropologist Claude Lévi–Strauss hypothesized two distinct modes of thought that can be illustrated in the following example – a version of which he himself employed. Through the processes of sense perception alone, using the nose and the relevant parts of the brain, we can detect odorants, experience them as smells, and even classify these smell experiences into groups. Hence we might place the smells of lavender, peach, and banana into the same category – a different category from the one to which we ascribe vanilla and cinnamon (Table 11.1). Lévi–Strauss labelled this procedure the 'science of the concrete' – engaging the powers of sense perception and the basic rational process of categorization.

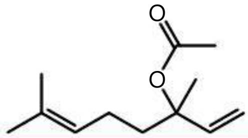
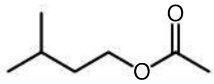
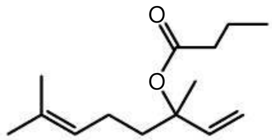
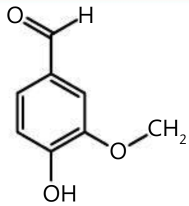
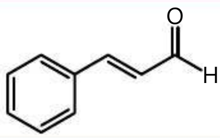
With the development of analytical chemistry, it turns out that the former group of odorants are all esters and the latter are aldehydes – thus, the knowledge gained through sense perception alone is borne out at a deeper theoretical level. This kind of knowledge is clearly dependent on the employment of a battery of new concepts that are available to the chemist – to do with bonding, functional groups, and so on.

Lévi–Strauss called these two ways of finding out the same thing (in this case) 'untamed' and 'domesticated' thought, and maintained that all of us possess the faculties to undertake both types, although some activities call on one mode much more strongly than the other. It was his contention that 'domesticated' thought has come to dominate the modern condition, except in the field of the arts.

CHALLENGE YOURSELF

The search for a predictive theory of smell is interesting because chemists do not have a comprehensive theoretical basis for predicting the smell of a particular molecule. Thus, there is still a gap between direct perceptual experiences and the deeper theoretical explanation of them. You can research the work of Luca Turin in this area.

Table 11.1 Untamed and domesticated thought

Common name	Chemical name	Chemical structure
lavender	linalyl acetate (an ester)	
banana	lisoamyl acetate (an ester)	
peach	linalyl butyrate (an ester)	
vanilla	vanillin (an aldehyde)	
cinnamon	cinnamaldehyde (an aldehyde)	

Given the fact that the kind of modern theoretical science exemplified by analytical chemistry, with all of its laboratories and scholarly sophistication, is not evident in indigenous knowledge systems, would we be justified in claiming that such systems are predominantly 'concrete' in nature? This would imply that sense perception has a key role to play in indigenous knowledge, which we could describe as being highly empirical. It would imply that the recognized links between causes and effects are relatively simple in nature, and they do not make use of theoretical representations as a way of elucidating the precise mechanisms that are responsible. This description would seem to outline a highly pragmatic conception of knowledge – what matters is what works – rather than knowing the why.

Ethnobiology

It is true that sometimes causal connections are left only partially examined in knowledge as a whole. This does not necessarily hinder the usefulness of that knowledge, although it may limit its development. For example, in West Africa, the baobab tree (we met this tree in a proverb, Chapter 3, page 66) is an important source of food and building materials, as well as shelter. Extensive studies have shown the ability of people from this region (particularly older women) to link observable traits (appearance of leaves, seeds, etc.) with the characteristics that would need further investigation and might interfere with the integrity of the tree (extracting pulp for tasting). We are now entering the field of ethnobiology (Figure 11.6, overleaf).

hairy leaves	⟷	tasteless
tardy capsule maturity	⟷	sweet pulp
soft seeds	⟷	no fruit production
slimy pulp	⟷	bad taste
round capsules	⟷	high pulp yield
scratched capsules	⟷	sweet pulp

Figure 11.6 Baobab characteristics.

The mechanisms that relate leaf hairiness to tastelessness, seed softness to lack of fruit production, and so on, are unknown, but presumably could be elucidated by controlled investigation resulting in a theoretical frame of explanation. How useful would this extra layer of knowledge be?

Nevertheless, causal relations are often examined in detail, with distinctions and explanations that differ from those likely to be invoked by people of a scientific disposition. In this passage, the Ghanaian philosopher Kwame Gyekye (1995) explores a typical case from the Akan peoples of Ghana.

> “The occurrences that engage [the attention of Akans] are those that they regard as extraordinary or contingent occurrences that are held to fall outside the course of nature and so are taken to be exceptions to the laws of nature. [...] Some examples might be an unusually long period of drought, a tree falling and killing a farmer on his way to the farm, a pregnancy that extends much beyond a period of nine months, a person dying from a snakebite, a person being afflicted by a certain kind of disease, a person being accidentally shot to death by a hunter, and so on. Such occurrences have certain characteristics: they are infrequent [...], discrete and isolated; they appear to be puzzling, bizarre and incomprehensible [...]. It is not that Akans do not know that a falling tree can kill a person or that certain diseases can be fatal. In such situations, the question the Akan poses is not ‘Why did the falling tree kill him?’ but ‘Why did that tree fall at that particular time and kill that particular person?’. [...]
>
> In an Akan community, if a falling tree kills a man, or if a man dies in a car accident or from a snakebite, the cause of the death would generally be thought to be a spirit. A purely scientific or naturalistic explanation would not suffice, because a snakebite or car accident does not always result in death. For the Akan, then, a purely scientific or naturalistic explanation of natural events presupposes an absolute regularity of uniformity in nature. But such an absolute uniformity is subverted by the existence of irregular, abnormal occurrences.”

The Tzeltal are people of Mayan descent who live in Mexico. Recent scientific work has shown that their knowledge of local butterflies was more advanced than that of mainstream biology. In one notable case, taxonomists claimed that the population of the two-barred flasher butterfly comprised a single species, while it was noted that the Tzeltal possessed a sophisticated vocabulary for describing differences.

Their classification was based on observable traits of larvae – the stage in the life cycle of most importance to the Tzeltal because of the negative impact they have on the crops. Only in recent years, with the advent of gene analysis at the molecular level, has it emerged that the Tzeltal were closer to the truth – with the recognition that there are at least ten sub-groups that do not freely interbreed, forming what is technically called a species complex.

Agriculture is at the heart of the Tzeltal's way of life, leading them to observe natural phenomena unknown to scientists until recently.

What can we learn from this? The Tzeltal have not had the benefit of harnessing the technology for DNA analysis but they have still succeeded in constructing more accurate knowledge than biologists achieved with the traditional methods of taxonomy. This indigenous knowledge is understood as tightly connected to its utility – sharpening the perceptual faculty in a direction obviously linked to usage. This Tzeltal knowledge is highly empirical, but does it help us in our quest to verify or falsify the other claims for indigenous knowledge on page 332?

Exercises

14 Does the above example support the idea that indigenous knowledge is primarily local?

15 Is it an example of knowledge of a holistic character?

16 Do you think it is an illustration of concrete thinking?

A somewhat similar example comes from Brazil and the Kapayó people. Theirs is a culture that revolves around bees and the products that they provide. According to Posey (1983), they have a complex taxonomy of different types of bee – with vocabulary that describes them:

- by behaviour (docile, stinging, biting, blistering)
- by ecozone (campo, forest, mountain, etc.)
- by nest type (height, shape, size, etc.)
- by location within ecozone (in tree, earth, vines, etc.)
- by morphology (colour, markings, size, etc.).

There is a near 90% correlation between the taxonomy of the Kapayó and that developed by field biologists in the area. There are also rituals that connect the harvest of honey to the spiritual realm. But what is perhaps particularly striking is the way that hats are constructed out of beeswax to model key parts and aspects of the Kapayó universe, including cardinal directions, the daily cycle of day and night, the village and the field, the Sun and the Moon, and so on.

Exercise

17 Does it appear that the Kapayó knowledge system might be strongly:

a local
b empirical
c holistic
d concrete?

11.4 Language and links to personal knowledge

Knowledge framework: *Language and concepts* – What role does language play in the accumulation of knowledge in this area?

Knowledge framework: *Links to personal knowledge* – What is the nature of the contribution of individuals to this area?

Knowledge question

1 How might shared knowledge in indigenous knowledge systems differ in character from shared knowledge in other AOKs?

Indigenous knowledge is often oral knowledge

What is to be learned from the fact that most of the development of indigenous knowledge systems has taken place without the use of written script? What might be the implications for shared knowledge in such a context? Might these implications shed any light on the other aspects of indigenous knowledge that we have been discussing? More broadly, in what ways do oral and written cultures create different environments for shared knowledge (Figure 11.7)? Can you identify more specific questions that could be posed about these issues?

Figure 11.7 Different environments for shared knowledge.

Perhaps some of the following features and questions emerged from your answers.

- Fidelity – How accurately can the knowledge be stored and transmitted?
- Access – To whom is the knowledge available?
- Acknowledgement – How, if at all, are individuals recognized as producers of knowledge?
- Ownership – To whom does the knowledge ultimately belong?
- Interrogation – How easily can the knowledge be questioned or challenged?

It is not too difficult to list some of the dangers to cultures that continue to depend on oral storage and transmission. How do these dangers relate to personal knowledge? These kinds of issues are of great interest to American professor of linguistics David Harrison, who has drawn attention to some of the examples discussed in this chapter, including those below.

One interesting case study related to these questions is that of the Kallawaya people of Bolivia. Inheritors of the herbalist traditions of the Inca empire mentioned earlier, the Kallawaya have succeeded in encoding their specialist knowledge of thousands of medicinal plants for several centuries in a language that remains unknown to outsiders – even to certain classes of their own society. How successful in principle do you think this strategy might be in assuring desirable answers to the questions above? It would seem likely that it has had an impact on fidelity of knowledge, and may offer a productive prototype for what we might call collective ownership, even if individual contributions are not preserved as such. Legally-backed acknowledgement and restricted access to the knowledge may allow those who own it to extract proper recompense from others who wish to make use of it – indigenous knowledge systems have in many cases been plundered by outsiders because it is easy to do so in the absence of the kind of safeguards that accrue from the ways that written knowledge is codified.

On the other hand, members of oral cultures sometimes point out that spoken knowledge is easier to interrogate because those who offer it are immediately available for discussion. Words in a book just sit there – passively – but the spoken word is alive. However, spoken words can be alive only in the presence of those who can speak them. Out of approximately 7000 languages alive today in the world, it is estimated that perhaps half of them will not outlast this century. The vast majority of such languages are highly localized and hence the ongoing extinction will have a disproportionate effect on indigenous knowledge. For example, the language of the Tofa people of Siberia is already at risk of falling out of use – it is no longer taught to children, and is thus almost certainly doomed as new generations gravitate to Russian. Latest estimates put the number of speakers at less than 100. The loss of the Tuvan language will mean much more than a slight reduction in the world's linguistic diversity. As has been discovered in many other instances, language can evolve in ways that reference what seem to be disparate aspects of the local environment, making connections that would seem natural to its speakers but elude outsiders. For example, descriptions of actions may be tied to geographical landmarks or directions; habits encoded in myths and stories. The extinction of a language is followed by an unavoidable cultural amnesia, for which a remedy no longer exists. Soon the Tofa will have no more actively used vocabulary of reindeer types by age, sex, fertility, or rideability, and no one to sing songs of milking, herding, hunting, or the spirit world.

Exercise

18 Do you agree with the above paragraph about the value of multiple languages and the need to try to preserve them? Why or why not?

11.5 Historical development

Knowledge framework: *Historical development* – How has the history of this area led to its current form?

Additional framework question: What is its relation to the history of other areas of knowledge?

Indigenous knowledge privileges a different way of thinking?

The history of Western anthropology is littered with attempts to draw distinctions between different ways of thinking in order to explain the alleged differences between cultural groups. These ideas need to be examined critically and with great care. We have already met the ideas of Claude Lévi–Strauss, who asserted that a major contrast between indigenous and Western people was the degree to which they relied on the tools of sense perception and theorizing. Lévi–Strauss further suggested that thinking in indigenous cultures is primarily symbolic and not truly 'conceptual' in nature. This does not seem to stand up to scrutiny. Witness, for example, the rich conceptual scheme found in Ashanti culture in Ghana (Ashantis belong to the wider Akan group mentioned earlier), in which a society without a written language developed a highly

	AKOKO NAN	**Akoko nan tia ba, na ennkum no.** *The hen treads upon its chicks but does not intend to kill them.*	Parenthood Care Tenderness Protection
	ODENKYEM	**Odenkyem da nsuo, mu, nso onnhome nsuo, ohome nframa.** *The crocodile lives in water but breathes air.*	Adaptability Prudence
	ADWERA	**Adwera nsuo, wo ne nkwansuo, nsu korogyenn a wohuru nso wonhye.** *Water of life – you are the crystal clean water that boils but does not burn.*	Purity Sanctity Chastity Cleanliness
	OSRAM	**Osram mmfiti preko nntwareman.** *It takes the moon some time to go around the earth.*	Patience Understanding
	SANKOFA	**Se wo were fin a wo sankofa a yennkye.** *It is not a taboo to return to fetch something you forgot earlier.*	Wisdom Learning form the past

Figure 11.8 Adinkra symbols and their meanings.

effective alternative in the form of adinkra symbols. Many of these are inspired by items from the natural world such as animals or plants, but they convey a rich repertoire of concepts that transcend their origins. In the words of the Ghanaian philosopher Kwame Anthony Appiah (1993), *[adinkra symbols] were one of the means in a pre-literate society for supporting the transmission of a complex and nuanced body of practice and belief.* In many cases, they are handy summaries of proverbs and provide an efficient way of storing and transmitting important social knowledge (Figure 11.8).

A further difficulty with pre-literate cultures is the paucity of evidence for tracing historical development. In many cases, this may make it easier to speculate in ways that are not accurate, and to allow unexamined assumptions to creep into conclusions. Nevertheless, it is important to consider divergent views on such matters. Another Ghanaian philosopher – Kwasi Wiredu – has been less reticent than Lévi–Strauss in positing a timeline of development in societies. Here, he writes with particular reference to Africa:

> “ [I]t is a matter of [...] importance to distinguish between traditional, that is, pre-scientific, spiritistic thought and modern scientific thought by means of clearly articulated criteria. [...]
>
> Unfortunately, instead of seeing the non-scientific characteristics of African traditional thought as typifying traditional thought in general, Westerners have tended to take them as defining a peculiarly African way of thinking. [...] One consequence is that many Westerners have gone about with an exaggerated notion of the differences between Africans and the peoples of the West. [...] Nevertheless, since traditional thought is inferior to modern science-oriented thought in some obvious and important respects, some Western liberals have apparently had to think hard in order to protect themselves against conceiving of Africans as intellectually inferior.
>
> Another ill effect relates to the self images of Africans themselves. Partly through the influence of Western anthropology and partly through insufficient critical reflection on the contemporary African situation, many Africans are apt to identify African thought with traditional African thought. The result has not been beneficial to the movement for modernization, usually championed by the very same Africans. These Africans have been in the habit of calling loudly, even stridently, for the cultivation of an African authenticity or personality. True, when such a call is not merely a political slogan, it is

motivated by a genuine desire to preserve the indigenous culture of peoples whose confidence in themselves has been undermined by colonialism. But the traditional and non-literate character of this culture enabled sparse groups of Europeans to subjugate large masses of African populations and keep them in colonial subjection for many long years; even now, it makes them a prey to neo-colonialism. ”

Wiredu, 1997

Exercises

19 Summarize what you think Wiredu is claiming about how thinking develops in society.

20 Do you think Kwame Gyekye's comments on page 340 support this view?

21 How is Wiredu's view different from that offered by Lévi-Strauss?

22 What is at stake here regarding knowledge in different societies? Whose view seems more likely to you?

Perhaps your response is that both Lévi-Strauss and Wiredu are wrong, and they have fallen for the temptation to create dichotomies where none really exist in the world (Table 11.2). If so, what would you suggest instead?

Table 11.2 Are these dichotomies real?

	Thought type 1	Thought type 2
Model 1 (based on Levi–strauss)	Untamed: thinking close to sense perceptions, 'concrete logic', direct analogy	Domesticated: scientific, theoretical, abstracted from sense perception, conceptual
Model 2 (based on Wiredu)	Pre-scientific: agentic* causation, superstitious, static, dominated by authority	Rational inquiry, empirical causation, application of concepts

**Agentic – causation ascribed to animate forces, including spiritual.*

Investigating the depth of knowledge differences between cultures

As we are starting to see, the study of thinking and the way in which it might shape knowledge and how it is constructed in different cultures can lead us toward larger questions concerning human knowledge as a whole. How deep do the differences that we might discern between different peoples run? This is a very contentious issue – one that has exercised many minds over the course of intellectual history. Consider the following four comments on the nature of 'African thought'.

Quotation A

“ Do not let us propound to primitives questions which escape their mentality, posed in terms involving a system of metaphysics of which they have not the remotest idea. Let us avoid asking them how they solve problems that they have never even considered. Let us not try to discover in [their] representations the distinction we make between soul and body. On the contrary, let us endeavour to grasp them without distorting them … and not force them into the framework which befits our own concepts. ”

Quotation B

“From our ancestors, we have inherited our own method of knowledge … In contrast to the classical European, the [...] African does not draw a line between himself and the object; he does not hold it at a distance, nor does he merely look at it and analyse it … he takes it vibrant in his hands, careful not to kill or fix it. He touches it, feels it, smells it … He does not assimilate; he is assimilated. He lives a common life with the Other; he lives in a symbiosis.”

Quotation C

“In our traditional life we do argue and we do evaluate arguments both with respect to their validity and soundness. In their disputations our elders are even wont to enunciate fundamental logical principles such as the laws of non-contradiction (*viz.* nothing is both the case and not the case) and excluded middle (*viz.* something is either the case or not the case). For example, among the Akans of Ghana inconsistent talk before any group of elders would be likely to invite the reminder that ‘Nokware mu nni abra’, literally, there is no conflict in truth, which, evidently, is an invocation of the principle of non-contradiction.”

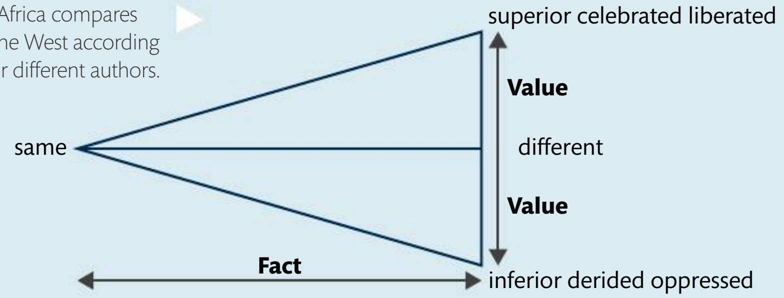
Quotation D

“We know that Africans have thought about the universe longer than any other people. The people of the world have been black longer than any other color. In fact philosophy itself originated in Africa and the first philosophers in the world were Africans. The African tradition is intertwined with the earliest thought. Yet from the beginning of Europe’s interest in Africa the European writers referred to ancient African works as ‘Wisdom Literature’, in an effort to negatively distinguish African thinking from European thinking.”

Exercises

23 Now reconcile these four excerpts with particular positions on the chart below. The descriptions beside the axes refer to what the contributors think about Africa in comparison with the West.

How Africa compares with the West according to four different authors.



Exercises

24 What are the implications and dangers of adhering to each of the following positions?

a In every society, methods of thinking evolve along the same pathway, and knowledge is ever more successfully produced. Some societies are further along this timeline than others.

b People from different societies have quite different methods of thinking, resulting in the production of different knowledge, or the same knowledge by different means.

25 Are there any assumptions about African and Western knowledge built into the basic layout of the above diagram?

These are the sources for the four quotations:

- Quotation A: Lucien Lévi-Brühl, France
- Quotation B: Léopold Senghor, Senegal
- Quotation C: Kwasi Wiredu, Ghana
- Quotation D: Molefe Kete Asante, USA.

To see the online source of these quotations, go to www.pearsonhotlinks.co.uk insert the ISBN or title from this book and click on weblinks 11.1 to 11.4.

Does knowledge of the authors make a difference to how you interpret what they have to say?

Modern developments in biology, neuroscience, and psychology have provided strong evidence that many human attributes are shared at a deep genetic, structural, and cognitive level. It is not so easy nowadays to claim that different ethnic groups build knowledge in fundamentally different ways. Nevertheless, the influence of culture as a response to specific environments must still be taken into account, as shown by the diversity of indigenous knowledge systems around the world.

11.6 Development issues

Most of the world's primary health needs are serviced by traditional medicine based on herbal and other products that have never seen the inside of a pharmacological laboratory. Most of the world's fishing and agricultural activities are based on methods that arise from continually refined traditional practices rather than the direct application of what we would call scientific findings.

It is also for these kinds of reason that the study of indigenous procedural knowledge has become central to the work of development agencies intent on boosting food production, encouraging sound environmental practices, or responding to emergency and disaster. The words for knowledge in many indigenous languages translate back as closer to 'wisdom' rather than 'knowledge' (for example, *nyansa* in the Akan languages of Ghana) – what implication can you draw from this?

CHALLENGE YOURSELF

Make an analysis of terms in different languages for 'knowledge' – how many of them also encompass 'wisdom' or at least allude to it?

In this highly practical area, it is essential that indigenous knowledge systems are studied and appreciated for what they are and what they have achieved. Failure to do this can lead to disaster. The communities that live around Lake Turkana in northern Kenya are pastoralists. Despite the stocks to be found in the lake, local people have very little interest in fishing.

> 'If you fish it means you are poor because you have no livestock', said Philip Ayane, 22, who lives in the remote village of Nandapal. 'Mostly, it is people who have lost everything to drought who go fishing, when there's no other choice.'

Cocks, 2006

Nevertheless, the Norwegian government went ahead and funded the production of a fish-freezing factory on the edge of the lake – a facility that has subsequently fallen into disrepair and disuse.

> ‘It was the old top-bottom approach’, said Cheanati Wasike, government fisheries officer for Lake Turkana. ‘The lake was identified by outsiders as a resource but they never consulted the Turkana, never asked them what they thought of fishing it.’
>
> **Cocks, 2006**

To learn more about Wade Davis's views and the biosphere and ethnosphere, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 11.5.

This is one simple example of many that can be cited around the world – cases which illustrate anything from a lack of consultation to a complete disregard for the value of knowledge built and applied in the very context in which the outside intervention is intended to succeed.

The Canadian anthropologist Wade Davis, whom we met earlier, has used the concept of the biosphere in order to promote the idea of a corresponding ethnosphere – suggesting that we should pay equal attention to the dynamics of the biological and cultural worlds, although this is a distinction that many indigenous societies might not make. Local cultures thrive because they develop sustainable relationships with their local environments, and it makes no sense to ignore the knowledge that has supported and nourished the success of this arrangement. But the reasons for studying indigenous knowledge systems go beyond straightforward practical matters, important though they undoubtedly are. Many people recognize the value of an appreciation of the diversity of knowledge and the range of possible perspectives from which understanding can be achieved. This recognition often brings with it a welcome sense of humility.

CHALLENGE YOURSELF

How far can we push this comparison between the biosphere and the ethnosphere? Contrast the view of Wade Davis with what he claims Jared Diamond thinks in his review of Diamond's work. What might be meant by geographical determinism and cultural relativism?

As we reach the end of this chapter, it is worth reprising Exercise 1 on page 333, concerning the labels we might choose for what we are calling in TOK ‘indigenous knowledge’. Have you changed your mind about any of these?

Many people in the world live with multiple layers of knowledge, with a superstructure of Western education resting on indigenous foundations. Often the differences between them can be reconciled; and sometimes they must be separated by a sort of mental compartmentalization in order to avoid conflict or contradiction. The march of globalization and the expansion of development projects can only create more situations in which such ‘knowledge dissonance’ will have to be addressed.

Ideal knower: Tupaia

When Captain Cook reached the islands of the Pacific, he was confronted by the brute fact that local people could navigate with great accuracy in the absence of the tools considered essential by Western sailors. His initial scepticism was eventually tempered by curiosity, and he invited the navigator Tupaia to join him on HMS *Endeavour* as he explored the area.

> Captain Cook was extraordinarily lucky. Not only was Tupaia highly skilled in astronomy, navigation, and meteorology, but he was an expert in the geography of the Pacific, able to name directional stars and predict landfalls and weather. At any

stage in the convoluted course of the voyage, including in the East Indies, he was able without hesitation to point unerringly to the position of distant Tahiti. He even drew a chart of the Pacific, which encompassed every major group in Polynesia and extended more than 2500 miles from the Marquesas to Rotuma and Fiji. In normal times such privileged knowledge of currents, weather patterns, geography, and astronomy would never have been revealed to anyone outside Tupaia's select group. But, as an exile . . . and a man who had boarded the British ship to evade capture and sacrifice by his enemies . . . the navigator–priest was willing to share this secret lore.

Tupaia was also the ship's translator, able to communicate with all the Polynesian people they met, including New Zealand Maori. As a noble member of the arioi sect, which was going through its greatest flowering at the time, and was famous for its gifted orators, artists, actors, dancers, and lovers, Tupaia commanded awe and respect wherever he went. ”

Druett, personal website

Ideal knowers: the Inuit

Some might claim a special place among indigenous peoples for the Inuit. If one of the characteristics of indigenous knowledge systems is mastery of the locality, then the ability to live in such an inhospitable environment must count as a particularly noteworthy achievement. Living largely above the tree line in Canada, Alaska, Greenland, and Siberia, the Inuit are unable to cultivate plants and thus rely on a diet dominated by large animals acquired by hunting.

The harshness of the environment confers a very high value on knowledge of Arctic ecology, as failure to learn or apply it can have catastrophic consequences for the individuals or communities involved. The sophistication of Inuit knowledge of this kind has come to be appreciated by itinerant outsiders, such as scientists, whose work takes them to the same areas.

Efforts to accommodate Inuit claims to land in Canada during the 1990s resulted in an agreement between federal government and Inuit communities that eventually gave birth to Nunavut Territory with jurisdiction over its own area. The political nature of these events motivated the new territorial government to reflect in a comprehensive fashion on Inuit knowledge – not just in terms of the practicalities of life in the Arctic but more widely in terms of indigenous principles, values, precepts and beliefs, and the nature of the language in which such things are expressed. The result was the consolidation of what is now called Inuit Qaujimajatuqangit – a concept that addresses not only the preservation of social and environmental knowledge but its promotion in ways that protect and advance it within the political sphere.

So on one hand, a description of Qaujimajatuqangit as knowledge might look like this:

- a set of practical truisms about society, human nature, and experience passed on orally
- knowledge of country that covers weather patterns, seasonal cycles, ecology, wildlife, and use of resources
- knowledge as holistic, dynamic, and cumulative
- learning through observing, doing, and experience.

adapted from Arnakak, 2001

And then on the other, at a deeper attitudinal level, expressed in the Inuktitut language:

- Pijitsirniq → using power to serve others
- Aajiiqatigiingniq → respecting differences and seeking consensus
- AvatimikKamattiarniq → stewardship of environment, holistic approach
- Qanuqtuurunnarniq → problem-solving, creative improvization
- Pilimmaksarniq → skill/knowledge acquisition through practice
- Papattiniq → guardianship of that which one does not own
- Piliriqatigiingniq → cooperative work for common purpose.

adapted from Wenzel, 2004

It is worth comparing these concepts with the suggested characteristics of indigenous knowledge as a whole on page 332. Although the question of the degree to which these features are shared by indigenous knowledge systems is still open, there does seem to be some strong congruence with the Inuit example.

In the globalizing world of the 21st century, with the prominence of development issues in public discourse, it might be that the experiences of the Inuit in Canada can act as an example as to how other indigenous communities can protect and advance their knowledge systems in the face of powerful forces arrayed against them. In this way, the value that accrues from the diversity of approaches to knowing can be preserved for future times and generations. This value might be expressed as a desire for plurality for its own sake, or we may find as a species that alternative ways of thinking and knowing are essential to our own survival and prosperity.

12

Shared and personal knowledge

On previous page – In 2011, American jazz musician Herbie Hancock was named UNESCO Goodwill Ambassador for the Promotion of Intercultural Dialogue for promoting peace and understanding through music.

12.1 Introduction to shared and personal knowledge

The TOK subject guide observes that the verb 'to know' has two first-person forms: 'I know' and 'we know'. It suggests that these mean slightly different things. 'I know' means knowledge that is held by individuals. It could be that others have no access to this knowledge but it could also be that this knowledge is difficult to share. When this is the case, we call it *personal knowledge*. Lionel Messi possesses great personal knowledge of how to play football. It is knowledge that is difficult to share with others. He might instruct us in a training session but it is unlikely that we shall leave that session being able to play as well as Messi.

'We know' is not just a collection of a lot of 'I know' statements. Rather, it is a type of knowledge that is shaped by processes that operate at a social level. Through social interactions over time, groups establish methods for producing knowledge. These methods might include standards for the type and quality of evidence needed to establish knowledge claims or what counts as a fact, what experimental procedures to use and even what counts as a rational justification. These methods evolve over time and are not the work of a single individual but rather emerge from social interaction between a group of people, often a large one, often widely spread geographically. The recognition of the social nature of this type of knowledge is perhaps the biggest innovation of the TOK subject guide. The guide calls this second type of knowledge 'shared knowledge'.

We have seen that shared knowledge undeniably plays a very important role in our lives. In its informal form, it is the foundation for the social world in which we are embedded. We need common understandings of language, convention, and tradition in order to function socially. Social institutions structure our social lives and produce a horizon against which our lives have meaning and significance. Moreover, we rely on informal versions of AOKs such as folk physics, folk psychology, folk sociology, and folk economics to run our lives.

We have also seen that, in its formal form, shared knowledge is made up of the subject disciplines, some of which we study in the IB diploma programme. These are grouped together to form the AOKs of interest to us in TOK. Shared knowledge is something we can discuss and argue about. It is something dynamic that changes over time, responding to new methods and ways of thinking. Shared knowledge can bridge continents and cultures, and can persist over time. Individuals can help to produce shared knowledge by working on and developing knowledge that was produced long before they were born and that will, in turn, be taken further by future generations. But the contribution of individuals has to be validated by the group before it becomes shared knowledge. Shared knowledge is a huge edifice on which we are working like bees in a beehive in close cooperation over space and time.

Personal knowledge, on the other hand, has a different character. It tends to be difficult to share largely because it does not lend itself to being expressed in language. The deep knowledge possessed by the pianist Herbie Hancock or the tennis player Maria Sharapova is not something that can be easily shared or passed on. These greats of the worlds of jazz and tennis acquired their knowledge not through language but through practice – a lot of it. In his book *Blink: The Power of Thinking Without Thinking*, psychologist Malcolm Gladwell estimates that mastery of a discipline requires on average about 10 000 hours of practice (Gladwell 2008). In all likelihood, Hancock and Sharapova had done their 10 000 hours practice by quite a early age, say, 18.

Herbie Hancock has great personal knowledge of jazz piano.

Maria Sharapova has great personal knowledge of tennis.

Gladwell emphasizes that this type of single-minded devotion is probably more important in shaping personal achievement than native talent, although the latter helps to motivate the discipline required to get the hours on the board. While Sharapova had access to top-class coaching and training, it was not sufficient for the coach to tell her how to play a forehand top-spin volley. She then had to practise the shot hard and modify her technique in response to the results over a long period of time. So language might be used in acquiring this knowledge but the point is that the knowledge itself is not linguistic. Knowing what you must do is not the same as doing it.

Distinguishing between shared and personal knowledge

In times gone by, the distinction between shared and personal knowledge might have been described as the difference between knowledge and skills. Being able to play jazz piano would have been classified as a skill rather than as knowledge. What might go with this way of thinking would be a hierarchy of activities, with those that are skill-based being at the bottom and those that are more knowledge-based being at the top. Such a hierarchy might be reflected throughout society: from the importance given to some subjects in school to the pay awarded to different jobs in life outside school. These hierarchies might still exist. We still use the term 'skill' when referring to certain types of manual labour and these jobs are typically at the lower end of the pay scale. The fibre-optic joiner might earn considerably less than the management consultant because one is seen as possessing a skill while the other has knowledge. But the view taken by this book is that both are knowledge.

The TOK subject guide uses the metaphor of knowledge as a map of the world, a simplified representation; it is constructed and used to solve a particular set of problems. Herbie Hancock undoubtedly has a very intricate map of the territory of jazz piano playing. He has a complex set of internal representations of the world of harmony, rhythm, melody, texture, and structure that are required to produce the sort of stunning improvised passagework that we expect from him. Maria Sharapova has a highly elaborate map of a game of tennis. She uses her internal representation to understand the strategy of her opponent and devise counter measures. She monitors the weaknesses of her opponent and uses her map to produce an effective match plan. She then uses the physical representation of the tennis court to carry it out physically in real time. These maps are often very detailed and elaborate, and deserve to be taken seriously and described as knowledge. What makes them personal is that they cannot be easily transferred to others. Table 12.1 gives a broad-brush description of the major differences between shared and personal knowledge.

Table 12.1 Shared and personal knowledge

Shared knowledge	Personal knowledge
belongs to the group	belongs to the individual
easy to communicate	difficult to communicate
produced by internal structure of AOKs analysed using the knowledge framework: • scope and applications • language and concepts • methodology (including WOKs) • history	produced directly by WOKs: • sense perception • language • reason • emotion • memory • imagination • faith • intuition
map-like/model-like	mainly story-like
language based	non-language based
propositional knowledge	procedural knowledge
global	local
produces group perspective	produces individual perspective

There is a natural two-way relationship between shared knowledge and personal knowledge. Talented individuals can contribute to shared knowledge through their personal abilities. We shall see below that Srinivasa Ramanujan made significant contributions to the field of number theory in mathematics through his very personal manner of thinking about numbers. But in order to count as mathematical knowledge, Ramanujan's imaginative leaps and creative intuitions had to measure up to the standards of the mathematical community. One of these standards was the insistence on formal proof – something that Ramanujan did not consider important. Only then did his personal contribution become shared knowledge.

Similarly, shared knowledge profoundly influences personal knowledge. We take shared knowledge and apply it to our own local circumstances making sense of it in our own terms. Knowledge of the shared discipline of psychology might make sense of our personal thoughts, feelings, and behaviour, and lead us to a degree of self-knowledge that would have been impossible otherwise (Figure 12.1).

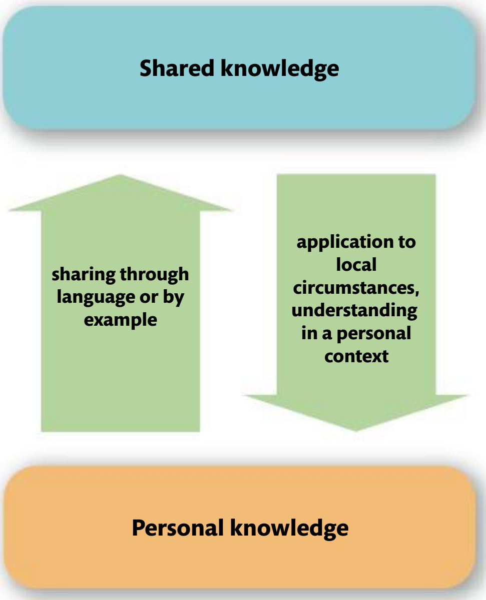


Figure 12.1 The relations between shared and personal knowledge.

We shall explore the nature of personal and shared knowledge, and the relations between them, in more detail in the sections that follow.

Exercises

1 Find three more examples of personal knowledge. How does the individual acquire knowledge in each of these cases? What sort of map is constructed of the world? What makes this knowledge personal rather than shared?

2 In a developing child, what type of knowledge might come first: personal or shared?

3 Is there any evidence of personal knowledge being treated differently from shared knowledge in your daily experiences at school and outside?

4 How should society decide how to reward the different types of knowledge in the labour market?

5 The knowledge that is required to run a household is often based on experience and might be for a large part personal knowledge. What are the implications of this regarding gender equality?

6 Look at the high school curriculum you designed in Chapter 6. What proportion of resources did you devote to personal knowledge and shared knowledge? What arguments could be used to justify the split between personal and shared knowledge?

12.2 Shared knowledge

Most of the knowledge we have discussed so far in this book is shared knowledge – being shared and shareable means that it has certain essential features. Broadly speaking, being shared lends it a degree of objectivity. It is not restricted to the experiences of individuals and is in some sense impersonal. It is knowledge that can be discussed and criticized. The criteria for validating it are available to the group. It is fundamentally systematic. There are feedback mechanisms to modify it if it doesn't do the work that is expected of it. Like any topographical map, if it does not solve the problems of navigation because it omits significant features on the ground then it has to be altered accordingly.

Shared knowledge is a collective endeavour and today this means that it involves a vast web of cooperation. Think of the sharing of knowledge that goes into building a car or a computer. There is probably no one on Earth who can build a computer from scratch. These projects rely on millions of small items of specialized knowledge. The global economy functions to connect together these disparate knowledge spaces. Even in the case of the subject disciplines we study in the IB diploma programme, they are now vast, highly specialized, and deeply interconnected. Unlike the models of knowledge of the Enlightenment, they are far too vast for any one person to master in their entirety. In some sense, a subject such as physics exists 'out there' and yet there is no single person who has access to all of it. We are living in a time of increasing specialization and, what goes with this, rapidly increasing interconnectedness.

Shared knowledge is always re-assessing itself. Built into its methods of inquiry is the possibility of critical self-examination. This is particularly true in the natural sciences but it can also be found in the arts. We are familiar with the idea of peer review of the results of a particular experimental team, but might be less familiar with the idea of a major re-evaluation of the work of this or that artist via retrospective exhibitions or radical new interpretations. These internal checks and assessments are characteristic of shared knowledge.

As we shall see, one of the features that allows shared knowledge to break out from the confines of the personal knowledge space is that it is predominantly linguistic. Shared knowledge by definition must be shareable. That requires language of some sort.

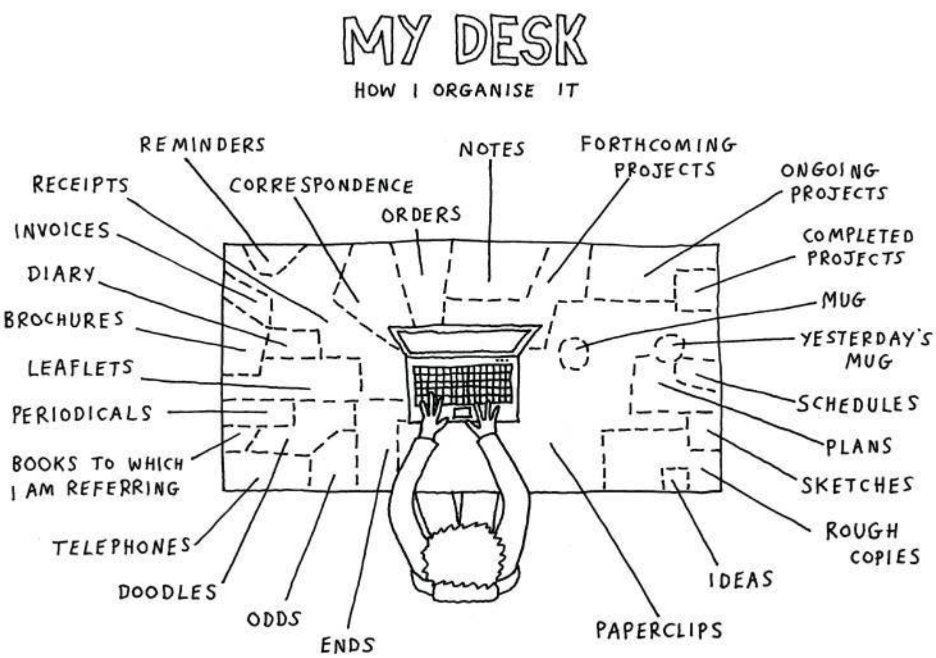
Shared knowledge produces knowledge communities. These are groups of people who are linked together through having access to a particular system of shared knowledge. For example, chemists the world over belong to a knowledge community. They share concerns, interests, concepts, methods, and they have a shared history through chemistry. If the shared knowledge is cultural, the resulting community might be an entire cultural group sharing traditions, history, language, and systems of value. Shared knowledge produces a particular group perspective – a particular view of the world through the lens of the system of shared knowledge.

The TOK subject guide states on page 18 that we belong to many such groups. Examples are:

- family groups
- gender groups
- religious groups
- groups associated with particular academic fields, such as physics
- groups associated with particular views within an academic field, such as subatomic particle physicists
- groups sharing a particular culture
- groups sharing particular artistic knowledge, such as film-makers
- groups sharing particular interests, such as bird-watching
- political groups
- national groups
- ethnic groups
- language groups.

The perspectives produced by access to such group knowledge might not fit easily together. For example, there might be tension between the materialist view of the world of the natural scientist, where human desires and intentions play no role, and the view of the ethicist where they are central. There might be tension between a religious view of the world and one that is associated with political or cultural knowledge. There might be tension between a local indigenous knowledge system and a global one. Individuals might need to think hard about how to reconcile the different perspectives produced by the different knowledge communities to which they belong. These ideas should be familiar from the work on human sciences in Chapter 5.

Recognition of the existence of these different perspectives is part and parcel of international-mindedness. In the final section of this chapter, we shall explore the link with this and the IB mission statement. But first we need to return to the production of shared knowledge and ask what conditions need to be satisfied for knowledge to be shared.



How to organize your desk – shared knowledge or personal knowledge?

Conditions for sharing knowledge

Throughout this book, we have supposed that knowledge is, broadly speaking, a map of reality designed to solve a specific set of problems. It is then natural to ask what conditions allow this knowledge to be shared. Let us go back to an example discussed in Chapter 11 (page 336). How could local Inca knowledge of successful agricultural practice in the extreme conditions of the Andes be passed on to locations far from the capital Cuzco?

It seems that there are six main conditions that have to be satisfied in a particular case.

1 There are shared problems that motivate the production of shared knowledge and an incentive for sharing the knowledge in the first place.
2 The required knowledge exists in a form that can be transported over distance (and time).
3 There are technologies that can transport knowledge over distance (and time) in this form.
4 There are shared concepts and conventions that allow knowledge produced in one place to be understood in another.
5 There are shared methods for producing this shared knowledge.
6 There is some element of shared history that allows the knowledge in question to have a shared significance.

You will notice that these conditions correspond exactly to parts of the knowledge framework. We shall deal with each of these conditions in turn.

Shared problems and motivations

Remember our mantra: knowledge is a map of reality that is used to solve problems. The possibility of shared knowledge requires that there are shared problems whose solution motivates the production of shared knowledge.

Let us return to the example of the Inca. Agricultural knowledge in the Inca Empire is a clear example of a set of problems that might require shared knowledge. Such a huge empire can reap considerable benefits by sharing agricultural and technological knowledge. Economists call these benefits 'network externalities'. They confer advantages on larger organizations over smaller ones. Small independent communities could be at a big disadvantage compared to the Inca and would eventually come under their political control – not just because of the military superiority of the larger power but more generally because of the efficiencies gained though the bigger shared knowledge base.

But it is not just shared knowledge of science and technology that confers advantages on a group. Shared knowledge of cultural practices and traditions allows groups to build social cohesion and internal organization which are necessary conditions for the growth of a society. A bigger group probably means a group that is more able to meet the needs of its individual members and better able to convert the resources at its disposal into the things necessary for life. So the circle becomes self-sustaining.

These are strong motivations for sharing knowledge. But the opposite motivations might also apply in some situations. The competitive commercial world gives us plenty of examples where it is not in the interests of individuals to share their knowledge. Antonio Stradivari (1644–1737) knew how to build extremely good violins. He could demand high prices for his instruments. He clearly had no interest at all in sharing his knowledge. This lack of motivation was sufficient for this knowledge to be lost with Stradivari's death. It is a good example of purely personal knowledge that did not make it into the shared category.

Exercises

7 Give an example from history where access to shared knowledge on a large scale has been one of the factors in empire building.

8 Tradition and custom are useful tools that enable a society to build internal cohesion and structure. Give an example of a tradition or custom local to the place where you live. How does this help knit your society together? How is this cultural knowledge shared?

9 Give another example of a situation where there are strong disincentives to share knowledge. Is the result that personal knowledge remains personal or that local knowledge remains local?

No incentive for sharing the knowhow to make this ... A violin by A Stradivari, early 18th century.

Transport over distance (and time) by shared language and concepts

The second condition seems to imply that the knowledge to be shared is, in some sense, formulated in language. Without language, shared knowledge could not exist. Here we have to sound a note of caution. We are not talking about knowledge that can somehow be converted into language for the purposes of communication. As we discussed in Chapter 4, without the use of scientific language there is no scientific knowledge. Scientific knowledge is about linking together key scientific concepts, such as mass, acceleration, and force, to produce scientific laws. If you take away the language and concepts, there is nothing left. The same argument applies equally to the other AOKs. They are also built from concepts. So the possession of shared building blocks or shared concepts is a necessary condition for sharing knowledge (Figure 12.2).

But also discussed in Chapter 3 is the requirement that certain basic ideas are standardized; units of measurement are a case in point. There could be no science

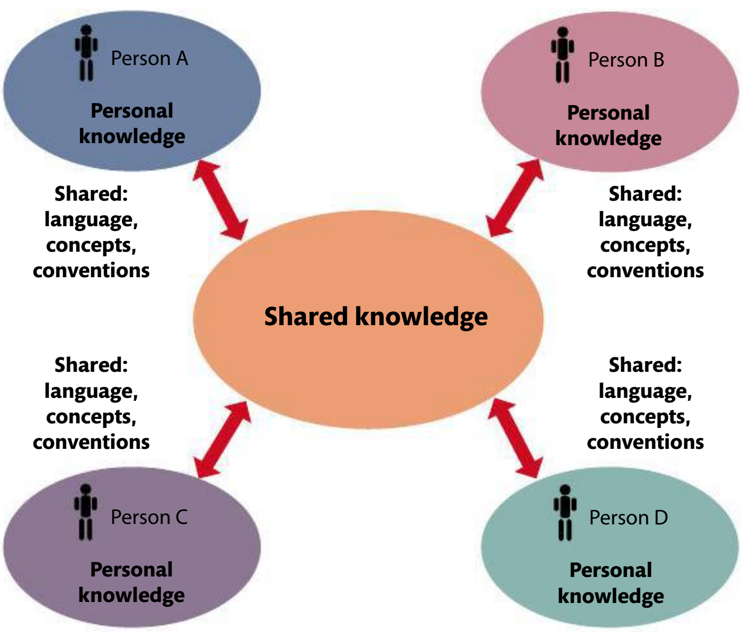


Figure 12.2 Shared language and concepts allow the building of shared knowledge over distance and time.

if each small town had its own systems of measurement. In fact, there could be very little cooperative economic activity at all under these circumstances. In the past, when human life was lived within a tight, highly localized environment, there was little need for standardization. Each small town could have its own idiosyncratic system of weights, volumes and, even, measurement of time (page 364). With the coming of greater economic integration there was a need for bigger shared knowledge structures, and weights and measurements had to be standardized. Ironically, time was one of the last areas in which standards needed to be introduced. In many areas it was the arrival of mass communication in the form of railways and then air travel that forced a standardized system of time zones on a localized world. Imagine trying to run a railway network between towns having their own local time running completely independently of each other. Our system of time zones, like many other human conventions, is a hotch-potch of compromise shaped strongly by historical and political factors.

It is useful to observe in passing that, in a sense, the time-zone map is a stark illustration of the deep tension between the requirement of global standards to allow the production of knowledge that can be shared between communities in different geographical locations, and the requirement of systems of knowledge that reflect local circumstances. We want intercontinental travel but we also want the Sun to rise in the morning, local time. The most extreme form of this tension would be between the most localized form of knowledge which is personal knowledge (knowledge local to the individual person) and the most global form which is global knowledge systems such as those of the natural sciences.

World time zones – an attempt to standardize the measurement of time to allow the possibility of shared knowledge.

Exercises

10 It is sometimes said that humour is an aspect of culture that is difficult to share. To what extent do you agree with this?

11 Is it possible to really know a culture other than one's own? What are the problems involved with such knowledge? Why might cultural knowledge be difficult to share?

12 In what way is the ability to share language and concepts relevant to the problem of translating poetry from one language to another?

Technology for sharing knowledge – three TOK inventions

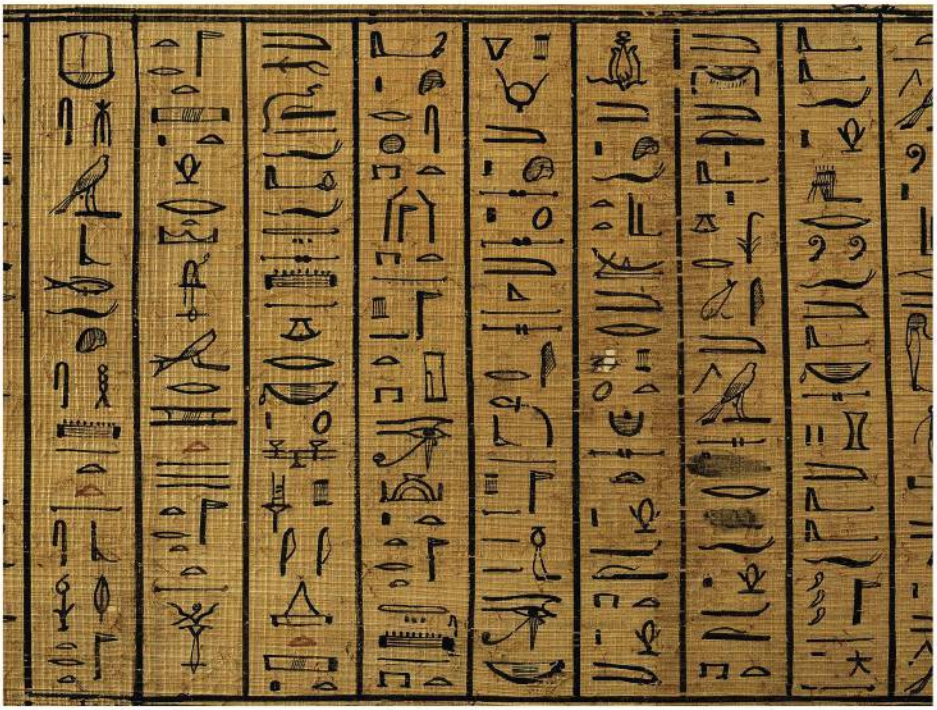
The third condition for shared knowledge is for a technology that can transport knowledge from one place to another. For the Inca of Peru, the central administrators in Cuzco could call on an elaborate system of messengers to transport the knowledge about sowing, cultivating, and harvest to the outlying parts of the Incan empire. They used a system of knotted strings called *quipu* which were carried by the messenger – the *quipu* master.

An Inca *quipu* – an example of a digital technology for shifting knowledge from one place to another.

The relative positions of the knots on the strings encoded knowledge. It is a digital technology that held a huge empire together politically, socially, culturally, and economically. Interestingly, each string in the *quipu* corresponded to a particular important line of sight or *ceque* from the centre of Cuzco to the surrounding landscape (Chapter 11, Figure 11.5). These lines of sight had religious significance. As we saw in Chapter 11, the Inca had a deeply integrated holistic system of knowledge quite unlike our modern separated subject disciplines.

An Inca *quipu* master.

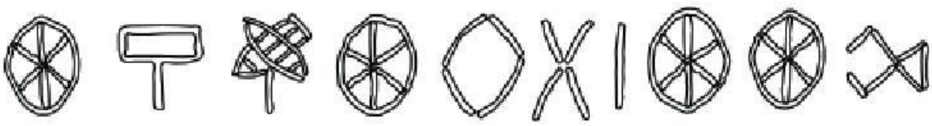
A far more ancient digital technology is possibly more familiar to us than the *quipu* of the Incas – it is called writing. There is a sense in which the invention of the written word is the most impressive TOK invention ever. Through writing, knowledge from ancient Babylon and Mesapotamia reaches us after a period of between 4000 and 5000 years. Being a digital technology, writing has a stability that is missing from analogue technologies. Small degradations of the surface of the clay tablet, papyrus, parchment, or paper have little effect on the content. Writing enables local knowledge to be disseminated – it allows knowledge to be shared.



The most important TOK invention of all time – writing – allows knowledge to be shared over great distances and times.

Exercise

13 Why are digital media more stable than analogue media? Think about the difference between vinyl LPs, digital CDs, and DVDs, or between digital telephony and old analogue telephony.

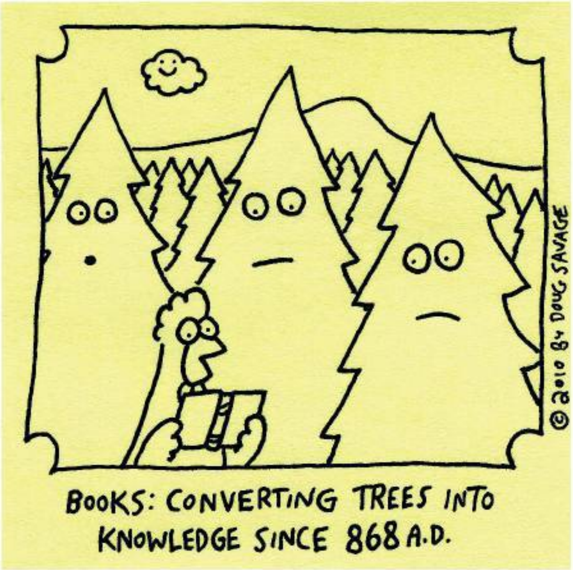


A bronze-age script fragment from the Dholavira citadel in NW India dating from around 3000 BCE.

Perhaps the second most significant TOK invention is that of the printing press using moveable type in the 15th century. Suddenly, the process of sharing knowledge is 10 000 times more efficient. Instead of armies of scribes laboriously copying important documents by hand and taking weeks to complete a document that can be read in a few hours, we have a machine that can print thousands of copies in the time that it takes to read one. The cost of sharing knowledge is dramatically reduced. The effect on shared knowledge space is revolutionary. It produces an explosion in the sheer volume of shared knowledge in the world. There is also a corresponding effect on personal knowledge: a vast group of individuals now have personal access to knowledge that was previously denied them. It is no wonder then that English thinker Francis Bacon credited the printing press with changing '*the whole face and state of the world*'.

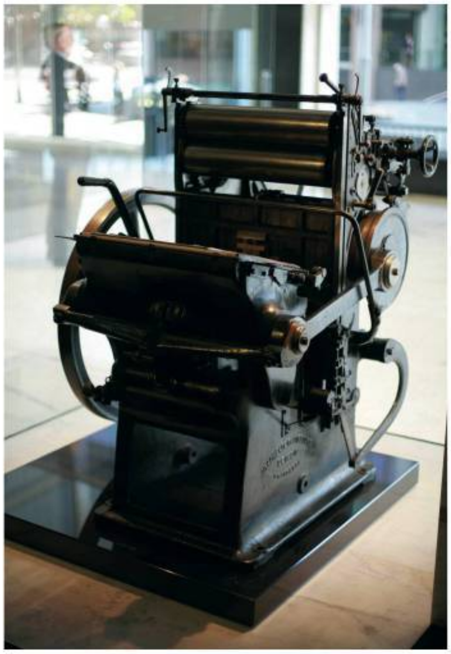
These developments have big implications for political power. In the 15th and 16th centuries, access to shared knowledge was still restricted. Being able to read and understand printed documents was not universal and was strictly controlled. For long periods in history, this was a privilege afforded to the ruling and bureaucratic classes

– whether secular or clerical. With the increasing availability of the technology of shared knowledge – that is, books – the political authorities needed to exert strict control over who had access to the education that is required to benefit from books. Access to literacy meant access to shared knowledge and the power that it conferred. The deep social and political implications are clear. Political and religious structures that control access to education control access to shared knowledge and, in some sense, control access to power. We shall look at this issue further in the section on personal knowledge.



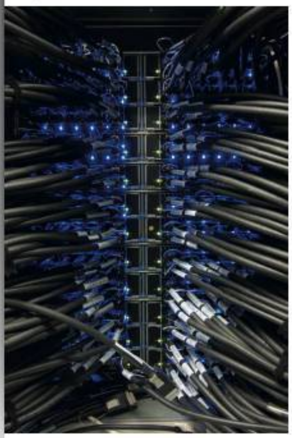
What trees might think of printing presses.

In many parts of the world, the widespread adoption of digital technology by government agencies and large organizations in the 1970s, and then by private individuals in the 1980s, produced another sea-change in the way knowledge could be shared. The 1990s saw a set of systems originally designed for inter-university and governmental communication adapted for general private use. The internet as we now know it was born. Perhaps not quite so earth-shattering as the initial development of the written word or the printing press, information and computing technology nevertheless speeded up the sharing of local knowledge and allowed billions of ordinary people access to huge databases of information. The development of search engines gave the impression that the user could find anything that is out there held on the myriad servers that constitute cyberspace. Of course this is not literally true – search engines work according to quite specific algorithms that respond to the commercial priorities of the companies that run them. But despite these limitations, we do live in a world in which local knowledge can be shared on a vast scale very rapidly indeed.



The second most important TOK invention of all time – the printing press

Switching gear for the internet – TOK invention number three.



Exercises

14 Students often use search engines to gather sources for doing research for their extended essay in the IB Diploma programme. What are the disadvantages of this method compared to using library catalogue data or an index of academic journals?

15 In what ways might the internet change the way in which we produce knowledge?

16 How might information and computing technology shape education in the future?

Knowledge question

1 How does the structure of an AOK depend on the way in which that knowledge is shared?

The prototype kilogram stored at the Bureau for Weights and Measures in Paris.

Shared concepts and conventions

We saw earlier how the establishment of standard units for mass, volume and time were a necessary condition for increasing the sphere of human cooperation through trade. Common weights and measures, as they are called, are a good example of convention. But to cooperate in producing knowledge, people have to have a common pool of abstract ideas or concepts on which to draw. These are, if you like, a set of intellectual weights and measures that allow us to trade ideas. We have discussed this in detail in other chapters so an example will suffice here. Let us consider the problem of sharing knowledge of Euclidian geometry. We need to share the basic building blocks. For example, we need to agree on such things as points, line segments, circular arcs and what we mean by parallel. It is not just the meaning of the words that is important here, but rather that we can make more complex figures out of these basic conceptual materials. A creature that only had the conceptual machinery of squiggles and blobs would not be able to share our knowledge of Euclidian geometry.

To learn more about the standard system of weights, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 12.1.

Shared methodology

The technologies we have discussed so far have enabled local or personal knowledge to be shared. Technically, what is being shared is information – digital codes just like the knotted strings of the *quipu* or the marks on a papyrus scroll. This information has to be decoded and given significance before it can become the map of reality we call knowledge. We produce significance by following a shared set of procedures. The *quipu* master needed to be able to read the knots and then explain their significance through applying a set of shared methods, and invoking a set of shared cultural traditions and expectations. The kindergarten child needs to be able to decode the strange black marks on the paper using a shared method of reading, and then has to make sense of them in the context of a shared vocabulary and experience of the world. The scientist has to be able to interpret a paper in a journal using the conceptual resources and methods of science. In other words, we do not just share the message at the information level but we also share the means of making sense of it – not only through the process of decoding the symbols but also understanding what the symbols mean in terms of the social reality of our AOKs.

Sharing a methodology is an obvious starting point for doing any sort of natural science, as we saw in Chapter 4. There must be a way in which local ideas in London can be tested in Melbourne. We have already seen that a common system of standard weights and measures helps this happen. But we also need to agree on what counts as a well-conducted experiment and what counts as a positive result. We therefore evolve complex practices that determine acceptable ways to produce knowledge in the natural sciences. We see that similar ideas apply in other AOKs. In the arts, we have shared artistic conventions to allow meaning to be produced within a particular art form (Chapter 8). In mathematics, we have shared understandings of what constitutes a mathematical proof and shared expectations of standards of rigour (Chapter 6). These shared understandings form the basis for methodology in each of these AOKs and are crucial to the production of knowledge that transcends local circumstances.

CHALLENGE YOURSELF

Having read the article at weblink 12.1, make notes on what methods are used to produce standardized measurements to allow sharing of scientific and technological knowledge. What are the problems of producing these standards?

Exercises

17 Freudian psychoanalysis and scientific psychology could be said to employ really quite different methods. This has resulted in these two fields having little contact and in some cases regarding each other with suspicion. Can you think of any other examples in the human sciences where lack of shared methodology has led to fields becoming isolated from each other?

Exercises

18 Religious knowledge provides many examples where the lack of shared conceptual frameworks and methodologies has caused fissures between different religions. Are there any examples of shared methodology between religions providing the basis for mutual understanding?

Shared history

Throughout this book, we have spoken of how methodologies and understandings evolve. In other words, they are not static. Our methods change and improve, our conceptual frameworks and language change over time. Shared knowledge is dynamic. It changes to respond to changing needs and social structures. It reflects the changing place of humans in the world. It is not merely a reflection of timeless Platonic truths, but rather a dialogue between the world and changing dynamic humanity. The acknowledgement of the historical dimension of knowledge is an important component of the new TOK curriculum.

A crucial component of shared knowledge is, therefore, historical. It is important to examine the historical forces that have shaped a particular area of shared knowledge in order to understand its present significance. Not only is it difficult to understand a novel in our Language A class if we do not know the historical references it makes, but it is also difficult to understand literature itself as an AOK if we do not understand its own history – how the medium of the novel has developed and changed over time in order to adapt to changing needs and respond to different problems. The historical dimension is particularly clear in the arts but it is present in the human sciences too. Economics in the 19th and early 20th centuries modelled itself somewhat on the natural sciences. The aim was to produce a rigorous, almost experimental, discipline that used the same sort of modelling techniques as physics. As we saw in Chapter 5, in some cases literal physical models were used. Modern economics, by contrast, takes a somewhat different approach. It is far more aware of the role of random events, or 'shocks' as they are sometimes called, in the evolution of an economic system. Their models are statistical and designed to show how complex economies respond to unexpected events. There is less emphasis on the sort of scientific determinism present earlier. The whole subject has gradually moved on to different ground where different questions are top of the agenda and different methods are used to tackle them.

Exercises

19 Do you think that the methods of an AOK generally become more refined over time?

20 Is there evidence for optimism that the maps of reality that are our AOKs are improving?

21 How important is it to know the history of art in order to appreciate a particular artwork?

22 How important is it to know the history of a subject discipline when studying it as part of the IB Diploma programme? Does it make any difference if the discipline is a natural science, human science, or arts subject?

Knowledge framework

When we talk about shared knowledge we are not only talking about libraries of books or hard drives full of data. We are talking about shared problems motivating the production of the knowledge in the first place, shared means of making sense of them – shared language and concepts, shared conventions, shared understandings, shared methodologies, and shared histories. All these components are required to produce shared knowledge. These requirements correspond to the internal structure of each AOK – the knowledge framework (Chapter 3).

Shared knowledge should be a dialogue.

We have seen in the preceding chapters that by looking at each aspect of the framework in turn we can try to understand how our different areas of shared knowledge function and in what ways they adopt similar or different solutions to these requirements. 'Scope and applications' takes care of the question of shared problems required to motivate the production of this knowledge in the first place. 'Language and concepts' covers conditions 2, 3, and 4 listed on page 358. These are: the question of whether the knowledge in question can be formulated in language, whether the technology exists for transporting it, and whether there is a sufficient shared pool of concepts available to make sense of it at the other end. 'Methodology' refers to the requirement for a shared set of methods for production of knowledge in order to generate meaning and significance outside particular local circumstances. 'History' refers to the requirement that an important part of the construction of shared knowledge is historical. Shared knowledge is dynamic and responds to improvements in methods and techniques, changes in what the group expects this or that AOK to deliver, as well as changes in interest or in social requirements. Part of the meaning and significance of shared knowledge depends crucially on this history.

There is one extra prong in the knowledge framework mind-map labelled 'Links to personal knowledge'. Clearly, shared knowledge does not exist in isolation and one of its important functions is to inform and influence our personal map of the world. That is something that we shall take up later. First, we need to examine what happens if these conditions for sharing are not met and knowledge cannot be shared. The result is personal knowledge.

Exercise

23 Try to think of three examples of knowledge that humans once had but now lost. Perhaps one of the reasons that this knowledge is lost is because it was not shared – or not shared sufficiently. Examine the conditions required for knowledge to be shared and decide which conditions were not satisfied.

12.3 Personal knowledge

Personal knowledge is a personal map of reality. It differs in some important ways from shared knowledge. Because it lacks the social dimension, it lacks the complex social mechanisms for validating knowledge that are available for shared knowledge. It also lacks the breadth and depth of shared knowledge. Personal knowledge is held by individual persons with all the limitations this entails. After all, individuals only live for so long – and the knowledge of a single individual cannot compete with the breadth of the pooled experience of many. On the other hand personal knowledge has the advantage of being based on the direct experiences of the individual formed by a cluster of WOKs (Chapter 2). The subjective nature of personal knowledge can be an advantage in situations requiring a strong individual perspective. The arts are perhaps an important example here. The watered-down consensus of a committee can never replace the strong personal vision of the individual artist.

We mentioned Herbie Hancock and Maria Sharapova in the introduction. Clearly they both possess personal knowledge at a very high level. This is knowledge of how to do something – *knowhow* – in this case playing jazz piano and playing tennis. We are able to appreciate their personal knowledge through the end product. We are entranced by Sharapova's brand of aggressive, intelligent tennis and can appreciate its effectiveness against strong opponents. Likewise we can enjoy the intricate thread of a Hancock piano solo, at times strident, at others more thoughtful and introverted, all the while spun economically from the smallest musical raw material. The product of this knowledge is public even though the knowledge itself is very private. Using their internal maps they navigate their respective areas of expertise with great dexterity. They might not be consciously aware of these maps because through practice they have internalized them to such a degree as to render them second nature.

Here are some of the more important features of personal knowledge.

- The mental states of the individual play an important part in the formation of personal knowledge. Memory will be important and there might be a central role for the emotions, imagination, and intuition. There might be room for faith as a WOK.
- A personal map of reality will hinge on 'what it feels like' rather than a particular abstract conception of what is there. The starting point for personal knowledge is *phenomenal,* that is, it is rooted in the phenomena of human consciousness. We might call this type of knowledge *experiential* because it rests heavily on experience.
- It might be essentially inward-looking and based on personal reflection; self-knowledge is an important type of personal knowledge.
- It is more likely to be 'knowing how to do something' rather than 'knowing that such-and-such is the case'.
- By definition, pure personal knowledge is difficult to communicate, suggesting that it is a type of knowledge that is less reliant on language. It will be local to the individual rather than global knowledge.
- There will be big differences in how personal knowledge is produced. Whereas shared knowledge will require certain methods of inquiry acceptable to the relevant community of knowers, personal knowledge will be acquired through various personal WOKs listed in the TOK subject guide: sense perception, emotion, intuition, faith, memory, and imagination (Chapter 2). Reason and language will play a role but perhaps a more muted one.
- Practice and habituation will be important in the production of personal knowledge.
- Personal knowledge necessarily produces a personal perspective on the world. This is a (possibly unique) viewpoint that is coloured by the understandings that make up personal knowledge. But this viewpoint, in turn, influences the production of personal knowledge thus producing an important feedback circle (Figure 12.3).

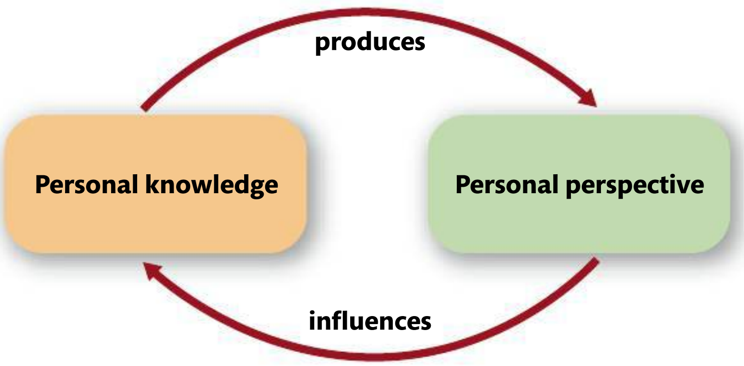


Figure 12.3 The circular relationship between personal knowledge and personal perspective.

Exercise

24 Think of a musical or sporting activity that you do. Are you aware of your mental map of this activity? How does one change or improve one's mental map?

Types of personal knowledge

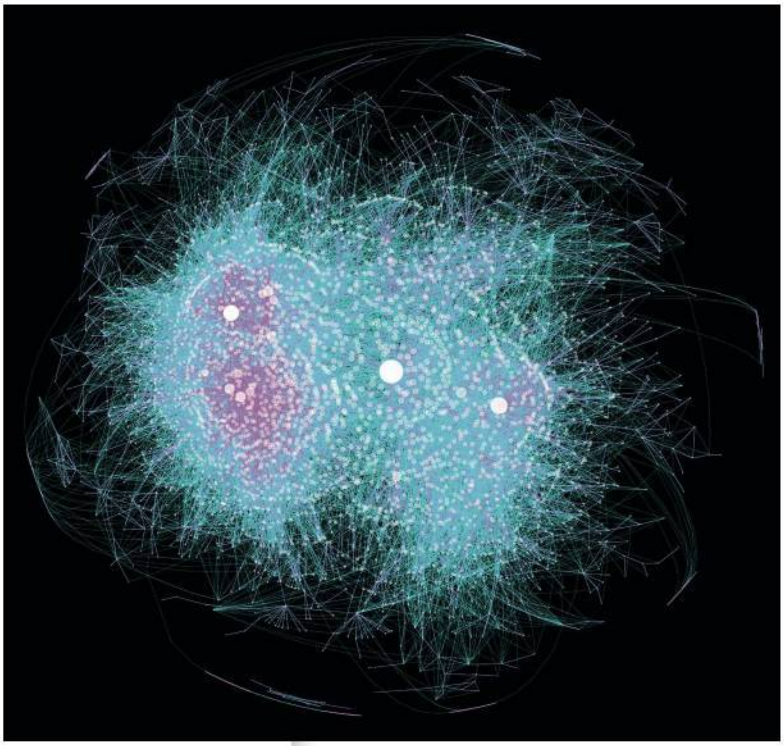
In some sense, personal knowledge is what results if one or more conditions required for the production of shared knowledge fail. Putting it this way gives the impression that personal knowledge is a failed attempt at shared knowledge. This view is too negative and does not do justice to the richness, variety, and creativity of personal knowledge. Of course, shared knowledge has the advantage of objectivity and public procedures for checking and validating knowledge claims, these are significantly absent from personal knowledge. But precisely this lack of objectivity allows great scope for a particularly personal and idiosyncratic view of the world that is the starting point for great achievements in the arts, the sciences, in sport, and in literature. That idiosyncratic personal map of the world might well ultimately feed into shared knowledge and enrich it.

Nevertheless, for personal knowledge to remain personal there must be reasons why it cannot be shared. It must fail at least one of the six conditions for shared knowledge. We get different types of personal knowledge depending on which of these conditions is not satisfied.

Let us examine each of the criteria in turn.

1 ***There are shared problems that motivate the production of shared knowledge and an incentive for sharing the knowledge in the first place.***

A global map of the blogosphere showing the density of traffic.



Some knowledge does not get out into the space of shared knowledge simply because it is not of any interest to others. Knowledge to do with the minutiae of an individual's life might not be of interest to anyone so might not become shared knowledge. A good example here is the so-called 'blogosphere', that is, the explosion of digital journals or blogs set up on the internet over recent years. It was estimated in 2011 that there were around 173 million blogs on the internet posting about 1 million new articles per day. Only a tiny proportion ever get more than a handful of readers. Those that succeed do so mainly because they tap in to topics that are of general interest already – they deal with issues that already lie within the space of shared knowledge. They are less about minute details of a person's biography. There is personal knowledge in blogs that never makes it into shared knowledge space.

There are also disincentives for sharing knowledge. It is clear that quite a few products of personal knowledge possess commercial value and lead to competitive advantage in the market place. Under these circumstances it would not be in the interest of the individual knower to share that knowledge with others.

A product of personal knowledge – Chartres Cathedral.

Medieval master builders of Europe's fine gothic churches and cathedrals offer a good example of these forces at work. Nowadays, we tend to associate large-scale, complex projects involving large numbers of people engaged in different tasks with a master architectural plan in the form of a drawing. But in the period before the formulation of Newton's laws of statics, such plans or overviews were rare. Instead the organization of the construction process lay in the hands of a master builder. His knowledge (and in this period it would always have been 'he') would consist of methods he had learned as an apprentice to other master builders supplemented by new insights he had arrived at himself. His personal knowledge, then, was essential to the project. Much of his knowledge was geometrical; it was knowledge of the shapes that could be used in the important structural components of the building such as arches and vaulting. Often this knowledge was stored in wooden templates used to reproduce the exact geometrical forms known to be successful solutions to the engineering problems encountered in cathedral-building. It was rather *ad hoc* knowledge of a local nature based on centuries of trial and error and geometrical insight, and was completely lacking the totalizing effect of a global theory such as that of Newton. This explains the variety of architectural forms seen in the gothic buildings of Europe such as the asymmetrical façade of Chartres cathedral. The asymmetry of the towers expresses the personal knowledge of at least two different master builders.

Templates in an architectural sketchbook by Villard de Honnecourt, held in the Bibliothèque Nationale de France in Paris.

Because they were paid many times the salary of a common stonemason, there were strong disincentives for the master builder to share his knowledge. The templates, therefore, represented the income differential between the master builder and the stonemason, and were locked away safely to avoid theft. This knowledge was personal. It was gained through a long apprenticeship. The templates which encoded it were analogue. It would be difficult to transport and copy them.

What we have here is a fine example of personal knowledge failing two of the conditions for shared knowledge:

- a massive disincentive for sharing (the loss of differential financial reward)
- the knowledge was formulated in an analogue manner that made it difficult to share.

This type of knowledge remains personal because it fails condition 1 completely and condition 2 partially.

Exercise

25 Do you possess any personal knowledge that will remain that way because you have a strong disincentive for sharing it? What are the implications of this for the writing of history?

2 *The required knowledge exists in a form that can be transported over distance (and time).*

Many of the examples of personal knowledge we have discussed already fail on this count. Herbie Hancock's knowledge of jazz piano playing is a good example of non-linguistic knowledge, knowledge that does not naturally exist in a form that is easy to transport. The end product of Hancock's knowledge of jazz piano playing is available to all of us in these days of mass reproduction of music. We can read the notes he played via a transcription. We can even listen to Hancock talking about his work. But what we don't have access to is his personal inner map of the world of jazz piano – and that is what we mean by his personal knowledge. This is not something that exists in a ready form for sharing. It is probably symbolic and representational in some sense but it is not a representation that we have access to. Indeed, we observed earlier that it might not be completely conscious because of the way in which it is learned.

Exercise

26 Give three examples of your own personal knowledge that cannot be put into words and therefore cannot be transported.

3 *There are technologies that can transport knowledge over distance (and time) in this form.*

We saw how the Inca solved the problem of knowledge-sharing technology with the use of the *quipu*. But there were many societies in which the sharing of knowledge was more problematic. Consider the immense challenge of governing a large region such as the Roman Empire in the 1st century CE. Any sort of government requires sharing of knowledge but at this time the distances involved were vast and communications technology was poor. One solution was a characteristically Roman decentralization of government powers brought about through a system of local governors and prefects who were granted a degree of local autonomy. The other solution was to improve communications technology by building a good system of roads which made (relatively) fast communication possible. These roads did not penetrate upland areas because engineering difficulties made the cost of such construction exceed the benefits. These areas became effectively ungovernable. Western and northern areas of Britain escaped Roman rule precisely because of the impossibility of efficient communications.

On a smaller scale, similar problems were faced by many communities. While the knowledge they possessed might not have been limited to individuals it still remained local and the benefits of access to shared knowledge denied. While there is a tendency

to romanticize these small communities retrospectively, we should not forget for one moment that for most of human history, human beings were, in the main, on the edge of starvation. Small communities were most vulnerable. For example, lacking the knowledge required for diversifying their agricultural production, they faced insurmountable problems if the main crop failed. What was missing was shared knowledge of agricultural methods.

Exercise

27 Analyse your favourite period in history using a TOK lens. How easy is it to explain the events that happened in terms of the ability or otherwise to share knowledge?

4 *There are shared concepts and conventions that allow knowledge produced in one place to be understood in another.*

Even if the technology exists for transporting it, knowledge remains localized when there is not the intellectual machinery available for accessing it. There are examples where we have difficulty decoding the knowledge of the past because we lack the necessary conceptual framework. A fine example of this is the problem of understanding the text of the Dead Sea scrolls. These were discovered between 1946 and 1956 in a cave at Qumran in the West Bank on the shore of the Dead Sea. They date from between 400 BCE and 300 CE and are written in Aramaic, Greek, Hebrew, and Nabataean. They are important because they seem to be the earliest surviving manuscripts of works incorporated into the Hebrew Bible as well as a number of other religious writings. They have generated considerable controversy, partly because the subject matter touches on sensitive religious topics such as the origins of Christianity, and partly because we do not possess the background knowledge required to make sense of the text. As a result, the best we can do is to make an educated guess at the significance of certain key ideas in the texts by comparing them with similar ideas expressed in later texts. What is clear from the texts is the sheer diversity of religious thinking that was present during late Second Temple Judaism. Here were a clutch of small sects each with its own characteristic practices and core beliefs. The knowledge that these texts embodied was clearly of a local and highly fragmented nature.

A fragment of the Psalms scroll with Hebrew translation.

The lack of a common set of concepts and conventions can lead to even more extreme cases of local knowledge. These will be situations in which personal knowledge remains strictly personal. The internal map of reality of a professional tea-taster will involve concepts that are very difficult if not impossible to share with others.

Ideal knower: Louise Allen

Louise Allen is the Managing Director and Chief Taster of a small tea-blending company in London.

“We service the whole online business from the office so we have a mini warehouse next door where we keep all the new products we're developing and store all our finished products, so it can get quite cramped! It's also full of tea samples. Especially in my designated 'tasting area' where I'll spend the early morning trying out any new samples and blends that we may have been sent from producers.

Tasting tea is quite similar to tasting wine but the key is to slurp it off the spoon to make it hit all your taste buds. I can get through hundreds of samples in a day – although I always spit it out, that much tea isn't good for you. I had my first cup of proper tea when I was tiny. My parents always had the finest loose-leaf Assam tea and they'd make it in a proper teapot.

As a result I've always been a tea snob so I also check our current blends for consistency, making sure the teas that we've packed taste just as good as when we first mixed them.”

Allen, 2012

Here are some tea-tasting terms.
Astringent a bitterness common in black/oolong/green tea, particularly if not brewed properly
Body refers to the strength and fullness of the teas flavour, examples of strong bodied tea: most black teas, peppermint tea
Brisk a lively taste in the tea, as opposed to having a flat or soft taste
Biscuit a pleasant aroma often found in well-fired Assams
Common a thin and light liquid with no distinct flavour
Fung a slightly fungal taste due to being stored in too much humidity
Green an immature raw character often due to under fermentation or under-wither
Hard a very pungent liquid
Light lacking strength and any depth of colour
Metallic a sharp coppery flavour
Pungent astringent with a good combination of briskness, brightness and strength, often associated with North Indian teas
Rasping a coarse and harsh tea
Raspberry jam strangely only found in some of the very best Assam teas – can't be explained
Raw a bitter and unpleasant taste
Weedy a taste of grass or hay often associated with under-wither

Notice how difficult it is to share taste concepts. It is almost impossible to do this without using the word 'like'.

Exercise

28 The next time you drink tea, try describing the taste using the terms above. What are the particular problems encountered when trying to describe experiences such as the taste of a particular tea?

5 *There are shared methods for producing this shared knowledge.*

Knowledge will not travel well if the conditions in which it is produced are not accepted by the group. In this case, there is a strong possibility that it remains very localized – even locked within the individual. The Indian mathematician Srinavasa Ramanujan (1887–1920) used techniques to solve problems in number theory that baffled the rest of the mathematical community at the time. Here is Marcus du Sautoy describing them:

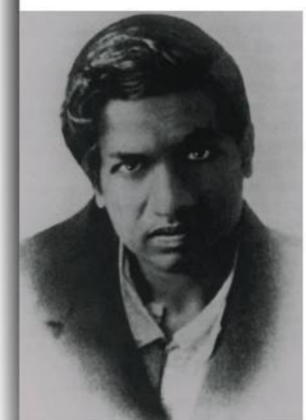
> “Mathematical creativity is difficult to understand at the best of times, but the way Ramanujan worked was always something of a mystery. He used to claim that his ideas were given to him in his dreams by the goddess Namagiri, the Ramanujans' family goddess and consort of Lord Narasimha, the lion-faced, fourth incarnation of Vishnu. Others in Ramanujan's village believed that the goddess had the power to exorcise devils. For Ramanujan himself, she was the explanation for the flashes of insight that sparked his continuous stream of mathematical discoveries. Ramanujan is not the only mathematician for whom the dream-world was fertile territory for mathematical exploration. Dirichlet had tucked Gauss's Disquisitiones Arithmeticae under his pillow at night, hoping for inspiration in his efforts to understand the often cryptic statements the book contained. It's as though the mind is released from the constraints of the real world, free to explore avenues that the waking mind has sealed off. Ramanujan, it seemed, was able to induce this dreamlike state in his waking hours. Such a trance is in fact very close to the state of mind that most mathematicians try to achieve.”

du Sautoy, 2003

Marcus du Sautoy goes on to describe the four stages of mathematical discovery proposed by the French mathematician Jacques Hadamard (1865–1963).
These are:

- preparation
- incubation
- illumination.
- verification.

The first three of these stages fit very closely with our idea of personal knowledge. They are all neatly tucked up inside the individual mathematician. It is only the fourth – verification – that requires the systems of validation provided by mathematics as an area of shared knowledge. It was precisely this fourth stage that was problematic for Ramanujan. He just did not see the need for verification. Once the goddess had given him the insight, that was it. There was no need for having one's work reviewed by peers. We saw in Chapter 6 that formal proof constitutes verification in mathematics. It appears that Ramanujan had no concept of proof at all. According to du Sautoy: *This intuitive style was quite at odds with the scientific traditions of the West.* If it had not been for the Cambridge mathematicians GH Hardy and JE Littlewood persisting in trying to understand what was, to most other mathematicians, the outpourings of a crank,



Srinavasa Ramanujan – extraordinary personal methods in mathematical discovery.

Grigoriy Perelman – unconventional methods: personal knowledge nearly remained personal.

we would still not know about Ramanujan and his personal knowledge would have remained with him to his death – it would not have been brought out into the light of shared knowledge, and Ramanujan would not have been recognized for the genius that he was.

A similar story about mathematicians using unconventional methods can be found in our own time. The Russian mathematician Grigoriy Perelman (b. 1966) announced in a paper published on the internet in 2003 that he had solved Thurston's Geometrization conjecture which is a more generalized version of Poincaré's conjecture. This was a problem that had been unsolved since 1904 and was considered to be one of the key problems in mathematics – it was cited as one of the millenium problems in 2000 (Chapter 3). It is unusual to offer such an important piece of mathematics on the internet, and Perelman's proof itself was also highly unconventional in its methods and format, containing many sections which were sketched but not fully worked out.

The American mathematician John Lott had also worked on the problem and was one of the group assigned to evaluate Perelman's work. Lott said at the International Congress of Mathematicians in 2006:

> “It has taken us some time to examine Perelman's work. This is partly due to the originality of Perelman's work and partly to the technical sophistication of his arguments. All indications are that his arguments are correct.”

Two Chinese mathematicians Cao and Zhu controversially wrote a paper in the *Asian Journal of Mathematics* claiming that Perelman's methods did not amount to a proof and that they had actually proved the Poincaré conjecture 'based on the ideas of Perelman'. This produced a storm of protest leading to the withdrawal of their claim, their acknowledging that Perelman had proved the conjecture, and that their work had drawn heavily on that of Lott. The problem was that Perelman's methods were so out of kilter with the rest of the mathematical community that it took a long time to recognize them for what they were – an extraordinarily original proof of an extremely difficult problem. Perelman was offered the Millenium prize of a million dollars for the proof, which he characteristically refused. He was also awarded the Fields Medal, the equivalent of the Nobel Prize for mathematics, which he again refused.

Exercise

29 Are there any examples you can think of where your own personal knowledge remains personal because the methods you use are so unconventional as to be incomprehensible to anyone else?

6 *There is some element of shared history that allows the knowledge in question to have a shared significance.*

Our final condition is a requirement for a shared history. We have argued that knowledge is dynamic in its response to changes in what we want it to do and in the methods we use to produce it. Knowing the history of an AOK will help us understand the significance of its present shape. This will be more important in some areas than others. We shall argue that in some areas, such as literature and the arts generally, the historical dimension is crucial in making sense of the present. There is a clear sense in which the tradition and conventions are historically situated and the area itself accumulates knowledge.

In others, such as the natural sciences, some work can be done without a detailed knowledge of the past. But even here, the problems that motivate the quest for knowledge are historical and that quest should be viewed against the historical horizon of previous attempts and strategies for their solution. There is a sense here too that the sciences accumulate knowledge over time.

Failure to appreciate this history will result in knowledge that is difficult to share and therefore is at risk of remaining pure personal knowledge. There is the possibility that an individual might have all the attributes necessary for helping to contribute to an area of shared knowledge, but because they are not aware of past discoveries and problems that remain unsolved, they are not able to align their efforts to the needs of the knowledge community. The personal knowledge that this individual possesses will remain so – not because it is not communicable but rather because it is largely irrelevant to the concerns of the group.

The arts might be an AOK where this condition is most sharply illustrated. As we saw in Chapter 8 meaning and significance in the arts depend crucially on the historical context. An artist who does not know this context might find it hard to share his or her knowledge. The art might not be understood because it does not observe conventions that presuppose knowledge of the history of the particular artistic tradition. Worse still, it might not even be recognized as art. What counts as art might well depend on the history of art. Such a fate tends to befall students of art and music who, in the early days, find themselves inadvertently reproducing some of the artistic discoveries of the past. Quite often these early works are not deliberate copies of historical styles but are accidental ones borne out of an ignorance of the past. These works rarely make it into the canon because they are unintentionally derivative. The other possibility is that the work produced by the student is so out of line with the immediate past that its artistic merits are not recognized. The artwork probably has to have something in common with other artworks to be recognized.

In other AOKs, knowledge of history is bound up with knowledge of methodology. It is important for the individual to know what is accepted as evidence for a knowledge claim and what counts as rationality. These standards of shared knowledge have a historical dimension. We have already dealt with these issues under condition 5.

Exercise

30 Can you think of an example where a lack of shared historical knowledge has led to your being unable to share some aspect of personal knowledge that you hold?

The centrality of literacy

Our main thesis is that there is two-way traffic between shared and personal knowledge. A necessary condition for this knowledge flow is literacy. Here we mean literacy in a broad sense: the ability to access and pass on knowledge in written form. Literacy is crucial because shared knowledge is difficult to produce without it. But it is also necessary because it allows the individual access to shared knowledge – it allows the individual to become part of shared knowledge communities. As such, literacy plays an important part in allowing the individual to participate in important social activities such as politics. Moreover, access to shared knowledge gives the individual the possibility of the autonomy in decision-making that is necessary for a flourishing life – flourishing in the ancient Greek sense of *eudaimonia*.

Of course, shared knowledge can be constructed in a society that is not literate. There are many examples of societies with strong oral traditions. But don't forget that a lot of energy has to go into the construction and maintenance of an oral tradition. Take the example of the Micronesian navigators discussed in Chapter 11. These are people who can navigate their canoes between islands lying in the Pacific Ocean. They have knowledge of literally thousands of kilometres of unmarked, un-signposted water. They pass on their knowledge through the development of oral techniques. These involve encoding the knowledge in songs and ritual, group learning, testing sessions, and the use of mnemonics. They develop overlapping and redundant ways of connecting the knowledge encoded in different ways.

Passing this knowledge on is not the only challenge for non-literate societies. The knowledge system has to be instantly accessible for use (to solve the problems for which it was devised). The Micronesian navigators manage this through constant repetition and practice until the knowledge system becomes completely tacit.

Despite the possibility of sharing knowledge without the use of writing or other digital technologies, there is still a strong argument that text-based knowledge is much more efficient than oral knowledge-sharing. Writing costs less time and energy, and has a much greater outreach than oral methods. It is more stable because it does not depend on the active memory of human beings. Ancient writings can out-survive the peoples to whom they ever meant anything. Writing has a stability that oral traditions do not, hence the predominance of written text in our shared knowledge.

These considerations place a great emphasis on literacy as a key to accessing shared knowledge and all that goes with it.

In 1851, when Britain was the most literate nation in the world, 55% of women and 69% of men were literate. In 1970, it was estimated that nearly 60% of the world's population was illiterate. According to UNESCO in 2008, 78.9% of females and 88.2% of males were literate. The ratio of the literacy rate for females to that of males (the gender parity index) is also increasing (Figure 12.4).

Master navigator Mau Piailug teaches navigation to his son and grandson with the help of a star compass. The compass consists of an outer ring of stones, each representing a star or a constellation when it rises or sets on the horizon, and an inner ring of pieces of palm leaf representing the swells which travel from set directions. In the centre of the ring, palm leaves serve as a model outrigger canoe.

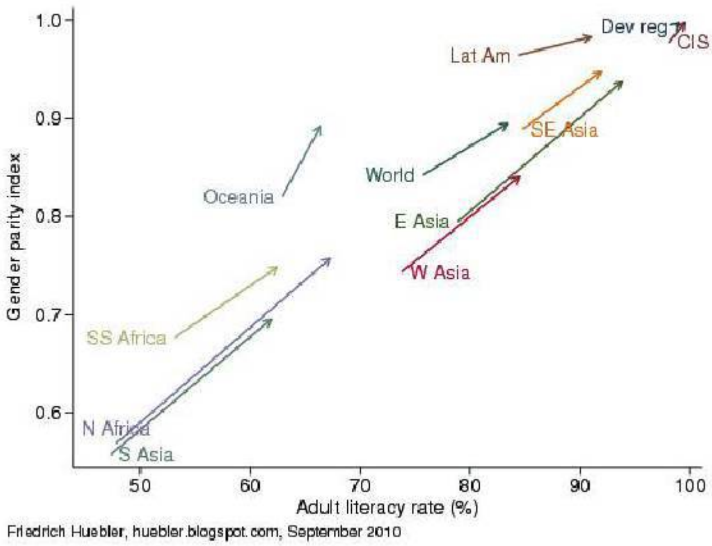


Figure 12.4 Adult literacy rate: gender parity index; UNESCO Institute for Statistics 2010.

If the written word makes it possible for individuals to access shared knowledge, and if access to shared knowledge makes it possible for individuals to live flourishing lives in which they can make their own decisions, then it is clear that literacy is of supreme importance. It allows the individual to access shared knowledge and empowers him or her to contribute to shared knowledge. There is a deep political theme here. Literacy provides the foundation for the democratic process. It allows the individual information about the decisions that affect him or her but that are made outside his or her immediate circle. It allows the individual to be able to contribute to the making of these decisions and acquire some measure of self-government.

The role of gender is also important. There is no part of the world where the gender parity index is above 1 (i.e. where women are more literate than men) but Figure 12.4 shows that there are areas that are doing well in this respect, such as Latin America, and areas that are not doing quite so well, such as North Africa and South Asia. Where women's literacy rate is lower than that of men, there are consequences in terms of the distribution of power between men and women. Cultures that restrict women's literacy also restrict women's ability to achieve personal autonomy and curtail their political influence.

Exercise

31 Find an example where a political or religious authority has tried to prevent access of a particular group to literacy. What are the consequences of this restriction in terms of shared knowledge and in terms of political power? What strategies has the disenfranchised group employed to change the situation?

Personal knowledge: what does it mean for me?

Each of the AOKs we have investigated in this book has the capacity to shape our personal knowledge and through this change our personal perspective. In this sense, the move from shared knowledge to personal knowledge is profoundly transformative. It can literally change one's life. While this sounds generally positive it is worth reflecting that we human beings do not always embrace change. Change means encountering the new. It is challenging. It requires us to go outside our comfort zones. This is particularly striking in school where we face these challenges every day. This might be what is meant by the phrase 'risk takers' in the IB learner profile. The flow of knowledge from the shared to the personal can be painful sometimes, as well as being immensely rewarding.

One area in which we have already explored the impact of shared knowledge on the individual is in the area of religious knowledge. Perhaps one of the most important functions of religious knowledge is that it shapes personal knowledge and allows the formation of a personal perspective on some very large matters, namely, the cosmos itself and its relation to the individual. The American thinker William James (1842–1910) in his book *Varieties of Religious Experience* seeks to establish the basis for a rational science of religion. At the end of the book he writes *I do not see why a critical Science of Religions of this sort might not eventually command as general a public adhesion as is commanded by a physical science* (James 2009). He expresses the notion of religion connecting the individual with something much bigger in the form of three very broad principles.

> “1 The visible world is part of a more spiritual universe from which it draws its chief significance.
> 2 Union or harmonious relation with that higher universe is our true end.
> 3 Prayer or inner communion with the spirit thereof – be that spirit, God or Law – is a process wherein work is really done.”

James was a psychologist as well as a philosopher, and he adds two psychological characteristics of religion.

> “1 A new zest which adds itself like a gift to life, and takes the form of lyrical enchantment or of appeal to earnestness and heroism.
> 2 An assurance of safety and a temper of peace, and, in relation to others, a preponderance of loving affections”

James also thought that, given that religious questions were still open, they could not be settled by appealing to other AOKs such as the natural sciences. He also thought that they were not questions which one could easily duck – even agnosticism is still a religious position and a definite decision that one makes. Thirdly, he thought that such questions were of vital importance to the whole way in which an individual lives his or her life. Given these features of religious thought, James came to the conclusion that it was up to the individual to decide such matters on faith alone.

As TOK students we can (and should) be critical of the substance of religious knowledge just as we can (and should) be critical of other AOKs. But we might observe, more generally, that the goal of understanding the significance of our individual lives within the context of a larger world is something that we can pursue using all our areas of knowledge.

This idea can be cashed out in terms of the IB learner profile. Understanding our relation to the rest of the world specifically through all AOKs might indeed allow us to be:

- inquirers
- knowledgeable
- thinkers
- communicators
- principled
- open-minded
- caring
- risk-takers
- balanced
- reflective.

The TOK analysis of the shaping of personal knowledge by shared knowledge can be used to examine the ways in which custom and tradition might produce social structures that might marginalize groups within society. We have seen how lower literacy rates among women deny them equal access to shared knowledge, and produce an obstacle to empowerment over their own lives and a consequent loss of autonomy. It is not impossible that these customs and traditions are themselves an example of shared knowledge. In other words, we have the idea that shared knowledge produces social structures that influence the access to further shared knowledge (Figure 12.5).

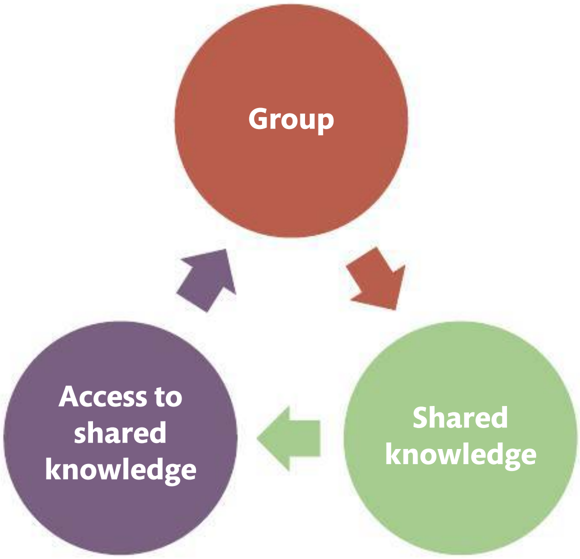


Figure 12.5 Shared knowledge can control who has access to it.

More generally, we can use the methods of TOK to construct a critique of precisely those customs and traditions that produce social structures that marginalize one group rather than another. This has a profound impact on personal knowledge. We might take for granted the structures of society in which we are embedded. We might even view them with a sentimental or nostalgic attachment, or with a fondness borne out of familiarity. But these very structures might create imbalance in access to shared knowledge, and skew the playing field one way or the other. French philosopher Michel Foucault remarked that when confronted with a system of knowledge, we must ask in whose interest it is constructed and whom it marginalizes?

Exercises

32 Think about how contact with shared knowledge allows the formation of the attitudes listed in the IB learner profile. How might these attitudes help produce a life in which the individual is empowered to make decisions and take responsibility for their outcomes, at the same time contributing to the common good and the life of the community?

33 How might we resolve conflicts originating in different religious perspectives?

34 In your own education, what challenges have resulted from the impact of shared knowledge on personal knowledge? How have you managed the transformation inevitably wrought by the process of education?

35 What effects can the transformation brought by education have on an individual's personal relationships?

36 Do you agree with the implications of Foucault's idea that any system of knowledge benefits one group and marginalizes another?

37 Can you find other examples of systems of shared knowledge that produce social structures that marginalize one group or another?

12.4 Conclusion: perspectives and international-mindedness

In this chapter, we have seen how the distinction between shared and personal knowledge might be a useful tool in TOK. We have identified six conditions that must hold for knowledge to be shared. These include the requirement that it exists in a form that is transportable – which usually means that it is linguistic in character. There also have to be good incentives for sharing it, and have a pool of shared concepts and methods that allow others access to it. In many cases, current knowledge only makes sense against a shared historical background. When these conditions are satisfied the resulting knowledge has a somewhat objective character. There are public procedures for validating knowledge claims, deciding on the sufficiency of justification, and agreeing on norms for rationality. Shared knowledge is likely to be relatively stable over time. Moreover, some of the greatest TOK inventions have been those that allow us to share knowledge. These might include the invention of writing, of the moveable-type printing press and, of course, the invention of digital computing technology. These conditions make up the structure of the knowledge framework discussed in Chapter 3 and they are used to structure AOKs in this book.

We might go so far as to suggest that shared knowledge, especially linguistic and cultural knowledge, might come first in the development of a child before personal knowledge (Exercise 2, page 355). Through acquiring a language and a sense of what is significant, the child might then be able to inquire within him- or herself, and gain personal knowledge. Maybe children are not born with fully formed ideas, opinions, desires, goals, and wishes. Perhaps these aspects of personal knowledge space are socialized and only come into existence through contact with others.

Personal knowledge cannot be so easily shared. It cannot be easily formulated in natural language and as a result cannot be transported easily. It is more likely to be 'knowing how to do something' – procedural knowledge – rather than knowing that something is the case – propositional knowledge. Personal knowledge is limited in space and time – it is local to the individual and ceases to exist when he or she dies. Personal knowledge is the result when one or more conditions for sharing knowledge fail. But rather than thinking of personal knowledge as failed shared knowledge, we might want to consider its strengths such as directness, idiosyncrasy, subjectivity, and creativity. Personal knowledge might be produced using a cluster of WOKs such as memory, sense perception, faith, imagination, and emotion. It almost certainly comes into being through practice and habituation.

The distinction between shared and personal knowledge, like many others, is not clear-cut and allows two-way traffic across its boundary. We have seen how personal knowledge can become part of shared knowledge if it satisfies the requirements of a particular subject discipline or AOK. We have also seen how shared knowledge can become interpreted within the particular situation of the person and can hence be personalized.

There might be a number of intermediate stages between personal knowledge and shared knowledge. We have hinted at the existence of local knowledge that belongs to a community but does not make it to the world outside. In this case, the conditions for sharing might be satisfied for the local community but one or more might fail for the world outside.

Access to knowledge produces perspectives. By this we mean a view of the world, a framework for making value judgements, and a horizon against which to judge significance. Personal knowledge produces a personal perspective. This might be a result of an individual's personal experiences of life and autobiography. At the same time, an individual is a member of many groups sharing knowledge. He or she is a member of an ethnic or cultural group, a member of a gender group, perhaps a member of religious, political, and philosophical groups depending on the knowledge that he or she shares. He or she might be a member of other groups by virtue of a profession or occupation. Each knowledge community associated with a particular type of shared knowledge might produce a perspective. These perspectives might collide or produce contradictory views of the world. Ultimately, it is up to the individual to make sense of, understand, and resolve these conflicts.

The existence of perspectives associated with particular knowledge communities assembling particular shared knowledge leads naturally to a central theme of the IB programme – international-mindedness. Using the terminology of this chapter, we can state that an **international-minded** view is one which acknowledges two things.

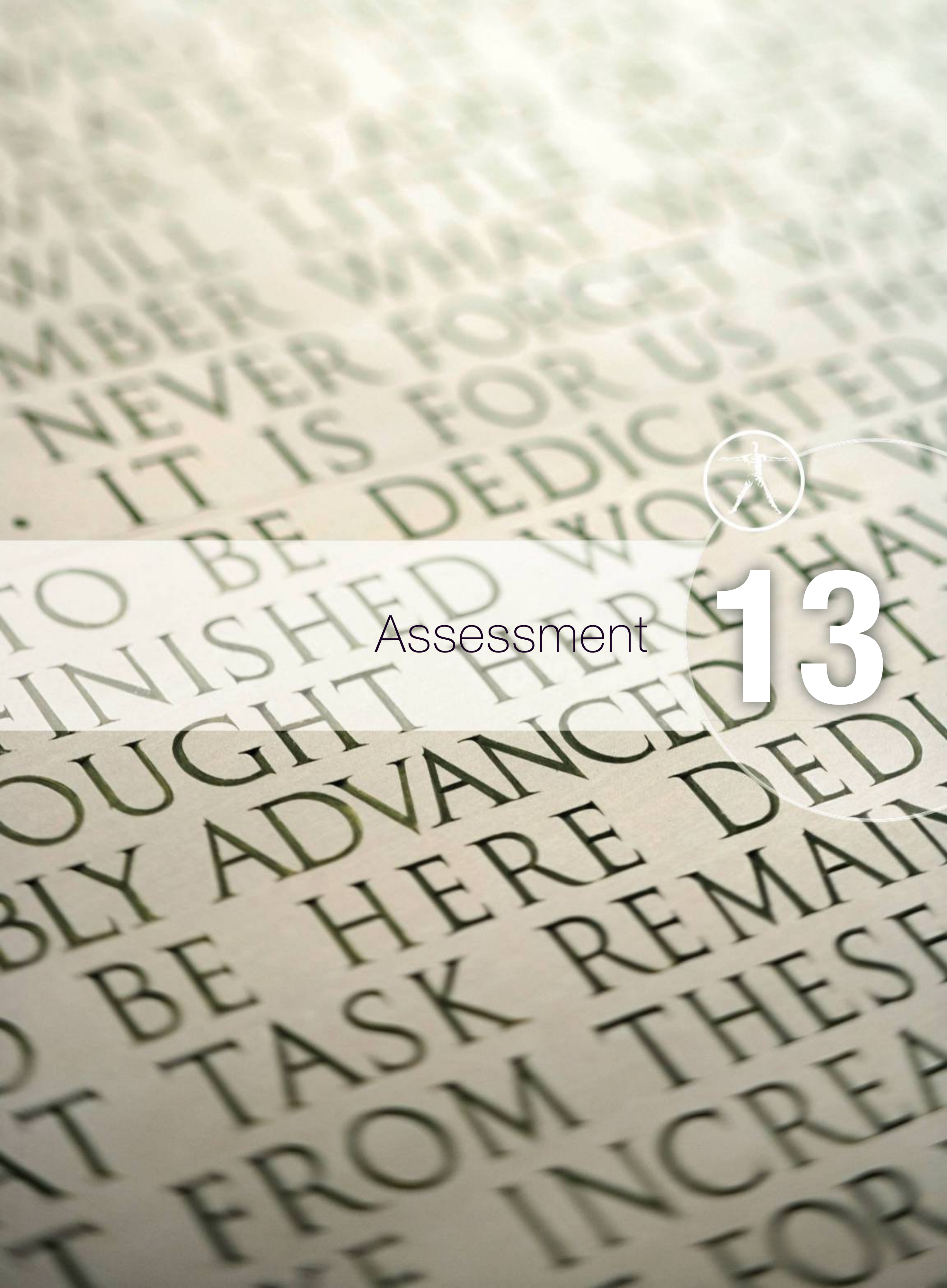
1 Membership of a particular shared knowledge community might provide a particular perspective on the world.
2 A given problem might be solved using quite different systems of knowledge belonging to these different knowledge communities.

Different solutions suggested in point 2 might turn out to be equivalent. For example, it is perfectly conceivable that there might be different ways to formulate physics – different maps of the physical world. But we are all answerable to the same physical reality and, if these different systems of physical knowledge do their job properly, then they should all solve the questions we ask of them in an equivalent manner. But if we are dealing with different social realities – realities containing social facts – then it is possible that the solutions are radically different. This might be what is meant by the final part of the IB mission statement (2002):

> “These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.”

One way in which the IB student might do this is to engage in the sort of TOK analysis of knowledge systems that reveals their effects on personal knowledge. It might be that knowledge systems produce social structures that act to marginalize one group and maintain the dominance of another. This might mean, as we saw in the discussion of literacy, that one group is denied access to certain forms of shared knowledge by another. It might be that this is the inevitable consequence of any system of shared knowledge.

The conclusion of this chapter is that we are in no position to be complacent about our particular favourite knowledge systems. For example, non-Western systems of knowledge might do the job expected of them just as well. They might approach the task of understanding the world from a different perspective but, and this is the point, they could still be right. This doesn't mean that we are committed to a wishy-washy relativism – that anything goes and all solutions are equally valid. Rather, it means that there are different ways of drawing our maps, but there are still better and worse ones. We might be interested in answering different questions, we might have different linguistic and conceptual resources for making our maps, or we might be mapping different social realities, but we are still accountable to them. The maps still have to work even if they employ different methods and mapping conventions. This applies as much to our maps of our personal knowledge as much as it does to the maps of shared knowledge. The job of the TOK student is to work out what it is about the way in which the map is drawn that enables it to do the job expected of it. That is what this book is about.



13 Assessment

On previous page – Engraving of Abraham Lincoln's Gettysburg Address at the Lincoln Memorial. Lasting just over two minutes, and containing only 272 words, the speech is regarded as one of the greatest in American history.

13.1 Introduction to assessment

“But there are advantages to being elected President. The day after I was elected, I had my high-school grades classified as Top Secret.”

Reagan, 1986

It would not be surprising if you have approached this final chapter with mixed feelings. On the one hand, the word 'assessment' can cause a shiver of anxiety, for it implies judgements being made about your work, which you may feel reflect more broadly on you as a student and person. On the other hand, you will be used to the idea that assessment is an unavoidable and a consequential part of your IB experience, and so it makes sense to treat it seriously and make sure that you are fully prepared. You may also relish the opportunity to show your capabilities in a public fashion to classmates, teachers, or examiners; you may want to be able to say, 'Look, this is what I can do.'

Exercise

1 How would you feel about enrolling on a course that was not going to be assessed? (Maybe this has been the case for you in the past.) Would you prefer this to what you find in your IB studies (remember that even CAS is assessed)? Why or why not?

Assessment is not a simple matter. We need to consider several things.

- Are we assessing whatever we intended to assess in the first place? (This is called validity of assessment.)
- Are we confident that what we assess can actually be measured in a fair and consistent way? (This is called reliability of assessment.)
- Why do we want to do this assessment in the first place? (This is called the purpose of assessment).
- Who should be doing the assessing? (This is called the choice of assessor.)

Each IB diploma programme course mandates assessment tasks that are directly related to a written syllabus that sets out the requirements for learning. This formal description is intended to help set standards of performance that universities and colleges can trust when making offers of admission. Therefore, the tasks must measure what these institutions are interested in, and the measurements must be consistently accurate. Such assessment is often called summative, because the intention is to measure what you have learned as a whole at the end of a particular stage in your education.

Exercise

2 Do the following terms in bold all have the same meaning? (You may think of others.)

The teacher or examiner will **assess** your work.

The teacher or examiner will **judge** your work.

The teacher or examiner will **mark** your work.

The teacher or examiner will **grade** your work.

The teacher or examiner will **evaluate** your work.

Most summative assessment in the IB diploma takes the form of examinations that are assessed by examiners independent of you and your school. But this is not the only form of assessment that takes place. Perhaps a teacher has encouraged you to evaluate your own work, or has created a situation where students take a critical look at each other's material.

Exercise

3 What would be the advantages and disadvantages if your work were assessed by each of the following?

Assessor	Advantage	Disadvantage
teacher		
examiner		
self		
peers		

You might also think about how the task and the assessment methods are related. Consider how the IB diploma includes different types of assessment task.

Type	Examples
formal examinations	final IB examinations
externally-assessed written tasks	extended essay, written assignments in groups 1 and 2, TOK essay
teacher-assessed written tasks	group 4 investigations, group 3 coursework, mathematics explorations and projects
teacher-assessed oral tasks	language orals, TOK presentation
self-assessed tasks	CAS self-evaluations, TOK presentation self-evaluation

Your responses to some of these tasks are assessed using different instruments, such as strict mark schemes (e.g. for science or mathematics papers) or assessment criteria with descriptor levels (e.g. for literature essays or history assignments).

Exercise

4 What might be the reasons for the differences in style of assessment instruments for:

a the sciences and mathematics

b the humanities in general.

Because there are so many possible responses that can plausibly be offered to knowledge questions, it is inappropriate to judge TOK work against the kind of specific mark schemes or analytic criteria found in other subjects. Instead, your TOK assignments are judged using what is called a global impression mark in which the various aspects of performance are considered together.

13.2 Assessment in TOK: an overview

The final summative assessment in TOK (i.e. the scores that contribute to your final IB mark or points) has two components as shown in Table 13.1.

Table 13.1 Components of the summative assessment in TOK.

	Written essay	Oral presentation
Assessment by	examiner (external)	teacher (internal)
Maximum possible mark	10 (weighted to 2/3 of the total assessment)	10 (weighted to 1/3 of the total assessment)
Size of task	1600 words	approx. 10 minutes per presenter
Origin of topic/title	from an IB prescribed list	free choice

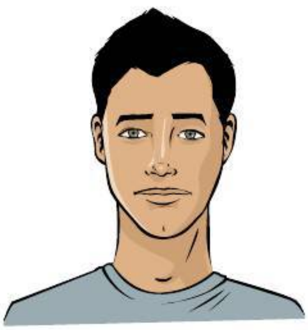
Exercise

5 Why do you think that TOK assessment has been arranged as shown in Table 13.1? Do you think it is a good arrangement?

Do you have sympathy with some of these points of view? Which ones? What is your view on assessment in TOK?

Consider the comments below, made by students after they completed the TOK course. Now, as you read about each student, imagine you are their best friend. What responses would you offer to the questions posed?


Akosua


Frank


Karen


Nishant

- Before she started the IB diploma, Akosua was looking forward to the TOK course as an opportunity to enter into heated debate on many interesting issues. In keeping with her combative character, she thought the general idea was to defend her own views and try to attack and 'beat' those of others. However, once the course began, she quickly came to realize that this was not really what was expected of her. Becoming disillusioned with this, she found herself muttering to friends that 'there are no answers in this course', with everyone seemingly entitled to whatever view they find most attractive. If there are no answers that we can agree on (and seemingly no credit for winning debates), she thinks to herself, then there should be no assessment.

  Q: What would you say to try to convince Akosua that TOK assessment is legitimate?
- Frank is a smart and pragmatic student who thinks that the amount of effort invested in something should be proportional to the reward directly available for it. In his life, he often finds himself calculating costs and benefits before making

decisions. Consistent with this, he directs his workload while paying careful attention to the mark allocation for each component of the diploma. Sometimes, in discussions with his friends, he finds himself arguing further that the points or grade associated with courses and their components are accurate indicators of the intrinsic value of these things themselves, and therefore the designers of the IB diploma basically think along the same lines as he does.

Q: What arguments or examples could you use to undermine the idea that the potential reward in TOK is not always proportional to its value?

- Karen is a very fair-minded and uncomplicated student who thinks that credit should go where credit is due. She normally performs quite well in her IB diploma work but sometimes she is frustrated and baffled when, despite all of her hard work, she fails to achieve the very top grade. She believes assessed tasks need always to be very clearly spelled out so that students can know exactly how to respond to them, and feels that sometimes this doesn't happen. Indeed, when she asks teachers for extra feedback on her work, they seem to be unable to tell her precisely what to do to improve it. For her, objective assessment is the only acceptable assessment.

  Q: What could you say to Karen that might persuade her that assessment is still worthwhile even if there is an element of doubt in the judgements made?

- Nishant is a conscientious student who can always be counted on to give all tasks his honest best. He feels he has made a lot of progress during the TOK course and is quietly proud of some of his contributions to class discussion, which other students have recognized as valuable. He is sure that, in one way or another, some of them have gained from his presence in the classroom. What worries him is that he gets nervous when deadlines approach and finds final assessment tasks rather stressful. He suspects that he will not perform so well under such circumstances.

  Q: How might you reassure Nishant and give him confidence?

Now reflect on what you think about these matters. Do you agree more with what the students thought or with the responses you suggested for them? You could discuss the issues raised here with other students in your class to get a feel for overall opinions.

13.3 TOK essay and TOK presentation: similarities

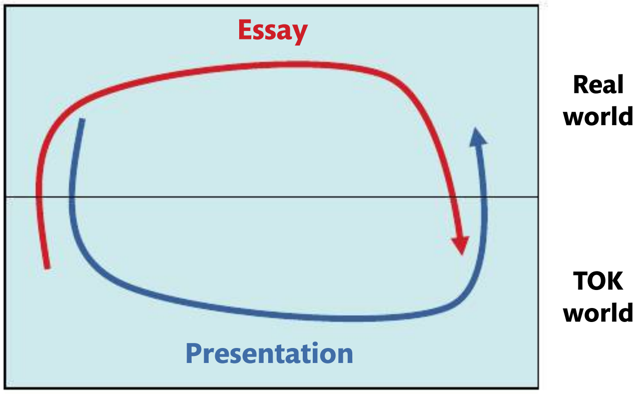
As we near the end of this book, with our minds focused on how best to showcase what has been learned, it's worth taking a look at the objectives of the TOK programme, as these set out what you are expected to be able to do by the end of your course. You can find these on page 17 of the TOK subject guide.

In a nutshell, you are expected to be able to provide some answers to knowledge questions which concern the structure of the areas of (shared) knowledge, and the roles that WOKs play in them and in the construction of personal knowledge. You are expected to provide and examine justifications for the knowledge claims you make – whether these claims are factual in nature or constitute answers to knowledge questions. And you need to demonstrate your awareness and understanding that there can be different perspectives from which to approach these knowledge questions – and that such perspectives can lead to differing answers.

Two worlds

One way of thinking about TOK is to consider it an activity that connects two worlds. With respect to these worlds, there is a rough and imperfect symmetry between the two tasks set for the TOK student. The essay assignment is presented as a general and rather abstract title, and the candidate is expected to flesh out his or her response with both logical argument and specific examples. These examples will help to shed light on the more general question posed in the title. To some extent then, the task is to move from the world of TOK concepts to the more practical world in which knowledge is at work, and then back again. With the presentation, the starting point is a single real-life situation which can be used to illustrate wider and more general points about knowledge. Having been developed, these points can then be applied to the original real-life situation and possibly some others too.

Figure 13.1 How TOK essays and presentations bridge two worlds.



This characterization of the two assessed components has its limits, and should be considered only as a broad way of understanding how they complement each other (Figure 13.1).

At this point, it is worth highlighting a key skill that is common to the two assessment components, not to mention important in TOK discussion as a whole: the weighing of knowledge claims.

Weighing knowledge claims

In your essay and presentation, you will be putting forward knowledge claims. Some of these claims will be factual in nature (e.g. the crime rate has decreased in New York City – a claim 'in' knowledge). Others will be claims concerning the concepts of TOK (e.g. scientific knowledge develops in a cumulative fashion – a claim 'about' knowledge). How you word the claims you make is very important. Both of the claims above are stated in an uncompromising way – that the contents of the claims are certain. But claims can be couched differently. For example:

- X is certain – it cannot be otherwise.
- X is probably the case – but there is a small chance that it is not.
- X is as likely as not.
- X is unlikely but is nevertheless possible.
- X is not possible.

This spectrum also exists regarding the confidence we have in making various claims. For example:

- We know X.
- We are fairly sure that X is the case.
- We are unsure whether X is the case or not.
- We are fairly sure that X is not the case.
- We know that X is not true.

It is important that you do not make stronger claims than you need for your arguments to work. Be prepared to use modal forms of expressing your claim. For example:

- It is possible that X …
- X is consistent with the evidence.
- It could be argued that X …
- X is not self-contradictory.
- X is a logically consistent with Y.

While each of these expressions makes a claim, it is much weaker than the original one. Saying that X is *possible* is much weaker than saying that X is *true*. Saying that X is consistent with the evidence is not the same as saying that X must be the case. Rather, it says that X is a possible explanation of the evidence *but doesn't have to be*. Get used to using the appropriate strength of claim for the work you want it to do.

Sometimes arguments rest on factual claims and it is particularly important that you get the facts right (and that means checking your sources and giving correct references). But most of the time, factual claims belong to more complex examples that make up a part of the analysis.

In keeping with the intended spirit of the TOK course, there are a few features that both assessment tasks ought to exhibit – these are discussed below.

A spirit of exploration

'TOK talk' is intended to be exploratory. Think of your work as a discussion between a number of different points of view rather than a statement of an unchanging truth about the universe. So organize your response in such a way as to allow you to play around with a number of different ideas without making commitments that tie you to a point of view that you do not hold.

A sense of progress

Your work for assessment is expected to enlighten the reader or audience – metaphorically shedding light on its subject matter. This means that it should advance the argument in some sense. There should be a feeling that the reader understands a little more about the nature of a particular TOK problem or knowledge question afterwards. Of course, this will require that some solid conclusions are reached after the more playful discussion – even if they are only tentative. The appropriate attitude to be adopted is exploration and discussion rather than dogmatic defence of previously established results or ideas.

The right sort of persuasiveness

Everyone would like their work to persuade others, but we must be careful to try to distinguish, as far as is possible, between different origins of persuasiveness. In the final analysis, the audience or reader should be swayed by content only, but of course the content cannot be cleanly separated from the way it is presented. The guiding rule must be that, while content and form are intertwined, there can be no compromise on the quality of the content, and the primary role of the form (including technical aspects of the presentation) must be to deliver that content faithfully to the recipient.

Self-containment

This is an important point because it marks out an important characteristic of the TOK assessments. While you might want to refer to external sources, the mere quoting of these will not be sufficient to guarantee validity of argument in a TOK essay. Evidence should be presented within the task and evaluated carefully. Just because someone famous has staked their reputation on a particular statement does not make it immune to TOK criticism.

13.4 TOK essay and TOK presentation: differences

Having looked at some of the features and attitudes that should be apparent in both assessment components for TOK, it is time to look at how the essay and presentation are distinct. Consider Table 13.2 as a starting point.

Table 13.2 differences between the TOK essay and presentation.

	Presentation	Essay
Pace	set by presenter (producer), not listener	set by reader (consumer), not writer
Durability	ephemeral (gone when done)	indefinite (can be re-read)
Relevant audience skills	listening	reading

In essence, the balance of power between producer and consumer is different, and this must affect the ways in which each format is exploited. This is something to remember while reading the rest of this chapter.

13.5 The TOK essay

Introduction to the TOK essay

It has been claimed that the essay genre is on the rise in recent times. But it is to the 16th century and Frenchman Michel de Montaigne that we must look for the origins of the modern essay. Montaigne set out to document his ideas and opinions on a multitude of topics – from friendship to cruelty, from education to lying, from smells to cannibals. He thought of each piece of work as a means to attempt (*essayer* in French) to reach the truth about the matter in question, and thus the form became known as an *essai*.

It is worth pursuing the etymology of the essay a little further. In Italian we have *saggio*, as in sampling, tasting; and going back to Latin we have *exagere*, which connotes a process like weighing or sifting. Running alongside all of these descriptions, is the idea of engaging the writer, the first person, openly with whatever topic is on display. American writer Christy Wampole (2013) puts it this way – that in essays:

> … everyday phenomena — what we eat, things upon which we stumble, things that interest us — rub elbows implicitly with the Big Questions …

Perhaps this is an echo of the imperative in the TOK essay to link together items of personal experience with the conceptual analysis of the TOK course.

The American essayist Phillip Lopate (2013) has discussed how these ideals of essay writing can easily be bent into the service of dogmatic defence of a particular viewpoint. Referring to his daughter's experience with college applications, he writes:

> I got it that they wanted her to sharpen her rhetorical ability. Argumentation is a good skill to have, but the real argument should be with oneself. ... a classic essay technique is to stage an inner debate by thinking against oneself. Doubt is my boon companion, the faithful St Bernard ever at my side. Whether writing essays or just going about daily life, I am constantly second-guessing myself. My mind is filled with 'yes, buts', 'so whats?' and other skeptical rejoinders. I am forever monitoring myself for traces of folly, insensitivity, arrogance, false humility, cruelty, stupidity, immaturity and, guess what, I keep finding examples.

It is the acceptance of uncertainty and a sort of therapeutic satisfaction derived from it that is often cited as a hallmark of a good essay.

But Montaigne's essays often show a looseness of structure, an apparent 'pottering about' the topic rather than the rigorous examination of it. And it is in this respect that we in TOK must part company with him.

CHALLENGE YOURSELF

To what extent does each of the following diploma tasks exhibit the essay features raised in this section?

- Language A written assignment
- Language B or *ab initio* written assignment
- Extended essay
- History investigation

'Think of an essay as a collection of tweets, only joined together.'

What would Montaigne say?

CHALLENGE YOURSELF

There have been suggestions among TOK examiners and teachers that the essay is an ineffective way of measuring TOK skills – even that perhaps it is not fit for the world of the 21st century. Would you agree with this? If so, what alternative style of assignment could fill the role of principal assessment tool? Keep in mind that it would have to measure performance according to the TOK objectives.

Advice for planning and writing your TOK essay

As two-thirds of the assessment for the course, the TOK essay is the main way in which the IB will assess your TOK ability.

It is important that you understand the nature of the essay task. Read thoroughly the assessment instrument for the essay (Figure 13.4) and understand what is meant by the paragraphs at the top of each. If possible, try reading a TOK essay (preferably written by someone else) from the point of view of the examiner. Give it a score according to the assessment instrument.

Having prepared yourself by becoming familiar with the nature of the good TOK essay, it is strongly recommended that you approach the actual task itself according to Figure 13.2.

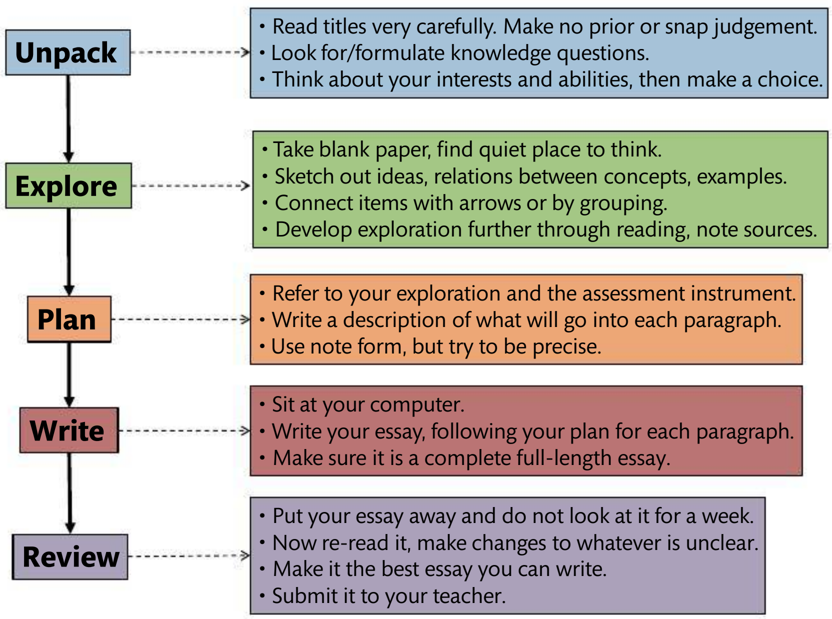


Figure 13.2 A 5-point plan for writing your essay.

Unpack

You may find that the wording of some titles on your prescribed list from the IB makes them immediately recognizable as knowledge questions. Whether or not this is the case, you ought to be able to recognize the knowledge questions connected to each title and lurking just beneath the surface – sometimes a little work is required in order to tease them out.

Remember that knowledge questions are open questions and thus tend to deal in uncertainty and controversy. If you don't think that a particular title suggests anything problematic or controversial about knowledge, then you should almost certainly look elsewhere.

In this unpacking stage, you should keep an open mind and examine all of the titles on your list. Do not make a snap judgement about which of them would be best for you, because it is often the case that the most tempting title is much more problematic than it appears.

For each title, ask yourself the following questions.

- What are the key TOK concepts in this title?
- Are they well formulated into a knowledge question as they stand, or will I need to do a little work in order to derive knowledge questions directly connected with them?
- Which AOKs and WOKs are going to lend themselves readily to answering these knowledge questions?

Explore

The next stage is to explore how an answer to the title might look. This exploration is best carried out on a large sheet of paper or a suitable computer canvas. The following points should be included.

- Make your exploration in the form of a mind or concept map radiating out from the central knowledge question.
- Find examples that illustrate the knowledge question – try to use real examples if possible. It is a good idea to have a couple of in-depth examples taken from contrasting AOKs.
- Identify important concepts to introduce in order to help the reader understand these examples – don't use dictionary definitions. Illustrate your definitions with (short) examples.
- Identify two (or more) sides to the controversy or positions regarding the knowledge question.
- Find arguments that support each position or side of the controversy.
- Evaluate these arguments (look for their strengths and weaknesses) – decide which seems more plausible on balance.
- Identify any assumptions that underlie the different arguments, or even your whole analysis – these may be universally necessary assumptions or those that arise from your own perspective.

It's very important to remember to carry out this exploration in your work. Some students go straight from unpacking the title to writing a plan, or even to writing the essay. The exploration allows you to expand your thinking so that you have the ideas and materials to play with and to insert into your plan. Without an exploration, the plan often dissolves into 'I will find an example to illustrate this point', etc.

It can be a good idea to leave your work for some time at this juncture so that you might return to it fresh and better able to see points in a different light.

It is probably wise to complete this stage for several titles before making a final choice, so that you can see in advance which will afford you the most fertile response.

Plan

The next stage is to convert your best exploration into an essay plan. This can be achieved by drawing up a macro-structure of introduction, development and conclusion, and then sub-dividing the material you want to cover into individual paragraphs. Your plan should indicate clearly the purpose of every paragraph of your essay. The idea is to convert your multi-dimensional exploration into a linear sequence of paragraphs that carry its meaning in a logical order.

Write

If you have rigorously carried out each of the stages above, you will be ready to write the essay. Here are some pieces of advice concerning the writing that relate to particular aspects of the essay.

- **Knowledge questions** – Make sure that your essay is always focused on the knowledge questions you have identified in the essay title. Think of knowledge questions as stepping stones in your analysis – it should always be possible to trace your path back to the title through these markers in your essay. Note that there is no need to spell out all of your knowledge questions as questions in the text; they can be formulated in different ways in order to allow the essay to flow.
- **Introduction** – Make sure the key concepts you use are discussed in the introduction, including some indication of the knowledge questions to be addressed. You should give the reader some helpful signposts here about how you will deal with the knowledge questions connected to the title.
- **Development** – The arguments and main examples should appear in the development, or main body, of the essay. Try to use real **examples** wherever possible – taken from a variety of sources. Make sure that you tell the reader what each example is supposed to illustrate. What is it an example of? There should be some anticipation of possible weaknesses in, or objections to, the arguments that you present. This would include possible **counterclaims** that should be thoroughly evaluated. You should not just leave them hanging – this implies inconsistency: why would you give priority to any particular position if there are valid arguments against it? Make sure that the reasoning you employ is valid and that all statements are supported. You should give arguments to show why you are warranted to assert what you do. Consider the conclusions that arise from each argument and what they might mean in a wider context – what might be the **implications** of the conclusion if it is true?
- **Conclusion** – The conclusion should state an evaluation of the arguments presented and the implications of this. There should be an answer to the question, so what?
- **Perspectives** – Show an awareness of other perspectives that are possible on the subject matter of the essay. Is there an alternative way of looking at things with respect to gender, life experience, culture, socio-economic class, education, or geography? How sensitive are your arguments to these other perspectives? Are the concepts you are treating in the essay particular to one or another perspective?
- **Clarity** – Try to think clearly and write clearly, and avoid using complicated language. TOK examiners like precise language so make it crystal clear what you mean when you use a term.

Figure 13.3 may help in providing an overview as to essay structure and the key aspects that need to be addressed:

Compare this diagram with the assessment instrument for the essay (Figure 13.4). Note how each of the aspects is reflected in the descriptions of performance. Aim for the top description (9–10) and re-read it regularly during the process of preparing and writing your essay. Although you should pay attention to the two segments (understanding knowledge questions and quality of analysis of knowledge questions) of each performance level description, they are interlinked and not independent aspects of the work.

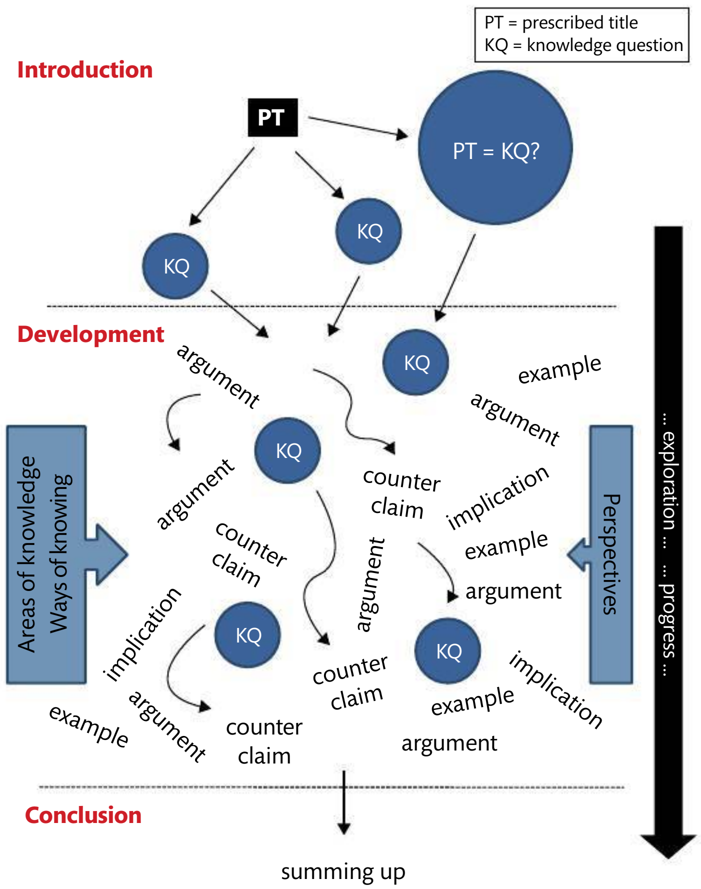


Figure 13.3 TOK essay: structure and key aspects.

The possible characteristics mentioned at the bottom of the instrument are intended for use primarily by examiners in order to develop a common vocabulary for describing essays that achieve different but distinct levels of performance.

Figure 13.4 IB assessment instrument for the TOK essay.

TOK essay assessment instrument

Does the student present an appropriate and cogent analysis of knowledge questions in discussing the title?						
Aspect	Level 5 Excellent 9–10	Level 4 Very good 7–8	Level 3 Satisfactory 5–6	Level 2 Basic 3–4	Level 1 Elementary 1–2	Irrelevant 0
Understanding knowledge questions	There is a *sustained focus* on **knowledge questions** connected to the prescribed title and are well chosen– **developed** with *investigation* of **different perspectives** and **linked** *effectively* to **areas of knowledge** and/or **ways of knowing**.	There is a *focus* on **knowledge questions** *connected* to the prescribed title– **developed** with *acknowledgment* of **different perspectives** and **linked** to **areas of knowledge** and/or **ways of knowing**	There is a *focus* on *some* **knowledge questions** *connected* to the prescribed title–with *some* **development** and **linking** to **areas of knowledge** and/or **ways of knowing**	*Some* **knowledge questions** that are *connected* to the prescribed title are considered, but the essay is largely *descriptive*, with *superficial or limited* **links** to **areas of knowledge** and/or **ways of knowing**	The essay has only very limited relevance to the prescribed title—relevant points are *descriptive*.	The essay does not reach a standard described by levels 1-5 or is not a response to one of the prescribed titles on the list for the current session.
Quality of analysis of knowledge questions	**Arguments** are *clear*, supported by **real-life examples** and are *effectively evaluated*; **counterclaims** are extensively *explored*; **implications** are *drawn*.	Arguments are *clear*, supported by **real-life examples** and are *evaluated*; some **counterclaims** are identified and *explored*.	*Some* **arguments** are *clear* and supported by **examples**; some **counterclaims** are *identified*.	Arguments are offered but are *unclear* and/ or *not supported* by *effective* **examples**.	**Assertions** are offered but are *not supported*.	
Some possible characteristics						
	Cogent Accomplished Discerning Individual Lucid Insightful Compelling	Pertinent Relevant Thoughtful Analytical Organized Credible Coherent	Typical Acceptable Mainstream Adequate Competent	Underdeveloped Basic Superficial Derivative Rudimentary Limited	Ineffective Descriptive Incoherent Formless	

There is a raft of common habits and tendencies to be avoided in essays.

- Meaningless opening statements such as 'Since the dawn of time man has been obsessed with knowledge.' The essay does not need a romantic lead-in; you can start it straight away.
- Unsubstantiated generalizations such as: 'Americans see wealth itself as a moral good.' And be very careful with the use of the word 'all'. Ask yourself whether it is necessary for your essay to make such a sweeping statement.
- Pseudo-examples. These are fictional examples usually based on stereotyping: For example, 'An Israeli would regard the wall as necessary while a Palestinian would see it as an infringement of basic liberty'. In such as situation, find a statement by a real Israeli and a real Palestinian. Worse are examples that typecast AOKs: 'A scientist would look at the statue and try to work out the forces in it while an artist would react emotionally to it.' Avoid these at all cost.
- Dictionary definitions. Concepts are best dealt with in your own terms. It is often useful to see a concept in comparison with another related concept and think of examples of one that are not examples of the other. Small examples that illustrate the way in which you see concepts are very useful. On the whole avoid being 'bogged down' by definitions. If you had to define 'art' before writing an essay on it, then you would hardly get anywhere at all.
- Non-critical borrowings from textbooks – especially those designed specifically for TOK (including this one). Textbooks used in an authoritative way without critical evaluation often lead to poor TOK essays. The examiners are interested in what *you* have to say; not the author of a textbook. If you use a textbook, make sure you stand back and look critically at what is said. Make sure that you comment on any such sources you use in the essay. Just because a source backs up your argument that does not mean that you have no further work to do.
- Giving up on knowing. Steer well clear of identifying a problem with knowledge and then concluding that we can't know anything (in a particular AOK). This is almost certainly not true. Try to explore the nature of the problem you have found and evaluate its effect on the AOK in question. It might only have the effect of weakening certain knowledge claims or limiting their scope or applicability.

Review

Once your essay is complete, shelve it for a week. Don't be tempted to look at it for this period. Then take it out and read it carefully again. As with your exploration earlier, it will strike you how you see your work differently – weaknesses that were overlooked may well be unearthed; structure that seemed clear may now appear unnecessarily convoluted. Use this opportunity to make your work better.

Teacher involvement in your TOK essay

Throughout this whole process you have the opportunity to engage with your teacher. It is recommended that you meet:

- first, in order to discuss the titles
- again to talk over the exploration for the title you have selected
- finally, to submit a full draft of your essay.

Your teacher is allowed to make overall comments to you but not to correct mistakes or make specific suggestions about the work. These are the only interventions that are allowed, so it is wise to make the most of them.

Example essay

With reference to two areas of knowledge, examine the claim that it is possible to attain knowledge despite problems of bias and selection.

Bias and selection are two different concepts or factors that knowledge seekers often encounter in their quest for knowledge. A quick definition of bias can be the presentation of an account that reflects an obvious sense of favouritism and also lacks objectivity. Bias stems from one's preference of something over the other and due to this, bias may often seem like a deliberate act from an individual. Selection on the other hand is a nearly unavoidable act where certain details are chosen over others. This may be due to limitations to the amount of data that can be collected at a particular time period and the relevance of details to one's purpose thus the issue of selection may not be avoided. However, despite the existence of bias and selection in the process of acquiring knowledge, it is still possible for a knowledge seeker to attain knowledge. This issue can mainly be seen in areas of knowledge where the process of attaining knowledge involves interaction with human beings because bias and selections are part of human weaknesses. Therefore, to examine this claim, the human sciences will be considered together with history.

History is one area of knowledge where this claim can be effectively examined. Historians and history learners rely on sources to acquire knowledge about the past. Sources might contain bias but through close and careful treatment of these sources, knowledge about causes and effects of certain historical events can be acquired. For example during the cold war, Lloyd George referred to communism as a disease from the East. Though this is a biased comment about communism, a historian who is interested in learning about communism as an ideology will not discard it because it is subjective. However, the historian and a history learner will analyse the statement by considering its origin and linking it to other sources related to the issue. Therefore through this, the historian will be able to attain knowledge about the nature of the cold war as well as the attitude of Britain towards communism.

There are several issues that arise from bias as an element in the process of acquiring knowledge in history. One issue is whether the historical method makes it possible for one to acquire knowledge despite issues of bias. In history, historians lean very much on interpretations. Different viewpoints are considered in the various sources, in order to draw meaningful conclusions. In other words, even if sources are biased, they do not contain a completely different account of historical events. As such, historians look for patterns in sources, and considering the fact that there is always a certain level of consistency in historical sources, knowledge can still be acquired.

Similarly, the study of the past is also prone to selection, which is mainly due to two reasons. A major reason that is common to most, if not all, historical events is the selection from the sources themselves. This is due to the various limitations in attaining sources about historical events such as language barrier, missing gaps in sources and many more. In this case, historians use available sources to acquire knowledge about the past which is also transferred to those who learn history. As such, even though in this case knowledge is limited, one is still able to attain some knowledge even if initially there was selection from the sources. Now, it is important to question how much detail do we need at all to acquire knowledge in history? This is because sometimes, even if there are numerous details about historical events, the same knowledge is acquired. For example, a lot of information has been provided about the causes of World War 1 but the causes and origins of the war are very similar. As such, it is possible to acquire knowledge even limitations from the sources.

Another reason for selection is from the side of the historian and a learner of history. These choose certain details that will suit their purpose or aim. For example, two historians, Martin Roberts and Kevin Shillington, give distinct accounts about Shaka Zulu, each under a different light. Roberts talks about Shaka Zulu under the issue of the mfecane or scattering of the peoples of South Africa in the 1820s and 30s. As such, he focuses on the role of Shaka's activities in the mfecane. Shillington, however, discusses Shaka under the rise of the Zulu kingdom thus he elaborates on Shaka's policies and gives less detail about Shaka's role in the mfecane. It is evident that these two historians chose certain details that would best convey what they want to talk about and thus attained knowledge through selection. In the same way, one will acquire knowledge about Shaka from these two historians depending on what they want to know about Shaka. However, an issue that is likely to arise is what happens if a knowledge seeker does not have a defined interest on a historical event but just wants to acquire knowledge about it? It is obvious that the person will be limited in terms of how much knowledge the person can acquire due to prior selection. Nevertheless, the person will still acquire knowledge which affirms the other part of the claim that even with selection, it is possible to attain knowledge.

This claim can also be further examined in the human sciences. Here, knowledge is sought about human behaviour thus it is important to note that the object of study definitely avails itself to issues of bias and selection. This, however, does not imply that all the knowledge in the human sciences is biased. Scientists acquire knowledge through experimentation and surveys in order to understand human behaviour. As such, the two concepts, bias and selection, are witnessed through this.

Bias in experiments and surveys aimed at understanding human behaviour may come from both the scientist and the individuals being studied. Individuals who participate in investigations in the human sciences sometimes give a positive view about themselves. In other words, 'We overestimate our strengths and underestimate our weaknesses' (Van de Lagemaat 258). For instance, in my TOK class, we tried out a test for character adopted from personality psychology where one was supposed to indicate either very unlikely, moderately unlikely, not moderately unlikely, likely and very likely. More than half of the class stayed away from the negative extremes when a question that would portray a possible weakness such as short temperedness was mentioned but rather chose either moderately likely or unlikely. Through this my classmates and I were being biased in this personality survey. Nevertheless, when we were presented with the corresponding character traits, we realized a trend. The results conveyed the personality of some of us. As such we still acquired knowledge about the nature of personality and why individuals happen to have certain character traits.

On the other hand, Social Scientists are faced with confirmation bias. They look for or focus on clues that will prove their assumptions or claims and thus ignore any detail that may be the opposite of what they think. For instance, in the investigation dubbed 'How Mad Are You?' the experts selected by the BBC failed to recognize that one of the volunteers had a history of psychological trauma because they were so sure that the traits displayed by this volunteer were indeed not a reflection of someone with such a history. In this case, the three experts overlooked the possibility of an individual to act in a way that is not reflective of their experiences. In this case, the confirmation bias clouded the three experts thus hindering their ability to acquire knowledge that would lead to a right judgement. Nevertheless, in a way, the bias led to new knowledge for these experts and any knower because it presented other possibilities of human behaviour which are not consistent with our expectations.

In the human sciences, selection most of the time comes from the scientist. This is because they conduct the experiments and thus choose the samples. Just like in history, the social scientist has to rely on inductive reasoning to form conclusions about human behaviour due to limitations. Firstly, social scientists cannot exhaust the human population in order to conduct their surveys or experiments. As such, they are compelled to choose from the large population. For instance, in the birth order theory by Kevin Leman he uses American presidents, famous newscasters and television talk show hosts as his sample to explore whether firstborns are natural leaders. This is because there is no way Leman could have used every leader or firstborn. Nevertheless, this may be a biased sample because of its localization but the fact that there is a notable pattern gives us knowledge about the relationship between leadership and birth order. Besides, when the theory is applied to other parts of the world, the same trend is noticeable. As such, even with selection in human sciences, it is possible to attain knowledge about human sciences which is mainly through identification of patterns.

In view of this, through the consideration of knowledge acquisition in these two areas of knowledge, the claim that it is possible to attain knowledge despite issues of bias and selection is possible to a very large extent but certain issues should be considered in order to effectively examine this claim.

Word Count = 1545

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Example feedback

The candidate focuses on history and the human sciences as AOKs for exploration, and the treatment of them does raise a sequence of **knowledge questions**, although they are not explicitly stated. These include questions about whether history should be concerned more with attitudes of historical actors than actual events, whether historical truth can be reached by concentrating on the commonalities between divergent accounts, how to gain an overall understanding of a historical period when historians have individual specialisms, how to design investigations in the human sciences to avoid the problem of participants' awareness of their involvement in them, and the degree to which the problem of induction places limitations as to what can be claimed in this area.

There is little evidence that the candidate has considered how her own **perspective** may impact the discussion; however, she does highlight the distinctions between the perspectives of different scholars of South African history, and those of investigators and subjects in the human sciences.

The candidate makes an immediate attempt to describe bias and selection – showing an awareness of the importance of **conceptual clarity** by distinguishing between them, even if the characterizations could be contested. The content of the rest of the essay is broadly consistent with these opening remarks – the candidate does not make the mistake of 'defining terms' and then forgetting about them – so the foundations for discussion are quite secure. However, the more detailed **argumentation** is opaque in places due to puzzling sentences or omissions – e.g. about sources (para 2), limitations (para 4), and human nature (para 6).

There are five **examples** in the essay, but they are generally not sufficiently elaborated or clarified for the external reader. The candidate does offer **counterclaims**, but does not explore them nor really justify them to a satisfactory extent. It is hard to see any meaningful identification of **implications** from the arguments presented.

Altogether, the essay can be said to be consistently **relevant** to the title, and there is some evidence that a **thoughtful** approach has been taken to the planning and execution of the work.

It can be maintained that the essay is more successful in fulfilling the higher-level descriptions of the first aspect of the assessment instrument than the second. The closest descriptions might be level 4 for aspect 1 and level 3 for aspect 2. On balance, a **level 4** has been achieved, with a score of **7/10**.

13.6 The TOK presentation

Introduction to the TOK presentation

Unlike the essay, the oral presentation as a form of communication clearly pre-dates all of what are arguably the three most important inventions in the history of knowledge – the invention of writing, the printing press, and the internet. But now that we have all of these things, why continue to communicate by standing and speaking in front of other people? One answer, of course, is the immediacy of contact between presenter and audience. What's more, there is often a bond between them that allows the presentation to make an impact not possible with other media. For instance, there is much debate at the moment about the use and effectiveness of MOOCs – massive open online courses – in which lecture content is made available on the worldwide web. As you might imagine, there is some resistance to this idea. Perhaps it is inspiring to remember that inquisitive people have used the oral medium for thousands of years to convey their thoughts – sometimes on topics not far from some of those that might be found in a TOK presentation.

In keeping with this tradition, you have the opportunity to explore the power of the spoken word in your TOK presentation. In addition to showing that you understand the nature of knowledge questions and can relate them to a real and significant example of knowledge at work in the world, you can demonstrate your ability to communicate your ideas orally in the presence of your peers and teachers. This is your chance to be leader for the day. It's important to realize that your presentation is not only a part of your final IB assessment, it is also a TOK lesson for the class. In short, you are central to their learning for a short but important period of time.

Advice for planning and delivering your TOK presentation

A major difference between the presentation and essay assignment is that you can choose to make this experience one of collaborative learning and achievement, since you are allowed to form a group of 2 or 3 for the task. There are many factors that may impinge on this decision (Table 13.3). These include cultural preferences in your school for working individually or in groups – and your comfort level with sharing the work and depending on others for the overall quality of the outcome (all co-presenters will receive the same mark). Whatever your decision, the expectation is that your presentation will last for approximately 10 minutes, multiplied by the number of presenters.

Presentations	Advantages	Drawbacks
individual	• total control of presentation	• exposition is short; hard to present divergent views
group	• a natural 'dialectic' approach is favoured • there are many contributors to bring ideas for the presentation	• the presentation may fragment; there may be 'audience fatigue' • a strong individual might dominate the direction of the presentation

Table 13.3 Considerations for an individual or group presentation

You may also find it helpful to read the rest of the advice in this section before deciding with whom, if anyone, to work.

Let's start thinking about the presentation itself. This is where you demonstrate that you understand that the TOK course is not confined to armchair musings but has impact far beyond the classroom. The focus of the presentation is on knowledge at work in the world, and how a consideration of knowledge questions can give us clarity about the nature of problems in the world and how to begin to solve them. To encourage clear focus, you are required to select one real-life situation and extract a single knowledge question from it (Figure 13.5). Success in setting up this axis between the two is the foundation on which the rest of your work and eventual performance will rest.

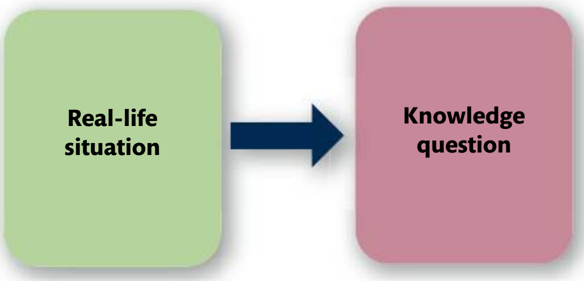

Figure 13.5 TOK presentation: a real-life situation and a single knowledge question.

By real-life situation we mean something which forms a part of your living experience – a particular piece of work or example from one of your IB courses, a situation that you faced in your CAS programme, or some other situation in your life outside the school environment. The important thing is that it should be specific, much like an example in an essay. It should also be something that you thoroughly understand, and with which you have some personal connection. If it is sufficiently straightforward and well-defined, then the TOK analysis that needs to take place will be that much easier and of a higher quality.

Ideally, the foundation for your presentation will invite the creation of a knowledge question. That is, you should pick the situation first and find the knowledge question inherent in that situation.

Having provisionally decided on your real-life situation and knowledge question, you then need to consider how much you can reasonably say on the matter. The expected duration for your presentation is an important factor here, since depth of analysis is required (this is of course an important issue to be considered by anyone working on their own).

Figure 13.6 helps to indicate the full intended relationship between a real-life situation and a knowledge question, and will help in the planning of different parts of the presentation.

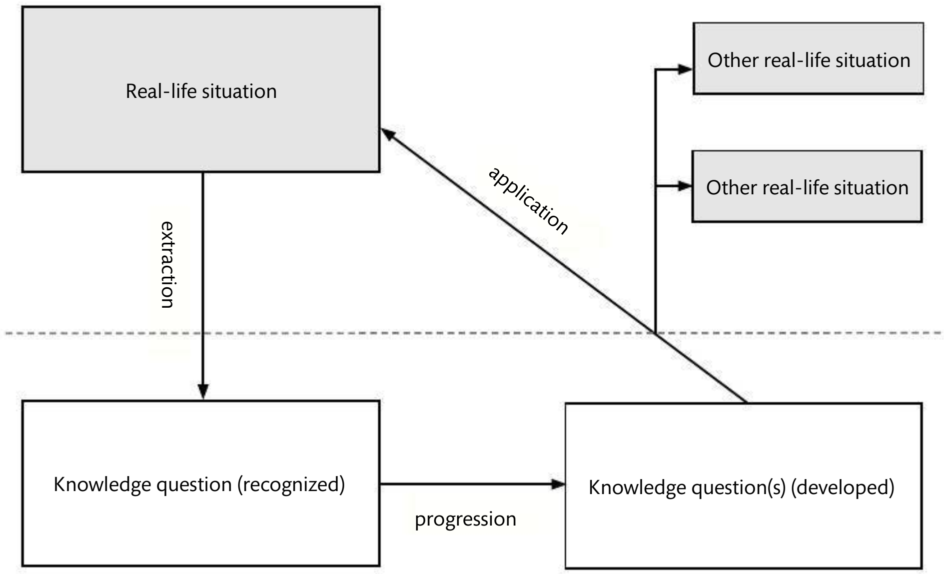

Figure 13.6 Extended diagram of the relationship between the real-life situation and the single knowledge question.

Notice the congruence between the levels in Figure 13.6 and Figure 13.1, comparing the nature of the presentation and the essay. Presentations will naturally vary in the details of their structure – according to the preferences of the presenters and the material – but the above diagram provides a guiding narrative that you should certainly not ignore. It goes as follows.

1 A knowledge question is extracted from a real-life situation. This knowledge question is examined using concepts from the TOK programme, and an exploratory analysis is developed with reference where appropriate to the real-life situation (and possibly some other examples that help to make relevant points along the way).

2 As this analysis proceeds, it is likely that subsidiary knowledge questions will arise, but (as with the essay task) these should never be allowed to eclipse the central knowledge question of the presentation.

3 Eventually, the outcomes of the analysis are applied back to the original real-life situation with the intention of throwing a new light on it – it is here in particular that a sense of progress should be manifest.

4 Finally, the fact that the knowledge question is couched more generally than the real-life situation permits the presentation to suggest how other real-life situations might be illuminated using the analysis that has been developed.

Now look at the assessment instrument for the presentation (Figure 13.7). Note how the performance descriptions at each level reflect aspects of the structure of the previous diagram. This should encourage you to take this diagram seriously, because its components are deeply embedded in the means of assessment to be used by your teacher and by IB moderators who check on these matters. Once again, the possible characteristics (terms at the bottom of the page in Figure 13.7) are intended primarily to help assessors develop a common vocabulary for discussing the merit of work.

It's important at this stage to think about the ways in which you will present your work. Particularly if you are working in a group, you may wish to consider including skits or simulations of various kinds to illustrate different aspects of your analysis. But if you go in this direction, remember that it will be crucial to step out of this mode of presentation at some point in order to comment on what has been presented. Sometimes a group of three works well with this format, as two students can present contrasting positions and the third can sum up what is at stake or explain in advance what is going to be discussed. The third individual is useful in order to prevent the topic becoming polarized and, in effect, an invitation to the audience to choose one or other of the two poles.

TOK presentation assessment instrument

Do(es) the presenter(s) succeed in showing how TOK concepts can have practical application?					
Level 5 Excellent 9–10	Level 4 Very good 7–8	Level 3 Satisfactory 5–6	Level 2 Basic 3–4	Level 1 Elementary 1–2	Irrelevant 0
The presentation is focused on a *well-formulated* **knowledge question** that is *clearly connected* to a *specified* **real-life situation** The knowledge question is *effectively explored* in the context of the real-life situation, using *convincing* **arguments**, with *investigation* of *different* **perspectives**. The **outcomes of the analysis** are shown to be *significant to the chosen real-life situation and to others.*	The presentation is focused on a **knowledge question** that is *connected* to a *specified* **real-life situation**. The knowledge question is *explored* in the context of the real-life situation, using *clear* **arguments**, with *acknowledgment* of *different* **perspectives**. The **outcomes of the analysis** are shown to be *significant to the real-life situation.*	The presentation identifies a **knowledge question** that has *some connection* to a specified **real-life situation** The knowledge question is *explored* in the context of the real-life situation, using *some adequate* **arguments**. There is *some awareness of the significance* of the **outcomes of the analysis**.	The presentation identifies a **knowledge question** and a **real-life situation**, although the *connection between them may not be convincing.* There is *some attempt* to explore the knowledge question. There is *limited awareness of the significance* of the **outcomes of the analysis**.	The presentation describes a **real-life situation without reference to any knowledge question**, or treats an abstract knowledge question **without connecting it to any specific real-life situation**.	The presentation does not reach the standard described by levels 1–5
Some possible characteristics					
Sophisticated Discerning Insightful Compelling Lucid	Credible Analytical Organized Pertinent Coherent	Relevant Adequate Acceptable Predictable	Underdeveloped Basic Unbalanced Superficial Derivative Rudimentary	Ineffective Unconnected Incoherent Formless	

Figure 13.7 IB assessment instrument for the TOK presentation.

While your presentation might include a video clip, it must be part of a 'live event' in the classroom; in other words you cannot pre-record your presentation as a whole. Video is powerful but ask yourself, does it make a point better than you could if you used more traditional means?

After the planning stage, decide on a brief phrase that embodies the gist of your presentation. This will be your topic, which you may need to enter on your preparation form (see below). Be careful not to confuse or conflate the terms 'topic', 'real-life situation' and 'knowledge question' – the topic is simply a label for identifying the presentation and not a intrinsic feature of its structure.

Some might argue that the planning of your presentation is almost as important as the actual giving of it. Never underestimate how much thorough planning will contribute to your understanding of the topic, your confidence in addressing it, and consequently the delivery itself.

Your teacher will have most of the say in what mark you receive for your presentation, because he or she is in a better position to do so than any external examiner. Your teacher knows what you have covered in class, and your particularities of character and interest. This is the basis on which some IB assessment tasks are assigned as internal assessment.

But as with all internal assessment, there needs to be some way of checking that the standards applied in different schools are roughly equivalent. So the second function of the planning form is to provide evidence that this equivalence has been achieved.

This form must be submitted according to the instructions supplied by your teacher. The questions on this form are shown on the filled example on the following page.

Do not forget to print a copy of what you have uploaded for your use during the presentation itself, and a copy for your teacher to be handed over immediately before you start. The documentation for your presentation will be completed after the event by your teacher, who will add comments to the form that you have uploaded.

Technical aspects of presenting

To learn more about presenting, including some fascinating analyses of well-known speeches or presentations that highlight the points raised above, visit pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 13.1.

Although the assessment instrument for the presentation makes no mention of the technicalities of giving a good presentation, it makes sense to pay attention to them. There are many online and print sources that provide advice in this area, so here we will confine ourselves to reminding you that, somewhere close to the beginning of your presentation, you must relate the real-life situation and central knowledge question, although it need not be the very first thing you say. It is worth marking crucial points of this kind for your audience by using signalling phrases in advance such as '… and so our knowledge issue in this presentation is as follows …'. Use pauses and consider repeating information of this type.

If you have been serious with your work, it deserves to be showcased in the best possible light.

Example TK/PPD presentation planning form

Describe your real-life situation

A recent physics class discussion related to Robert Millikan's oil drop experiment, carried out around 1908 to 1910, and designed to calculate the charge on the electron. It has been claimed that Millikan excluded some of his results that were inconsistent with his expectations.

State your central knowledge question (this must be expressed as a question)

How can we know when, if ever, to be selective with experimental data in the natural sciences?

Explain the connection between your real-life situation and your knowledge question

We are taught in science classes that actual observed results should take precedence over expected results from a theoretical model. But even if Millikan did withhold some of his data, it turned out in the end that he was correct about the charge on the electron. Ignoring some results enabled him to state his answer with more confidence – thus accelerating the progress of physics. It has also been claimed that he was more selective with his results at an early stage in developing his experiment – suggesting that his priority at that stage was refining the method rather than arriving at an answer.

Outline how you intend to develop your presentation, with respect to perspectives, subsidiary knowledge questions, arguments, etc. Responses below can be presented in continuous prose, bullet point, or diagrammatic form.

We will show a short video clip explaining the nature of Millikan's experiment, followed by some PowerPoint slides showing some of Millikan's results and the effects of ignoring some of them. Some justifications for data selection will be presented and evaluated. Possible wider implications will then be presented (as below).

Show how your conclusions have significance for your real-life situation and beyond

In biology, Gregor Mendel has been similarly accused of 'massaging' his data in his famous pea plant breeding experiments, so the issue may well have wider relevance to the development of science. In school practicals, we are usually very aware of the results we are expected to obtain, and are therefore much more likely to ascribe outliers to experimental error rather than the discovery of new science – so the question connects to the relation between 'school science' and 'real science'.

13.7 Coda

It remains only for us as authors to mention the down-to-earth and the lofty. Your scores for essay and presentation will be combined as indicated earlier, and used to generate a final grade for TOK on the scale of A to E. If you are a full diploma student, this grade will be combined with the grade you receive for your extended essay in order to yield a points score for the diploma core between 0 and 3.

It is common to hear people say that the modest yield of 3 points maximum must be an indicator of the relative importance of these tasks in the broader diploma scheme of things. But there is a counter-argument in that perhaps these experiences elicited by the heart of the diploma programme are, by their nature, too important to be assigned more points. As things are arranged, TOK affords you as a student the opportunity to explore responses to the myriad of knowledge questions that underlie almost everything we do or say, even if the pace of everyday life limits the time we can set aside for recognizing their presence. And, although we would be the last to underestimate the importance of the best grades in TOK and the satisfaction that they bring, arguably this opportunity can be enjoyed without the degree of pressure that would be brought to bear by the prospect of 7 points at stake.

We three teachers of TOK fervently hope that your engagement with this course brings with it the grades you deserve, together with a lifelong fascination of human knowledge as the greatest and most astonishing achievement of our species.

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