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Theory of Knowledge

for the IB Diploma

3rd Edition

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Pearson

Theory of Knowledge

3rd Edition

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Dedications

To Alec Peterson, a founding father of the IB, its first Director General, a passionate teacher of Theory of Knowledge, and my mentor. He brought out the best in me.

Sue Bastian

I dedicate my work for this book to my daughters Sophia and Olivia who have given me so much insight into learning and knowing. Throughout the writing, my wife Harriet has offered me the unstinting support and encouragement I needed during a very busy time. I can say with certainty that her contribution has been essential.

Julian Kitching

For my parents Sylvia and David Sims. I would like to thank my wife Caroline and my daughters Pashmina and Rebecca for their support during the writing of my part of the book.

Ric Sims

Contents

Introduction

More than 50 years ago a group of visionaries sat around a table talking about the world and how to make it better. It was the 1960s and change was in the air. Woodstock, free love, free speech, women's liberation. Also, terrible things were going on. Assassinations, riots in the streets, protests and tear gas, world wars still fresh in memories. Where to start? Start with the youth, they said. Start with education for a better world. Start with an international baccalaureate.

It should be no surprise that the International Baccalaureate (IB) was born against the backdrop of the tumultuous 1960s in the Western world. And even though educational debates lack the drama of the other movements of that era, there were radical notions at play in those early meetings. Men and women from only a handful of countries were making plans to shape a world-wide programme of academic rigour with the idealism of shared values – something they only vaguely yet called the International Baccalaureate, *an education for a better world*.

A better world? Think about these words. Not a better country, not a better nation, not a better job – a better world! That's ambitious! That sounds idealistic! That sounds radical! Those educational pioneers around that table were turning their backs on their own countries' educational systems, the schooling of their own young people – in favour of what? Sounds great, some said. Sounds like treason, others shouted. This is a history you should know. Big change does not slide in easily.

This question – in favour of what? – is also something you might ask yourself as you enter the ranks of the IB, as you learn its precepts and ponder its learner profile, as you aspire to its diploma. What is the IB about? It is astonishing how many people have joined up, have attached its name to their own, but cannot explain to a family member – or to themselves – what is the IB? What is it about? What does it stand for?

Yet you, your teachers and principals of schools, families even – and all of us who write books to move this endeavour along – should be aware of the values underpinning its international idealism as well as its baccalaureate of academic excellence; two values for a better world folded into a programme of the best kind of teaching and learning. Thus the name, the International Baccalaureate – the IB, as we say.

Just two minutes is all it takes to read the brief IB mission statement, but many times longer to understand the profundity of its meaning. A few more minutes and you can run down the list of what makes up the IB learner profile, yet more time still to understand what it means when they say – if this profile is a portrait of you, then you are by that very fact *internationally minded*. The same goes for your teachers or anyone else for that matter.

Can that be true? Even if you have not travelled far from home? Even if your teachers all come from the same place? Even if the students all look alike?

Does any of the above sound right to you? Or familiar? How close is it to something you might explain in your college or university admissions interview? Would it even occur to you to say that *international mindedness* is a perspective, a way of looking at the world, a way of being in the world, not just a head count?

It is not lost on us that many – if not most – of those signing up for the IB challenge do so, understandably, with the reward of being looked on with favour by those colleges and universities of the highest reputation. How proud we are in the IB to be so recognised.

But as IB students and teachers, we have an additional charge. We are asked to pay as much attention to the *International* name of our organisation with its implied idealism, as to the *Baccalaureate,* the academic. Because…

Think about the world's trajectory while you are reading this paragraph: not just the dominance or decline of the USA or China, or the power or passivity of the UN, or the disappearance of contemporary or indigenous cultures. Think about the *vroom* of technology – each day a newer, swifter something appears. It doesn't matter if we like it or not. A lot of people do and a lot of people don't; but also a lot of people are using it, for better or for worse, to talk across borders where traditional geopolitical identities begin to blur. Where personal identities may be fluid. We better learn how to understand this; we better learn how to feel at home here. It is the special mission of the IB to prepare young people to live within a community of many voices, all possibly chattering at once in every kind of boundary-crossing conversation. 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 barrio, 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.

In a real sense, then, you have the whole world in your hands. The IB knows this and is asking you to think today, tomorrow, and on and on, about how our teaching 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, disease, 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 and hear its message and sound its echo. We teach. We make a difference. You learn. You can make that difference happen.

Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.

Impossible? Not at all. Idealistic? Yes, indeed. But we need our ideals in this young IB organisation whose future is brighter than its history is long. We have to keep saying over and over what we are about – to remind ourselves of our ideals. We need young people who respect the pursuit of knowledge and multiple ways of seeing the world, who can experience the joy of discovery of the right word, the right fact, a good explanation, and the real truth – whatever that turns out to be.

Theory of Knowledge

Theory of Knowledge (TOK) is not simply another subject, it is different in kind and purpose. It is not intended to teach you new facts, but to enable you to put into perspective, into a framework of renewed understanding – our **knowledge framework** – what you already know at one level. When successful, the outcome will be better depth and breadth of thinking, both for academic and professional success as well as the imaginative and sympathetic exercise of mind in the future.

Admissions Director, Universal University: So, Jordan, why the name, Theory of Knowledge? Kind of intimidating, huh? Right up there with Theory of Relativity!

Jordan: Well, Sir. The Theory part is taken from the Greek word for theatre – θέατρο – a place from where something is seen, a way of seeing, so we are looking at knowledge… to put it another way.

In most educational circles, much thought is given to the design of curricula for subject expertise, but here TOK stands out as an exception. It takes as its goal not the further cultivation of any particular subject, but an exploration of what we call **areas of knowledge** (natural sciences, human sciences, mathematics, history and the arts) and **themes** (knowledge and politics, knowledge and technology, knowledge and language, knowledge and religion, and knowledge and indigenous societies) whose central concepts look beyond the classroom. TOK asks you to pause and reflect on your IB school experience – why history, why art, why mathematics, and even why TOK? – and, more introspectively perhaps, your own knower profile. Nothing else in the IB is designed exclusively around the stimulation of the kinds of questions, which are the point of departure for the TOK journey.

Areas of knowledge
Natural sciences
Human sciences
Mathematics
History
The arts

Themes
Knowledge and politics
Knowledge and technology
Knowledge and language
Knowledge and religion
Knowledge and indigenous societies

What does it mean to know anything at all? And more specifically, what is it to know something in mathematics or the sciences, in history or the arts? Are these the same kinds of knowledge? Why or why not? Further, what does it mean to claim knowledge in any strict sense for the value realms of religion, of politics, and of morality. Are there such things as ethical facts? Is it possible to live a good life in a corrupt society? How can a bad man write a good book? Does the strength of science rely on trust?

Can you ever prove that something is beautiful? Why don't our feelings always count as knowledge? Is it scientific knowledge if only one person knows it? What is a human science? Why did Einstein say that the more mathematics is about reality, the less certain it is?

Questions! Wonderful questions. Questions seldom favoured in the syllabuses of other courses where mastery of content is the model; where the imperatives of coverage contend with those of depth, and there is never enough time. The 'answers' to such open questions – what we call **knowledge questions**, not all of which need be known in every instance by the teacher in advance – provide what can be called a 'second-order approach' for understanding the various knowledge communities across subject areas; knowledge that is usually pieced out to students only by departmental division.

From Alec Peterson, the first Director General of the IB and a teacher of TOK himself:

> Within the IB, the nature of the TOK course is to encourage reflection upon what the student has learned both inside and outside the classroom. For even a broad and intensive curriculum can be studied as though the subject were in watertight compartments and unrelated to ordinary experience. No matter how good the curriculum is in its parts, we have not done fully right by our students if we deny them the chance to make an integrated sense of their high school life and the virtues and limitations of their learning and to bring it to the critical light. TOK makes a start in this direction.

It's one of the more interesting and unusual features of TOK that the teacher need not be an expert in all areas of exploration. In fact, it's quite possible – sometimes a surprise – that the teacher will need to relinquish the emotional pleasure of the *sage on the stage* for the equally challenging *guide on the side*.

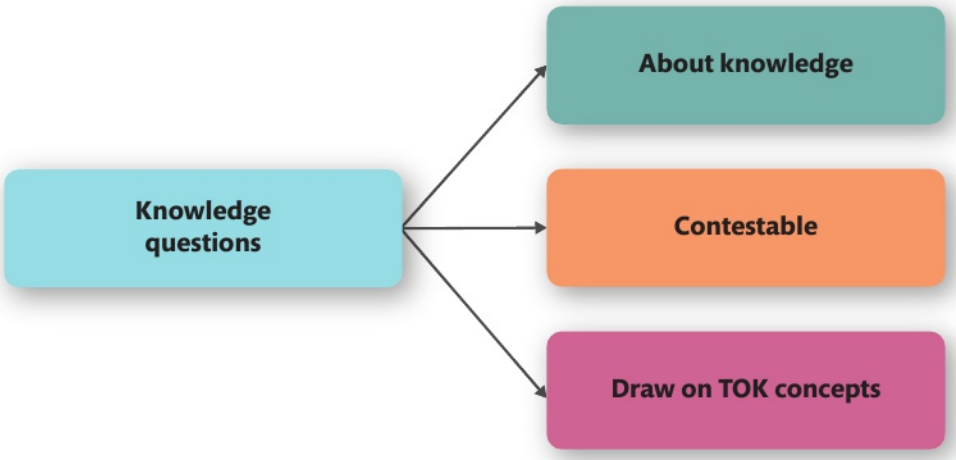
Alec Peterson again:

> One of my profoundest convictions is that example and passion are crucial when we are trying to stimulate thought in our students about the nature of their own intellectual experience, and the best teachers to do that will be those who are reflecting and puzzling themselves about it and can communicate [that engagement rather than rush to impart their own conclusions and erudition].

New TOK teacher: I never majored in TOK, I never read philosophy. Thinking about all this is not easy, but, it reminds me why I went into teaching!

The question

The heart of TOK teaching is made up of knowledge questions. Such higher order questions drive instruction, discussion, and assessment. Take away those questions that manifest the spirit of inquiry, and the subject as it should be virtually disappears. But questions, as we know, perform many functions. They can be complex and loaded. They can be accusatory or disguised assertions. And sometimes, always a challenge for a TOK teacher, the very act of asking a question, especially (How do you know?) can be seen as subversive or rude. Try this tonight. Try asking your parents, 'How do you know?' three or four times and see what happens.



But for now, more specifically, in TOK there are five areas of knowledge to explore, each with its own knowledge questions about scope, perspectives, methods, and ethics – our knowledge framework. There are themes to explore, each with its own questions. There is the **exhibition** assessment of three objects explored through a question that frames their relevance to the world outside the classroom. And finally, there is the **essay**, the summative assessment of 1600 words. This is a response to a **prescribed title**, itself a knowledge question. It is an essay whose quality may well depend on the quality of a chain of questions you ask of it, questions that will mirror the 'answer'.

Below is an example of a prescribed title for the essay, followed by a sample student analysis of the prescribed title.

Prescribed title: Why do experts disagree given the same set of facts?

Student analysis: Who would be asking this question? And why? What makes it a knowledge question? What is it getting at? What does it remind me of? Did we talk about this in TOK? Or my other classes? What are the key words here? What does this question have to do with different ways of knowing? What areas of knowledge are relevant here? What examples come to mind? How many different ways of thinking about this are there? What is at stake in the question? What assumptions are folded in? What is my point of view here? What would a different perspective look like? What are the implications?

There is no false refuge in the right answer, because there is no 'one right answer'. A staggering fact to those who must have an immediate right or wrong signal, but the thrill of the intellectual chase to those who find freedom in their search for meaning and how this attaches to their lives, here now and ongoing.

So it's not too far a stretch to generalise from what a student said during a return visit on Alumni Day years after graduation: 'I was so grateful for your class. It gave me permission to ask questions. It gave me permission to think.'

If you've read this far, then you've seen a variety of questions in the earlier pages that sit easily in the written TOK syllabus, but may not be so easily handled by students or teachers in the real life of the classroom. In fact, 'the question' has not become a close friend of students over the school years as elementary grades move into middle school and on into the diploma programme. Yes, young children ask all the 'Why' questions – but as their schooling advances, their inquiry nature gives way to memorisation and recitation skills as per the design (understandably) of our schools during these years.

Of course there are the managerial questions – when is this due? how many words? – and the text-based questions when something needs clarity. But the wonderment questions, which reflect curiosity, puzzlement, scepticism, or a knowledge-based speculation that advances the dialogue in TOK, are much less in evidence, if at all.

Traditionally we give less prestige to questions. They're easy; it's the answers that take the work. By design for years, students learned a prescribed body of knowledge in classes in a tutorial fashion. To the extent that they were good at this, there were rewards in terms of grades, of personal satisfaction, of reputation – smart kids answer questions right and they answer them fast – and these habits are imprinted over the years. Even in homes and some cultures the question is not admired or welcomed.

Even in a broad swathe of situations the question can be labelled 'out of line'. Imagine how this social norm can affect the production of knowledge and classroom practice. Who gets to ask? Who gets to answer?

So the question, and its function and value as central to the TOK enterprise, needs to be consciously cultivated as a skill in emulation of the way knowledge is produced in the world. This reverence for the good questions, and what counts as a good response and the risk this may involve, must be recognised by students and teachers as a turning point in their school experience. Also important is the realisation that their TOK class is more like their real world of tomorrow than the certainties of the agricultural exports of Peru or Pythagoras's Theorem found in their textbooks.

In life outside the classroom, when the big issues come up people exchange views all the time with questions of many stripes – sometimes calmly, sometimes dramatically – and offer arguments to get their point of view accepted. This is true in any field where people judge competing claims: from scientific propositions to theories of artistic excellence; from the ethics of war to child rearing. Even whether or not to sign up for the IB! Such dialogues are going on right now in every walk of life: in corporations, in government, on campus, in courtrooms, in tribal councils, and, hopefully, in the classroom. Perhaps, also, in your own family.

Some welcome the voices of diversity and celebrate and recognise that, within this context, diversity of thought or person is neither a problem to be solved nor a defect to be tolerated, but an open door to understanding that the world and oneself are increased by pooled cooperative thinking and exchange. That being said, there are many situations where diverse views are not welcome but TOK is not one of those places:

> People with their differences can also be right.
>
> (IB mission statement)

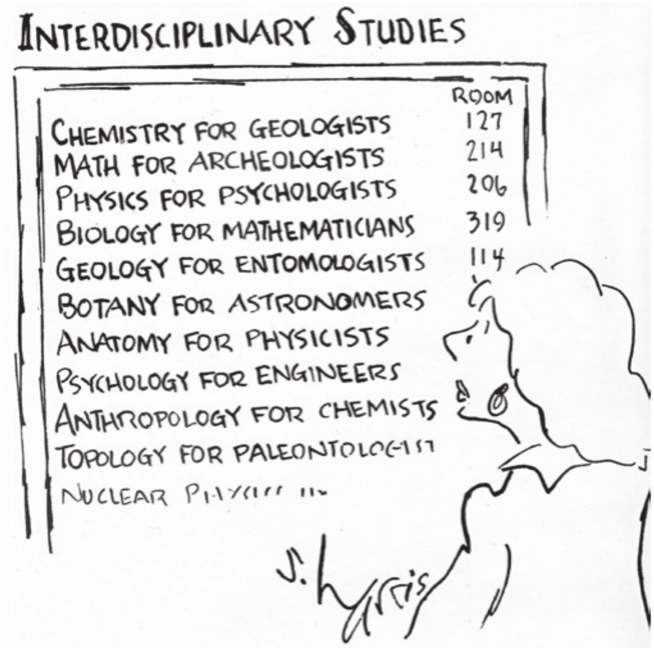
While underscoring the virtues of open-mindedness and open questions, of diversity and dialogue, care should be taken to avoid the two most prevalent misinterpretations of the course.

TOK is not about reeling off 'isms' or schools of thought, although extracts from philosophers (and others) are frequently used for discussion. While a philosophical perspective should be taken with second-order questions, TOK is not a course in philosophy in the conventional sense. Anyone who fails to recognise this distinction will mistake the proper channel of inquiry.

The second pitfall is the temptation to over-indulge in haphazard rambles to the point at which no one moves beyond the obscurity of Plato's expression of knowledge as a 'mysterious union between a knower and the known'. The TOK course was never meant to be a free-wheeling 'rap session' on the meaning of life. It has its own identifiable reason for being: to confront the disciplined ways in which our knowledge is organised, disciplines that have standards and experts and limitations, and then to express this understanding with the utmost clarity and precision of reason and language in response to the challenge of our TOK knowledge questions.

Areas of knowledge

It is crucial to your success in TOK that you understand what *a discipline* means, since the course is organised in large part around the areas of knowledge, or *disciplines*.



In order to get a feel for what a discipline is in the real world, it is good to remind ourselves that this very minute, real people are making their living as scholars within their chosen fields of study – in research, in teaching, and in practice. In that sense, disciplines are dynamic, not just collections of knowledge and methods and rules to follow.

What is the crossover with the term *discipline* from behaviour in school and behaviour as a historian? What can the term mean in the arts? If you wanted to belong to the Society of Historians, what would you have to pledge to do to discipline yourself to stay in 'the club'. These interesting questions are answered in part by the American Historical Association, whose key ethical tenet as a code of conduct is: *Do Not Betray!* Think about this. What could it mean? A good TOK question.

Figure 1 Alberto Giacometti, a major 20th-century artist, was once a member of the Surrealist movement who was known for his thin, pinched bronze figures. He was no longer welcome as a Surrealist when he returned to figurative sculpture in violation of the Surrealist Manifesto.

In professional life, as in any social group, academic or not, there are leaders and followers – even cliques – all performing their scholarly and artistic work according to written and unwritten rules about acquiring and justifying and explaining knowledge, and defending what they bring to the table. Disputes within disciplines are endless. Should graphic novels be counted as literature? Should anthropology belong to the sciences or to the humanities?

While there is always an accepted body of knowledge within any discipline, there are also people working at the cutting edge, thinking new thoughts, debating the issues of the day, and publishing discoveries or refinements in the trade magazines or periodicals associated with their field. So it is not surprising that some people get prizes (such as the Nobel prizes), money, fame, authority, and some do not. Some work in the trenches of everyday activity, while others make the discoveries and breakthroughs. Some are in and some are out; some are lucky, some are not. Some get to ask the questions and give the answers and others have to fall in line. Yet, at the same time, all scholars and practitioners use questions, doubts, theories, facts, imagination, intuition, reason, passion, patience, power, evidence, and intellectual honesty as they try to make sense of the world and pass it on.

Your knower profile

With TOK, it is hoped that each IB diploma holder will gain a thoughtful awareness of the knowledge so far learned in school, and of the way knowledge 'works in the world' and the grounds for their personal belief systems. And, more, that they will come to realise that knowledge, seemingly so certain and final in their textbooks and imparted with almost gospel credibility, is the answer to questions someone once asked – in curiosity, wonder, or doubt.

Teacher: See this chemistry book, it weighs almost 1.5 kg and costs almost 100 dollars. Did you ever stop to think that everything in it is the answer to a question someone once asked? Did you ever think that this book is a triumph of what we have come to know so far about the world of chemistry?

But your schoolbooks are only a partial inventory of what Chapter 1.1 **Knowledge and the knower** calls 'the end of a seemingly endless stream of claims to knowledge offered up by family and friends, the school environment and from whatever other sources with which we choose to engage or are exposed to'. In coming to understand your own knower profile, doesn't this call for even more questions; sometimes about knowledge, but just as importantly here, about self? We can begin with these words from Albert Einstein: 'If most of us are ashamed of shabby clothes and shoddy furniture, why are we not more ashamed of shabby ideas and shoddy beliefs?'

It's not as woolly as some might suppose to ask, 'Who am I?' As you contemplate the next step in life with IB diploma in hand, the hard fact is that the response to these questions and others will make their way into writing personal essays, interview discussions about character and values, what you want to do, and what you need to know in order to do it. Self-knowledge as such is not taught in school.

Yet, it is not just self-knowledge that is valuable, but the way others know us or think they know us, or believe us or trust us. Because we live in a world with others, there is an other-relatedness to what we know and believe and how we talk about it. And while academia will take for granted that you know your times tables and your ABCs, they will not assume that you 'know thyself' as Socrates implored. Perhaps our knowledge framework will help here.

Scope – What did you once believe but now no longer do? Why? What does that tell you about yourself? What would you really like to know that you don't know now? What difference does it make in your life to believe or not believe something? How might it make you a different person? What do you think about the Hindu prediction that whatever you give attention to, grows in your life?

Perspectives – How do you navigate the tri-focal perspectives of yourself as an individual, as a member of a species, and as a member of different groups? What does it mean to say, 'We all have many names'? Do you see differing perspectives as a treasure house or competition? What do you think John Stuart Mill meant when he said, 'He who knows only his own position knows little of that'?

Methods and tools – How do you use social media to educate yourself? As a knower in a dispute, what is your first line of defence? Can we count on our feelings or intuition to give us knowledge? How do you use writing or language to shape your thoughts? How do questions shape your thoughts? What do you mean when you say, 'I know' and why should anyone believe you?

Ethics – How wide is the net you use to cast your ethical concerns? What opinions do you hold of those who other people call 'losers' in this world? Do you know any good people? What makes you say that?

Have you ever gone a full day without telling a lie? Is it worse to lie or to be lied to? What did Dietrich Bonhoeffer mean when he said, 'When regard for truth has broken down or even slightly weakened, all things remain doubtful'?

The IB student

Beyond the stereotypical smart student scoring high on exams (itself a marvel), is someone beginning to weave in all the above as the contours of an educated person who knows how knowledge is created and justified, how it is organised and 'at work in the world', and how to make their own knowledge work for a better world. They know all this because they have taken on the ethos of the theory and practice of being a **knower**.

TOK is a tremendously ambitious addition to an already exacting IB subject programme, yet we see it as pivotal and necessary for the observance of what it means to be an educated person. To try to strengthen the intellect in its reflective forms has a natural base: it is natural to try to make sense of our experience. To begin to see knowledge as a whole is to begin to live in a larger world; when the world is larger, we can think with more sympathetic imagination and resolve to do better by our mission and values.

It bears repeating that the nature of TOK is to encourage reflection on what the student has learned both inside and outside the classroom. For even a broad and intensive curriculum can be studied as though the subjects were separate from one another in sealed-off ways and unrelated to ordinary experience. No matter how good the curriculum is in its parts, we have not done fully right by our students if we deny them the chance to make an integrated sense of their high school life; so many years of school up until now, and so many yet to go. Our TOK book is both a guide and a helpmate, and also a map on this journey.

Here is one TOK teacher's 'splendid instance' as she prepared her students for the last day of class.

> Students come to us at the beginning of the year who have studied something of great human significance in art, literature, the sciences, maths, and history – all the IB subjects. Experience is then deepened with the exposure to new, challenging, and relevant ideas from other places, other groups or a voice not earlier 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 judgment 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 as a treasure house. All of this has become part of their instinctive responses to challenges and novel situations. They are ready to take the next step. They are ready to graduate.

How to use this book

Throughout the book, you will see a number of features to support and enhance your learning.

Knowledge framework

Each chapter follows the four elements of the knowledge framework: scope, perspectives, methods and tools, and ethics. Helpful progress bars show you where in the framework you are.

Activities

Throughout the book you will find individual and class activities to help you put your learning into practice.

Activity 1 The political leader profile

Create a political leader profile using the same ten-attribute structure (but not necessarily the same content) as the IB learner profile. Which attributes would you include and why?

Now create a profile for the ideal citizen. Again, note down some justifications for your choices.

We will address your responses to these tasks later in the chapter.

Things to think about

At the end of each section you will find a things to think about box. These boxes will help you reflect and build on your learning so far. Some of these things to think about will also be labelled as 'challenge' to take your understanding even further.

Things to think about

- Use the QR code to visit the political compass website. Track your own political views on two axes and compare with plots for various prominent political individuals. Do you recognise an affinity with those located near you on the graph?
- What are the differences, if any, between claiming, 'I know God exists' and 'I believe God exists'?
- **Challenge** London taxi drivers are of interest to cognitive scientists and neurologists because the structure of their brain is somewhat different from the brain structure of non-cabbies. In particular, the taxi drivers have a bigger posterior hippocampus – an area of the brain known to be involved in spatial memory. This is an interesting case of a cultural phenomenon – learning the Knowledge changes neural structure and circuitry suggesting that the evolution of human thought processes is parallel to the evolution of culture (and is not driven primarily by genetics). Do you think this idea is plausible? Investigate this issue by checking out some of the sources at the end of the chapter. What are the implications if it is true?

Knowledge questions

You will also find knowledge questions at the end of each section to help you become accustomed to the style and format.

Knowledge questions

- How is the practice of politics distinct from the discipline of political science?
- In what ways is factual evidence sometimes used, abused, dismissed, and ignored in politics?
- What can 'alternative facts' mean in the context of politics?
- Is being knowledgeable an important quality in a political leader?
- Why have political leaders sometimes tried to control or eradicate specific bodies of knowledge?
- With regards to politics, do we know as much as we think we know?
- How might knowledge reflect or perpetuate existing power structures?

Vocab boxes

Vocab boxes introduce and explain key terms.

V

Norm: there are two different senses of this word. The first sense is descriptive: a norm is normal – something that usually occurs: 'Having supper at six is the norm in Sweden.' The second meaning is imperative – a norm is something that *ought* to occur: 'It is a norm to drive on the right in Sweden.' A norm in this second sense is a sort of rule and is often used in a social context. The term *normative* is derived from this second, imperative, sense of the word.

Exhibition thoughts boxes

Exhibition thoughts boxes give you a reminder about the organisation of the virtual exhibition objects discussed in the chapter.

Exhibition thoughts

- In the **Scope** section of this chapter, we organised our treatment of objects around the IA prompt #17: *Why do we seek knowledge?*
- In the **Perspectives** section, the deliberations on the tensions between insiders and outsiders to religious experience might be the spark for an exhibition addressing IA prompt #20: *What is the relationship between personal experience and knowledge?*
- For **Methods and tools**, the focus could be on the limits to knowledge with IA prompt #18: *Are some things unknowable?* Or perhaps on the efforts to establish public verifiability for religious knowledge with prompt #8: *To what extent is certainty attainable?*
- Under **Ethics**, one suggestion is to focus on the role of authority in establishing acceptable moral standards – IA prompt #22: *What role do experts play in influencing our consumption or acquisition of knowledge?*

Info box

Robust

Knowledge is **robust** if it can withstand change. The London cabbie's knowledge is robust because short of a bad head injury or a missile attack on London the cabbie's knowledge can get a passenger from A to B. The rideshare app driver's knowledge of London depends critically on a complex system being in place and functioning correctly. If the system changes, the rideshare app driver may not be able to get a passenger from A to B. The rideshare app driver's knowledge is easier to come by but at the cost of robustness.

Info boxes

Info boxes give you more information about something that has been mentioned on the page.

Case study and Specific exemplar boxes

Case study boxes give you a summary of an important issue discussed in the chapter. Specific exemplar boxes show you precise examples.

Case study: 1946 Faroese independence referendum

A consultative referendum took place on 14 September 1946 in the Faroe Islands in order to decide whether the islands should remain united with Denmark or become an independent state. The questions and results were as follows.

1. Do you want the government's proposal established? [the proposal was home rule within Denmark]
2. Do you want separation between Denmark and the Faroe Islands?

Place an X next to one of the questions.

Result: Votes in favour of 1: 5,499; Votes in favour of 2: 5,660; Spoilt ballots: 481; Turnout: 67.6%

Due to the consultative status of the referendum and the close result, there was argument as to how to proceed. Eventually, a general election was called, the parties opposing independence won a majority, and within two years home rule was declared within a union with Denmark.

What lessons can be learned from this case study about the advantages and limitations of referendums as a political tool?

What might be the problems with calling a referendum within the context of a representative democracy?

Virtual exhibition objects

Throughout the optional theme chapters we have curated our own virtual exhibition to give you ideas and inspiration for your exhibition.

1.1 Knowledge and the knower

Scope

At first glance, it seems quite straightforward. We all possess some knowledge, and are aware of ourselves as knowers. When we are small, we know rather little; when we grow, we come to know more. When you enrolled for the IB diploma programme, you may even have wondered why the IB should consider a course about knowledge itself to be necessary.

While your childhood development describes a path towards increasing independence made possible through sustained acquisition of knowledge, your personal growth has been forged by the influence of various communities to which you have belonged – arranged around family, friends, school, religion, ethnicity, language facility, and many more. As an adult, community affiliations will continue to exert great influence on your knowledge. All of this plays out against the wider backdrop of the sum of human knowledge, to which countless individuals and groups have contributed throughout the history of our species.

Activity 1

Write down the following.

- Three things that you know that many other people also know.
- Three things that only you (or only you and a few other people) know.
- Three fields of knowledge about which much is known but you know rather little.

Reflect on your responses to these three categories.

What can you learn from this exercise about the magnitude of your knowledge compared with all of the knowledge that exists? What are some of the possible ways to feel about this? How does it make you feel, and why?

Are there significant differences between the kinds of knowledge that can be shared compared to those that can't? What about knowledge that could be shared but isn't?

A key recurring tension in TOK is the relationship between the autonomy of the individual as a knower and the social aspects of knowing. One of the goals of this chapter is to set the scene for exploration in the rest of the book of the diverse contexts in which this relationship occurs.

Another goal is to explore how the attributes of the IB learner profile might assist us individually and collectively in the pursuit of knowledge. As an IB student who is familiar with the learner profile, you probably find it unsurprising – even obvious – that one attribute of a successful learner should be the personal accumulation of knowledge. What else could you have been doing in all of those lessons over the years? And what about your experiences in life beyond the classroom? School is supposed to equip you not only with facts but also with the skills necessary for acquiring, evaluating, and building on them. So perhaps we can embark on a deeper investigation of knowledge and what it means to know, by making a provisional distinction between things that we know to be the case (such as that Madrid is the capital of Spain, or that the atomic number of nitrogen is 7) and things that we know how to do (such as searching for an answer to a question on the internet, or using a burette in order to undertake a titration). The former type of knowledge is sometimes referred to as *propositional*, as it can be expressed in language for everyone to examine; the latter type can be referred to as *procedural*, as it involves an ability to perform a task. As you set out on this inquiry into knowledge and knowing, bear in mind all ten characteristics or aspirations of the learner profile and consider their contributions to the journey.

IB learners strive to be:

- inquirers
- knowledgeable
- thinkers
- communicators
- principled
- open-minded
- caring
- risk-takers
- balanced
- reflective.

The exhibition task in the TOK course requires you to identify three objects and discuss them in the context of knowledge. Here, we are going to set up a virtual exhibition of three objects to discuss in a knowledge context.

Virtual exhibition object 1

Sporting tournaments are always accompanied by fevered attempts to predict the results. Indeed, some people are of the view that the build-up is at least as exciting as the event itself. During the 2010 football World Cup in South Africa, an uncannily accurate forecaster became a celebrity, by correctly predicting the winning team in all seven of the matches played by Germany. This celebrity was Paul, who happened to be an octopus. Before each match, Paul was provided with two boxes, each of which contained a tempting snack and was labelled with the flag of one of the competing nations. Whichever box he opened first was taken to be his prediction. Paul accumulated many followers in Germany until his accurate prediction of German defeat in the semi-final prompted some to suggest he could find himself on someone's dinner plate.

Match	Paul's prediction	Stage	Result
Germany *vs* Australia	Germany	Group match	4–0
Germany *vs* Serbia	Serbia	Group match	0–1
Germany *vs* Ghana	Germany	Group match	1–0
Germany *vs* England	Germany	Round of 16	4–1
Germany *vs* Argentina	Germany	Quarter-final	4–0
Germany *vs* Spain	Spain	Semi-final	0–1
Germany *vs* Uruguay	Germany	Third place play-off	3–2

Can we say that Paul knew who was going to win each match? It would be hard to argue for this; a more convincing explanation involves luck. Do you think a lucky 'guess' can be considered to be knowledge? Can we even claim that Paul was guessing? In any case, even the most committed human beings struggle to assemble the knowledge needed before matches to make sustained accurate predictions. How could Paul possibly have factored in knowledge about the individual players, the record of past encounters between the teams, the conditions in which the match would be played, etc.? More fundamentally, how could he understand that flags attached to snack boxes represented countries, or even what flags or countries were? Many would add that there is a considerable element of chance involved in sport, and hence truly knowing in advance is not possible. A genuine prediction of a result would seem to require believing that it will happen, and it's not clear that octopuses possess the capacity to hold anything that we might classify as a belief. A 'common sense' response to this scenario seems the only reasonable one: Paul was not really predicting anything because his choices were not informed by relevant information, and they were probably not connected to any mental state that we could accept as a belief.

Figure 1 Paul the octopus in his tank

If knowing is about having beliefs and being able to provide good grounds for them, it follows that Paul did not know anything about the World Cup. This seems fair enough. But does it then mean that octopuses really don't know anything at all? It turns out that, for invertebrates, octopuses have extremely well-developed brains and nervous systems, although the way they are structured is rather different to ours. This makes them particularly interesting subjects for investigation. Paul was singled out by his keepers for the prediction business because he seemed to respond intelligently to his environment. There are well-documented cases of octopuses discriminating between different people by squirting water consistently at only some of them (is this an octopus's version of an insult or a compliment?). They can repurpose objects like coconut shells as shelters, and display sustained curiosity with inanimate objects. It has also been said that they have a knack of escaping from tanks when no one is paying attention to them.

While we do not know what it is like to be an octopus because we have no direct access to its inner life (if indeed it has anything that can be described in this way), we can see that octopuses do respond to their environments in ways that seem purposeful and well adjusted. Rather than exploring knowledge as something requiring beliefs and good grounds for them, perhaps we should focus on actions and responses as indicators of a creature being knowledgeable – without worrying about what goes on inside an octopus's brain. More boldly, we could regard these actions and responses as instances of knowledge in themselves. It seems likely that, in the event of humans doing things that roughly correspond to those that octopuses quite routinely seem to do (including learning), we would accept that those things at the very least required knowledge or demonstrated skills that count as knowledge in themselves. Perhaps then, we could think of knowledge in terms of solving problems and the actions that provide responses to them.

In TOK, successful inquiry is predicated on an initial open-mindedness that permits us to draw tentative or speculative distinctions for the purpose of analysis. On more detailed reflection, these distinctions may or may not bring our understanding forward, and then we can elaborate or dispose of them. Here we have made a start in two distinct directions in our exploration of knowledge and knowing.

	Knowledge in the form of	Paying attention to
1	Claims	Beliefs and evidence
2	Skills/abilities	Actions/responses

Claim: a statement that asserts something to be true

Activity 2

Using each of the two ways of thinking about what we mean by knowledge, and looking at the table above, what conclusion do you draw about the capacity of an octopus to know? More generally, what might be the advantages and difficulties of insisting that knowledge must be, or must arise from, a certain kind of belief?

Does the second interpretation suggest that all living things have knowledge? For example, what about plants that respond to light and gravity, or yeast that switches to alcohol production in the absence of oxygen? If not, why not? If so, is this interpretation still helpful as a description of knowledge? If not, might it be possible to tighten it up somehow?

Virtual exhibition object 2

Among the many achievements of the Flemish cartographer, Gerardus Mercator, the most well known is his ground-breaking map of the world, published in 1569. In the heyday of European expansion and exploration around the world, accurate navigation was limited by the technology of the time. Mercator's contribution was to develop a map that always allows a navigator to steer to a constant compass bearing in order to reach the desired destination. There is no way to produce a flat map of a globe without deviating in some way from the reality of the world, and in Mercator's case the simplification of navigation came at the expense of accurate representation of area – the further a territory is from the equator, the greater its size appears on the map (see Figure 2).

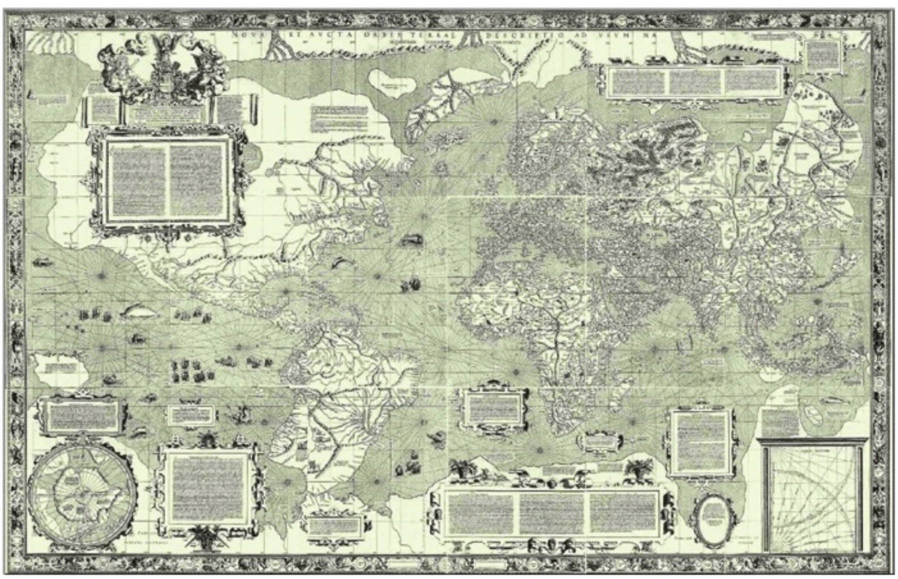


Figure 2 Mercator's map of the world, 1569

Are you familiar with maps of the world that use different projections? There are many alternatives now, and the reason why Mercator's projection has lost advocates in modern cartography is that the original trade-off has shifted. The global positioning system (GPS) and other items of modern technology have undermined the reliance on simple maps as a primary means of navigation, and hence the disadvantage of size distortion is no longer offset by the practicalities of the map. We are left with a map that misleads observers in ways that have an impact on their understanding of the relative importance and power of various regions of the world.

Mercator assembled the best available geographical knowledge about the world available to him in the 16th century and offered this knowledge in the form of a map. Here is a third way of thinking about knowledge: while Mercator literally produced a representation of the world, we can try thinking of knowledge in general as a representation of some aspect of the world.

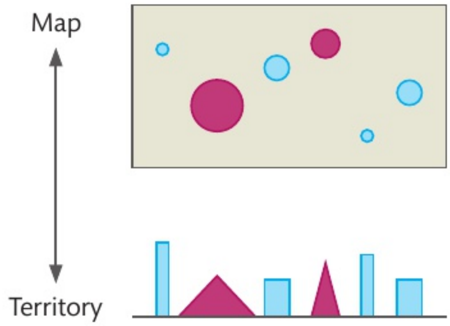


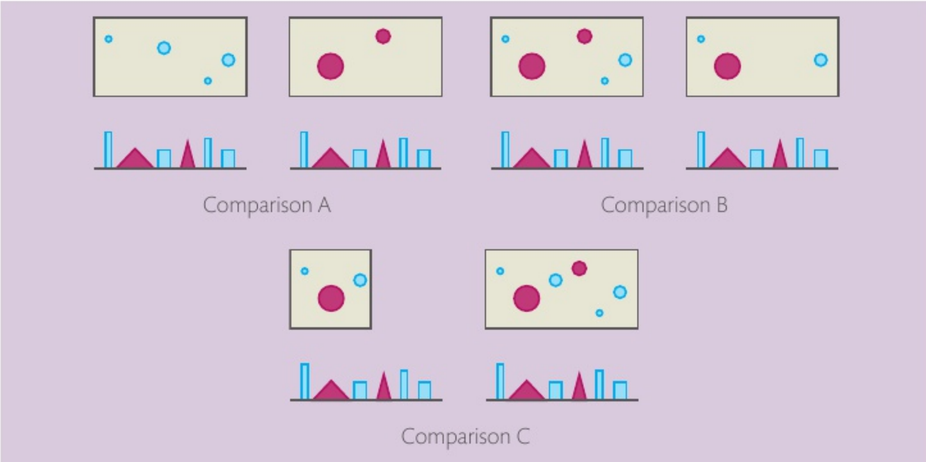
Figure 3 The map is to the territory as knowledge is to the world.

Figure 3 shows an overhead map (top) of a cityscape (the territory) shown in sideview (bottom). The relationship of the city to the map is the same relationship that we find between the world and the knowledge that describes it.

This metaphorical approach can be quite successful. It reminds us that the map and the territory are distinct things, and the map can never be completely correct or else it would have become the territory itself and hence lost its value as a tool. There can be alternative maps that emphasise different aspects of the (same) world. Maps can leave out things about the world that are unknown at the time, or add features speculatively about unknown things. As new discoveries are made, they can be added to the map or used to correct errors. Maps are often designed to solve particular problems (such as navigation). The aspects of a map that distort the world may be there by necessity or by deliberate design in order to solve the problem for which the map was created.

Activity 3

Consider the variants below on the map/territory figure. In what significant way do the two members of each pair of maps differ from each other? Can you 'translate' these differences in the maps such that they illustrate features of knowledge? What examples of knowledge can you think of?



Our inquiries have now raised the following three ways of thinking about knowledge.

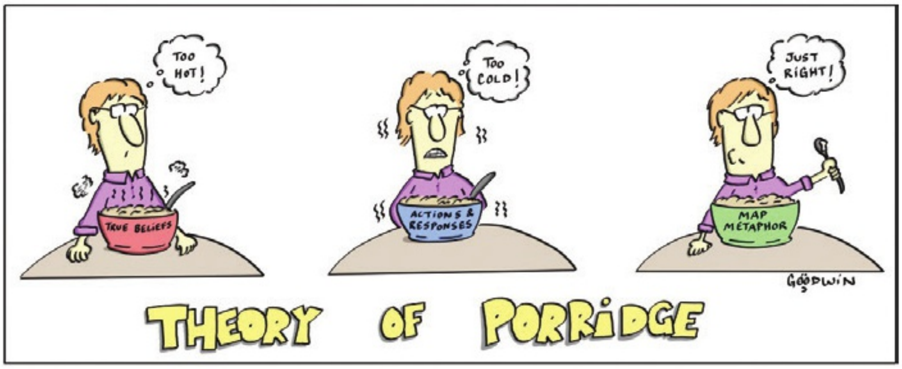
	Knowledge in the form of	Paying attention to
1	Claims	Beliefs and evidence
2	Skills/abilities	Actions/responses
3	Metaphorical maps of the world	Representations

Take a moment to revisit the provisional distinction introduced at the start of the chapter – *knowing that* and *knowing how*. How does this distinction relate to the three ways of thinking about knowledge?

If we insist that, in order to count as knowledge, beliefs must correspond exactly with the state of the world, the first way of thinking seems to set a very high bar for knowledge. While we might agree that Paul's predictions do not merit the knowledge label, it does not seem reasonable to suggest that Mercator was ignorant just because his map was not 100 per cent accurate. This sets us on the road to the conclusion that each of us knows very little indeed! The second conception carries with it the danger that, by focusing on actions, we include behaviours that are more readily described as adaptations or instincts as knowledge, and end up stuck with a description of knowledge that is too broad to be useful. Arguably the third conception is troubling because it allows for knowledge that is false in some respect. 'False knowledge' sounds like a weird idea.

Activity 4

Are the three conceptions of knowledge in the table above entirely distinct, or is there some overlap? Does one of them strike you as having more potential as we progress through this book? Or do you think it will be 'horses for courses', with each of them providing enlightenment as we go along? Is it OK to keep switching from one description to another, or is that a kind of argumentative 'cheating'? Does the map metaphor provide middle ground between those approaches to knowledge that are either unrealistically ambitious or unhelpfully inclusive?



Whatever your responses to the questions in Activity 3, let's keep all three conceptions to hand for now.

Virtual exhibition object 3

The last object in our virtual exhibition is the best-selling jazz album of all time by any solo artist – a recording of the concert given by the pianist Keith Jarrett on 24 January 1975 at the Opera House in Cologne, Germany. On this recording, Jarrett is not playing a pre-existing piece; he is improvising throughout, yet his ability to generate this music spontaneously rests on a rich foundation of knowledge about harmony, melody, rhythm, and musical styles. Jarrett has a sophisticated internal map of musical theory, but that seems insufficient on its own to explain what he has achieved with 'real time' improvisation. There are many people who have comprehensive and deep musical knowledge and yet are not able to do what Jarrett does.

Figure 4 The Köln Concert, Keith Jarrett

Activity 5

Try to employ one or more of the three conceptions of knowledge in order to explain how a musician can give a concert of this kind. What roles, if any, do beliefs, actions, and representations play?

Consider the following quotations from Jarrett himself.

> When I'm out there and there's just a piano, it's like my body knows exactly what to do – it's just like my left hand knows how to play. And if I tell it what to play, I'm stopping it. Not only am I stopping it but I'm stopping it from playing something better than I can think of.
>
> (www.youtube.com/watch?v=fDbOKHOuy9M; after 1 min)

> I myself am a pawn to this whole thing [...] I am either going to be in there inside the process of improvising or I'm going to be on the outside wondering what it is and coming up with a theory and an answer.
>
> (www.youtube.com/watch?v=a-kznTN66Ho; after 7 min 30 sec)

Activity 6

Do you think Jarrett is expressing something worth noting about the relationship between *knowing that* and *knowing how* in the context of improvisation? How could it be that his musical performance is diminished by his effort to understand the process by which it is achieved? Even memorisation of a scored piece of music can be undermined by paying too much attention to individual notes and chords. If you are a musician, have you had any such experience?

Perhaps the scenarios in which one kind of knowledge can be successful only by subduing another are more widespread. Golfers, snooker players, cricket bowlers, darts players, and baseball pitchers are all susceptible to a condition known as the yips, in which the motor skills needed to perform a particular repeated action (such as a golf swing or a baseball pitch) suddenly desert the player. The exact causes are disputed, but one explanation involves a conflict between performing the action and systematic knowledge of what is required in order to achieve it. Sporting actions of these kinds become automatic through repetition, and this permits the player to focus on their immediate strategy in the game (hitting the ball long to avoid a bunker, exploiting a weakness in a batsman's defence in order to dismiss him) rather than the mechanics of the action. When something goes wrong, the player starts to rely on analysis of their internal map of all the components of the action that are required, in order to understand where the problem lies; but this only worsens the problem and the result is an inability to perform the action to any successful degree at all.

> [T]he yips are restricted to a quite specific range of sporting activities. They afflict only those actions that are triggered by the players themselves, as opposed to those that are responses to someone else. It is specifically when you need to initiate a sporting action that you are in danger of thinking about the movements you must perform.
>
> (Papineau, 2017, p. 49)

Pinning down the nature of knowledge and what it means to know is not a straightforward task. There seem to be different kinds of knowledge, different ways of describing them, and some controversy as to how they interact. But with the assistance of three objects (the octopus, the map, and the album) we have flagged some distinctions and applied some concepts in order to try to tease out the nuances and subtleties. Rather than reaching for the first definition that comes to hand, success in this course involves taking a balanced approach to analysis, with ideas that can be refined or rejected according to circumstances.

Things to think about

- Mercator's projection is only one of many. Research some other projections and their effects on accuracy – do they add any further insight into the nature of knowledge conceived as a map of reality?
- The metaphor of the map might work well in principle for thinking about knowledge but, in a world in which map-reading and interpretation are increasingly delegated to technology, do you think the metaphor will become ever less powerful for TOK students? Does this question resonate with you? Why or why not?

Knowledge questions

- Why are the criteria for what counts as knowledge not obvious?
- What criteria can we use to distinguish between knowledge, belief, and opinion?
- Are there situations where *knowing how* is more important than *knowing that*?

Perspectives

People hold different beliefs about many things. Sometimes, this just amounts to disagreement about individual and specific claims, and often this kind of dispute can be resolved by reference to other facts or experiences about which there is agreement. There are times when we are just wrong, can be corrected, and are willing to accept the correction.

For example: 'Barack Obama was the 45th president of the United States.' 'No, he wasn't – here is the complete list; count them.'

But not every belief can be so easily verified or abandoned. For example, you will have an opinion about the success of your school as a place for learning. We can call this opinion your **personal point of view**. This view will have been formed through your experiences at school, and also shaped by a number of factors external to the school itself yet important to your own identity. Before proceeding, consider what some of these factors might be.

Now read through the following two passages about the nature of education and schooling.

Passage A

Education can benefit from the application of concepts and methods from the business world. Students can be viewed as consumers of education, and their performance measured, quantitatively as far as possible, in terms of 'value added'. Teachers and schools can be made accountable in terms of their success in administering this extra value to students, leading to an effective results-driven and competitive market in educational opportunity. Computers and related technologies have advanced to the point where they are more effective than humans in delivering curriculum content and adjusting learning experiences according to the needs of individual students. The role of the teacher needs to be downgraded to managing the environment in which technology takes centre stage, or perhaps removed altogether along with schools themselves as institutions for learning.

Passage B

Education and business are fields with distinct differences. Students need to be treated as whole persons with individual goals and interests that inform their intellectual development. Students can learn to take full account of these attributes and become self-directed and balanced citizens only with guidance from experienced adults. 'Well-being' should be understood as extending far beyond material concerns. Objective measurement of students' performance relative to each other is difficult and is often best measured qualitatively. Not only is the teacher key to effective learning, but schools as long-established institutions provide the nucleus of learning communities and safe spaces in which socialisation can take place, with teachers in *loco parentis*. Accordingly, teachers and schools continue to function as effective institutions for learning.

Activity 7

What is your opinion on passages A and B? Does one passage seem more convincing than the other to you? Or are you in the middle somewhere, or possibly somewhere else entirely?

You might be hesitant or deeply convinced by your view, but this doubt or conviction will come from a combination of the influences of factors such as your direct experiences, your interests, and components of your social background including culture, gender, age, or religious and political preferences. Identify how aspects of your own life and background in these categories might have had an impact on your point of view on this topic.

These factors work together to identify the 'location' from which you witness the world as a whole. We will refer to this matrix of circumstances as your *perspective*, and it shapes and explains the views that you hold. Let's set this in the context of the two views above.

Activity 8

Can we describe the perspectives that are likely to give rise to the positions above on the topic of the relationship between education and business? Think about the concepts, practices, and values that are implicit, and about what experiences, interests, and social backgrounds might lead to them.

'He would think/say that because he…'. In attempting to identify these perspectives, to what extent is there a danger of stereotyping? How serious are the dangers of reaching conclusions about someone's point of view on the basis of their perspective?

Perspectives are stable and durable features of our outlook that steer each of us towards particular views, and the acceptance and rejection of various claims. Later on, we will examine claims on an individual basis by focusing on the ways in which they might be supported, but a whole body of knowledge, such as one that may arise from a perspective, might require a different approach. It is important not only to unpack this knowledge and reveal the components of the perspective that lies beneath it; it is also crucial to examine it as a whole. One fruitful field for inquiry here is religion, as the perspectives that underpin religious beliefs and practices are particularly influential. These matters are explored in Chapter 2.4 **Knowledge and religion**.

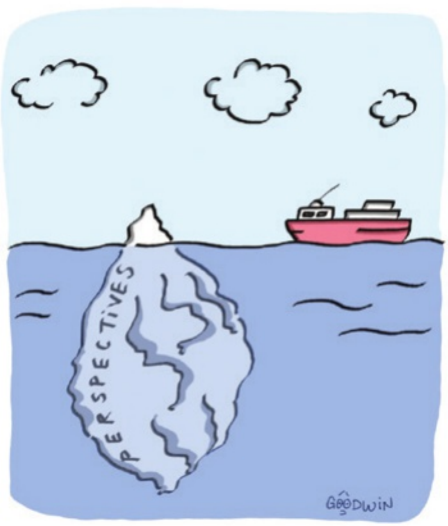
In the example above concerning education, each passage encompasses an interlocking set of claims that may be better described metaphorically as a map of the territory rather than as a set of independent assertions. Each 'map' has its own emphasis. For the sake of the metaphor, it might be argued that each on its own presents a somewhat distorted view on the subject. Nevertheless, there are areas of consensus: that education is important, that there is a need for differentiated learning experiences, that students must be motivated by whatever resources are considered paramount for learning, and so on. The positions overlap even though they may be steered by contrasting perspectives.

Activity 9

Perspectives are shaped by membership of communities. Take a moment to consider the communities to which you belong and the contribution that each has made to your overall perspective. Is there knowledge that you have acquired in complete isolation from any community? If so, what kind of knowledge might that be?

Think about how your portfolio of memberships has changed over the years and how these dynamics might have influenced shifts in perspective. Who is responsible for these shifts, given that membership is voluntary for some communities but not for others? Might there also have been stand-out events that had a major impact?

Like an iceberg, perspectives are to be found mainly 'below the waterline'. You have probably found in Activity 9 that it takes a concentrated effort to be reflective and uncover the foundations on which perspectives are built.



Activity 10

'It is easier to identify the perspectives that other people hold than it is to describe one's own.'

Would you agree with this statement? If so, why would this be the case? If not, why not? Either way, what might be the implications for social interaction and the sharing of knowledge?

Perspectives are unavoidable given the fact that there is no view available from nowhere. It is crucial to the success of our TOK journey that this point is understood. We are all embedded in a matrix of influences that shape the ways in which we understand the world. At first glance, this might be taken as a death blow to the search for objectivity and hence a licence to adopt an attitude of resignation with respect to knowledge. But as we shall see, knowing can make sense only when there is a particular foundation on which the knower can build. Taking a balanced approach and drawing on the insights provided from a variety of perspectives is often more effective in refining our knowledge than the quest for a single detached outlook.

There is no view from nowhere.

The British philosopher, Julian Baggini, has suggested three advantages of taking an open-minded approach to perspectives and the knowledge that they promote (Baggini, 2018, p. 388).

- **Cubist:** by gathering more knowledge about an issue, we can minimise the chances of overlooking something important.
- **Disaggregating:** by examining each perspective, we may discover that there is actually more than one issue at stake.
- **Pluralist:** by comparing perspectives, we may come to realise that there is more than one way of understanding the issue.

▲ **Figure 5** Dr Julian Baggini

While taking on board different perspectives might make sense in principle, achieving it is not always an easy task. It requires more than simply the application of careful reasoning to the claims that emerge from them. It also demands a willingness to develop empathy with those who hold them, and the imagination to bring to life somewhat different conceptions of reality that may seem alien to us. Where perspectives generate conflicting bodies of knowledge, empathy might be difficult and the motivation to explore points of view in opposition to one's own may be hard to sustain.

The map metaphor is an attractive way of thinking about knowledge in the context of perspectives. How far can we run with it? Remember that no map is entirely true, but some are better than others.

It does not seem too far-fetched to suggest that our appreciation of the issues surrounding education are given balance by an engagement with multiple perspectives and the views that they support. After all, there is much to learn, and the relationship between educational goals and the institutions that support them can be framed in different ways. More seems to be better here.

But the relationship between perspectives and knowledge is not always favourable, and it is sometimes the case that perspectives give rise to deeply oppositional stances. Under these circumstances, you might challenge some of Baggini's optimism. Such is the case with climate change: whether it is occurring on a global scale, and, crucially, the degree to which human activity might be contributing to it. While there is overwhelming agreement within the scientific community about the reality of this phenomenon and that there is a human contribution to it, there are still many people who do not accept these claims. Rejection can often be traced back to perspectives that foster a belief in freedom from government intervention in public affairs, and in the economic market as efficient in solving problems. These beliefs in turn are deeply associated with views from the right of the traditional political spectrum. More broadly, those who remain unconvinced by the human contribution to global warming as a component of climate change often have a more comprehensive suspicion of institutions – extending to the scientific community and those within it who possess specialised knowledge. In addition, some may have long-term experience of living in communities that are dependent on industries that emit large quantities of carbon dioxide, or are located in places where the effects of climate change are less likely to be obvious.

Activity 11

Given what has been written above, what values and practices would you expect to find in the perspectives of climate scientists? Can you make any speculative generalisations about aspects of their social background?

In common with many other pressing issues of the world, data can be interpreted in various ways. In such circumstances, the products of different perspectives can thrive. Those who wish to exploit the views of others can find rich opportunities to do so.

> Doubt is our product, since it is the best means of competing with the "body of fact" that exists in the minds of the general public.
>
> (1969 memo sent by an executive at Brown & Williamson Tobacco; Oreskes, 2010, p. 48)

If the evidence seems too stacked against a point of view, rendering the goal of convincing others impractical, the attempt to manufacture doubt may be sufficient to undermine opponents. Rather than trying to undermine the authority of the scientific community, a few scientists can be persuaded to abandon principles by lending their expert status to the task of creating this uncertainty – as happened for many years with the smoking lobby (and continues to happen with the emergence of electronic cigarettes and vaping). Contestable points of view are fortified by an accompanying raft of justifications that are equally disputable. The integrated nature of perspectives and the knowledge that they facilitate creates a structure highly resistant to change.

Activity 12

Review Baggini's appeal for engagement with multiple perspectives. To what extent do you think the advantages he proposes hold up in the light of the examples given in the areas of climate and health?

We have seen how we unavoidably live in a world of different perspectives. We need to try to unpack those perspectives whenever they can provide us with a better understanding of diverse points of view. Familiarity with different perspectives may enrich our knowledge or provide us with a more solid basis on which to challenge them. Sometimes this latter task is rendered harder when conflicting views are presented as if there were a 'level playing field' in credibility where this is actually not the case. If a principled knower is one who maintains a respect for knowledge and takes responsibility for the health of their own knowledge, then judgements about when to accept knowledge arising from a different perspective and when to call it out as flawed, false, or even dangerous assume great importance. Open-mindedness needs to be moderated by careful reflection. Some of these issues will be explored further in Chapter 2.1 **Knowledge and politics**.

In terms of the map metaphor, we need to distinguish between maps that enhance our understanding of a territory and our ability to navigate it, and those that are poorly constructed or based on principles that distort (unintentionally or deliberately) the relationship with the territory. This calls for a closer look at individual claims, and so in the next section we will focus more directly on the 'micro' business of identifying and examining claims carefully.

Things to think about

- With regard to the topic of education and schooling, is there a perspective that is more likely than others to offer knowledge that is useful for making decisions? Might this vary by place and time? What can happen when a 'foreign' perspective is allowed to dominate in a different environment? On what basis, if at all, can we judge perspectives?
- What might be the advantages and drawbacks of incorporating insights arising from a variety of perspectives into our knowledge?
- Different cultures sometimes exhibit varying responses whenever limits to knowledge are encountered. In modern Western culture, the reaction is often to take limits as challenges to be overcome, but this is not a universal response. Can you think of any circumstances in which limits to knowledge are met with acceptance or even celebration? Attitudes to the limits of what can be known are explored in Chapter 2.5 **Knowledge and indigenous societies**.
- How can we identify the point at which acceptance of the views that emerge from a perspective can no longer be sustained? To what extent can we blame the underlying perspective for toxic views, or overlook or excuse those views on the basis of the perspective from which they emerge?

Knowledge questions

- How is it possible to know what shapes my knowledge as a knower?
- How much of our knowledge depends on our interactions with other knowers?
- Are there types of knowledge that are specifically linked to particular communities of knowers?
- Presented with the belief system of a community of knowers, how can we decide what we personally believe?
- Is the truth what the majority of people accept?
- How do empathy and imagination help us to understand other perspectives?
- How can we know that current knowledge is an improvement on past knowledge?

Methods and tools

Reflect for a moment on the exchanges you have with other people. We are at the end of a seemingly endless stream of claims to knowledge offered up by family and friends, the school environment, and from whatever other sources with which we choose to engage or are exposed to. In order to navigate a world full of so many assertions, we often need to call on methods that might be effective in evaluating them. Accordingly, the first part of this section focuses on individual propositional claims. It will also be important to look at how these claims are acquired, and how they might be combined in the quest for new knowledge.

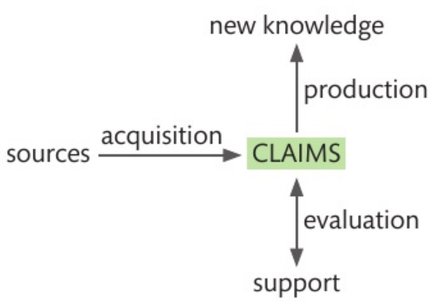


Figure 6 How are claims acquired and combined in the quest for new knowledge?

In our efforts to navigate our way in the world, we gain knowledge from other people and from the world itself (**acquisition** of knowledge). It is important that we subject this knowledge to scrutiny in order to have confidence in it (**evaluation** of knowledge). As consumers of knowledge, we need to engage both of these processes. Furthermore, new knowledge can be built on the foundation of what we have established (**production** of knowledge).

For instance, the video 'ForeverGreen: 8 principles of health' claims that 'Water conducts electricity', www.youtube.com/watch?v=zFC7xtXol2g; (after 1 min 34 sec).

Here we encounter the first challenge in evaluation – namely that we simply do not have time to test rigorously every claim with which we make contact. Imagine what would happen to social interaction and your peace of mind if you tried to do so! We must be selective, and being knowledgeable is the first line of defence against falsehood because it helps us to identify those claims that seem suspicious as they do not immediately seem to fit with our background knowledge. Once flagged in this way, what are some of the methods by which you could check the claim above?

1. You could undertake a basic scientific experiment in order to gather first-hand evidence to see whether there is a **correspondence** with the claim. At first glance, this might seem to be an attractive method; direct observation on a personal basis. But in this case and many others, it is not going to be the easiest option – materials and apparatus will have to be collected, and the outcome of the experiment is likely to be reliable only if several precautions are taken that may not be immediately obvious (such as the need to use water that is as pure as possible). Furthermore, you will need familiarity with the concepts in which the claim is framed – what does it mean to 'conduct' electricity, and what actually is electricity in the first place?

2. Alternatively, having flagged the claim as contestable, you could call on previous knowledge in order to check for **coherence**. Knowledge from chemistry or physics (either that you have memorised or can readily acquire) would help:

   No covalent compound conducts electricity./Water is a covalent compound./Hence water does not conduct electricity.

   In this case, it is fairly straightforward for you to build a watertight (!) argument that refutes the claim, but often this is not possible when claims are more complex or open to interpretation.

3. Another way forward would be to run the claim past one or more experts in the relevant field of knowledge. A good choice might be one of your science teachers; alternatively, expert knowledge can be accessed from sources such as books and the internet. You would need to be as confident as possible that this knowledge does indeed originate with an appropriate **authority**, and so the skills and practices you have learned concerning source evaluation need to be activated.

4. In the absence of experts you might resort to asking friends and colleagues what they think about the claim. There are obvious advantages and dangers of searching for the **consensus** – not least issues to do with the composition of the group involved, which may be unconsciously skewed towards a desire for confirmation or otherwise.

Figure 7 The search for good grounds for accepting a claim

Activity 13

Consider each of the following claims. In principle, which of the methods above is available for evaluating the claims? In reality, which of the methods is a viable choice?

1. No human being has ever set foot on the Moon.
2. Giovanni Riccioli's 1651 map of the Moon has an orthographic projection.
3. The shadow of the Earth on the Moon during a lunar eclipse is curved.

4. The Moon was formed from a collision between the Earth and another body early in the history of the Solar System.
5. The Moon plays a role in tides on Earth.
6. Luna 10 was the first spacecraft to orbit the Moon.
7. The acceleration due to gravity at the surface of the Moon is $1.62 m/s^2$.
8. On average, there is a full moon every 29.5 days.

We all know that a standard method of finding things out is to connect to the internet and conduct a search. What might be the implications of this? How can we be confident about the accuracy of what we discover? (Issues to do with authority and consensus remain.) What about the knower's motivation to sustain a comprehensive and deep reservoir of knowledge in a world where so much of it can be accessed so easily? We have already seen how critical evaluation depends on what we already know, and there are those who claim that the internet promotes a shallowness in our knowledge as a consequence of 'outsourcing' memory. Might a reliance on online sources undermine personal initiative in finding ways to test claims? Your teacher may decide to focus on some of these issues more deeply in Chapter 2.2 **Knowledge and technology**.

Whatever the answers to these questions, internet searches should not be considered as a method of evaluation that is independent of what has been outlined above. Identification of genuine authorities, the composition of groups in which to trust, the ways in which different facts need to be logically arranged – all these issues remain. Indeed, a brief survey will show how interconnected some of these methods are, and in particular how reasoning is involved in all of them. Reasoning is essential in order to establish what observations signify, and it is needed in order to establish who is (and is not) an appropriate authority.

An effective appraisal of the methods for evaluating claims will require an examination of the tools that make those methods possible. On the one hand, this set of tools permits us to acquire, evaluate, and produce knowledge on an individual basis; but at the same time the fact that we are aware that each of us possesses more or less the same set of tools makes shared knowledge and understanding possible.

Observation relies on a range of biological apparatus (eyes, ears, a variety of sensory cells) for collecting sense data from the world and relaying it to the brain, where it can undergo some interpretive processing. The result is what we call *perception*. You will probably be able to recall situations where you have been misled by expectations based on your prior experiences held in the memory.

What you perceive in the café wall illusion in Figure 8 is an example of a warped perception of reality that we all experience. Contrastingly, there are two distinct ways of perceiving the Necker cube as a three-dimensional object but neither is preferred and each seems equally persuasive. However, we all interpret the image of the indent illusion with light from above casting shadows accordingly – a perception that can be altered by imagining the image illuminated from below (you can try this, or alternatively turn the image upside down to see what happens). Nevertheless, we settle on the interpretation that is in accordance with the world which we normally inhabit. It is experience that creates a perceptual preference. The fourth image is the

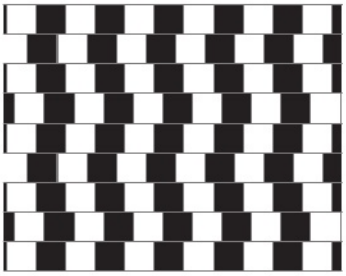


Figure 8 Café wall illusion

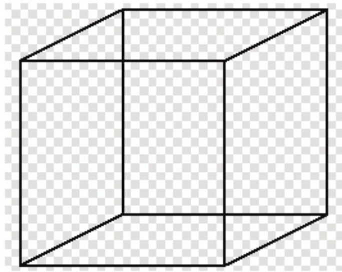


Figure 9 Necker cube

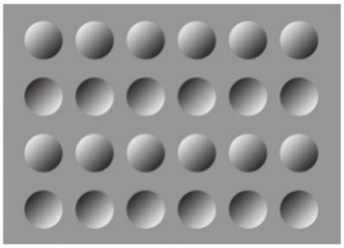


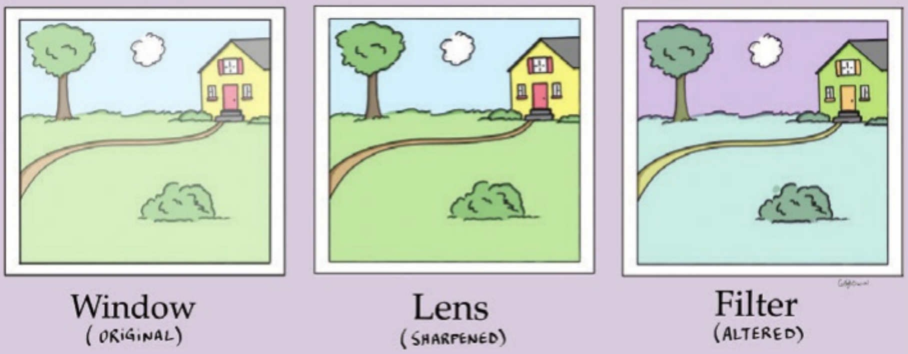
Figure 10 Indent illusion

Figure 11 The 'face on Mars'

'face on Mars' – we have a deeply ingrained tendency to perceive faces that interferes with the fact that, in this case, what we have is a particular landscape configuration. This time it is evolutionary forces at work. Perceptual illusions are engaging and provide a rich field in which to explore the bases on which we interpret the world. Despite the odd anomaly or confusion that perceptual illusions can offer, it is worth keeping in mind that our ability to function in the world does suggest that the process of perception is generally effective.

Activity 14

Lenses can sharpen, but also distort; filters can change, but also block. Consider the interpretations of these metaphors shown in the pictures below, as well as other interpretations. What are the implications of describing the perceptual process in terms of windows, lenses, filters, or maps? Do these metaphors pick out different features? Which metaphor do you think provides the most insight into the relationship between the world and what we perceive?



While observation makes use of essential connections to the world, relying solely on perceptual tools will never be sufficient in order to give us all the knowledge we need. In alignment with the discussion on authority and consensus above, much of our knowledge comes from what we are told by others, which of course is mediated by language. There is much more to consider about this dynamic relationship in Chapter 2.3 **Knowledge and language**. Languages offer great power for describing the world in different ways – for example, consider the use of the terms *climate change deniers* and *climate alarmists* with respect to what could be called *climate change* or *climate emergency*. Individuals or groups wield this power in the service of their particular agendas; we need to pay careful attention to the ways in which words are selected and presented if we aspire to the effective understanding of communication that is needed for our self-defence as knowers.

In addition to sensory and linguistic capabilities, reasoning on its own provides an effective means for evaluating claims and building knowledge. You may be familiar with two basic types:

Deductive reasoning	Inductive reasoning
All octopus species possess eight arms *O. mercatoris* is an octopus species **Hence *O. mercatoris* possesses eight arms**	*O. mercatoris* is an octopus species and has eight arms *O. vulgaris* is an octopus species and has eight arms *O. maya* is an octopus species and has eight arms *O. salutii* is an octopus species and has eight arms *O. rubescens* is an octopus species and has eight arms **So all octopus species have eight arms**

Deductive reasoning allows us to infer a conclusion that is as certain as the premises from which we started, although it could be argued that this conclusion is of limited value as it is already implicit in the premises. Inductive reasoning offers a trade-off between the advantages of generalisation and the necessity of risk-taking, as the conclusion is open to revision in the light of more data.

The examples of reasoning offered above are simple and 'clean' so that their structure is clear for the purposes of demonstration. But 'real life' is almost always messy and harder to reduce to such straightforward arguments.

Consider the following four examples.

> Greenhouse gases help to trap solar radiation.
> Greenhouse gases include carbon dioxide, methane, and water vapour.
> Hence carbon dioxide helps to trap solar radiation

The conclusion necessarily follows from the premises, but we have not learned much that we didn't know at the start.

> Mean global temperatures have increased over the past 100 years.
> Atmospheric carbon dioxide levels have increased over the past 100 years.
> Hence what?

The premises on their own do not lead to a conclusion about which phenomenon causes the other. Nor that there is any cause and effect relationship between them at all.

Mean global temperatures have increased over the past 100 years.
Anthropogenic emissions of carbon dioxide have increased over the past 100 years.
Hence what?

A definitive conclusion is difficult to reach because the premises provide no data on the relative size of emissions from each type of source, nor any data over a longer timescale with which to contextualise them.

Increased mean global temperatures will generate more clouds.
Some clouds produce a net cooling effect by reflecting solar radiation away from the Earth.
Hence what?

In this case the premises seem insecure and so the content of the argument may lead to a false conclusion.

As a result of these kinds of challenges, reasoning about the 'real world' tends either to become lengthy and less transparent as a result of trying to plug any 'holes' in the argument. As premises become more complex and more realistic in their description of the world, it becomes more difficult to spot assumptions in them that are not stated and may need careful exposure and scrutiny. Do you think that the messiness of real life diminishes the value of studying 'clean' forms of reasoning?

Nevertheless, you will no doubt be familiar with the notion that reasoning is a reliable and productive activity that is sometimes undermined by emotion. How many times have you heard that emotion 'clouds' our reasoning and is responsible for many of the errors that we make? This is an unflattering and inaccurate description of the role that emotions play in our lives – without them, we would struggle to know what to investigate, and decision making would be stripped of meaning and made impossible.

The eminent Israeli-American psychologist Daniel Kahneman and his late Israeli colleague Amos Tversky devoted much of their careers to setting out a different vision that explains aspects of human cognition. In addition to the activities that we traditionally think of as reasoning (such as careful, conscious, deliberate drawing of conclusions from premises, as exemplified above), they suggested a complementary mechanism that makes rapid judgements by comparing current situations with previous experiences of the world. This 'system 1' operates largely below the level of consciousness and may be essential in order to relieve the burden on the slower, more methodical 'system 2' (reasoning) which would otherwise quickly become overloaded by the effort to process the rich stream of events and data of daily life. The idea is that successful negotiation of events depends on a dynamic balance between these two systems.

We can think of system 1 as continuously monitoring the world and comparing it with prior experiences and deep-seated expectations. This kind of activity is often described as a kind of intuition, although it might be argued that it is really a form of rapid unconscious reasoning. The key point about system 1 is that it can respond in 'real time' to events, but it does this by applying some short-cuts (called *heuristics*) that run the risk of producing errors (called *cognitive biases*). In principle, some of these errors

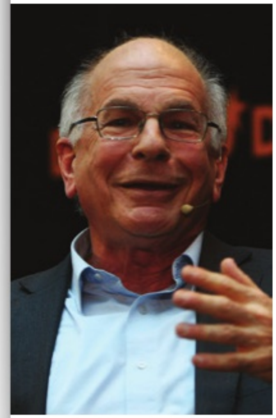


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Figure 12 Professor Daniel Kahneman

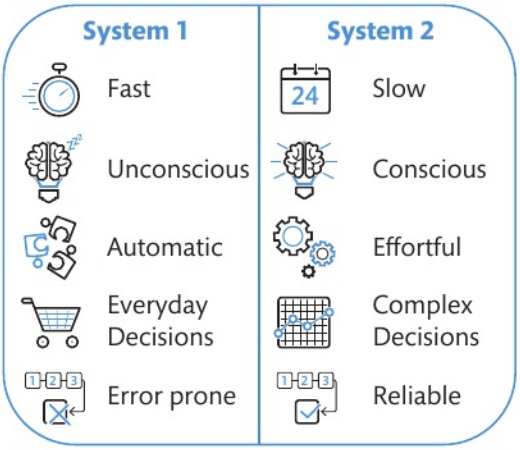


Figure 13 Kahneman's system 1 and 2 thinking

can be corrected by the careful application of system 2 thinking. However, despite the mental effort invested in the operation of system 2, some logical errors (called *fallacies*) can occur here, too.

	Speed	Application	Procedure	Drawbacks
System 1	Quick	Always available	Employs short-cuts	Prone to biases
System 2	Slow	Selective use	Methodical processes	Possible fallacies

System 1: here are a couple of examples of cognitive heuristics proposed by Kahneman and Tversky:

Availability	Estimating probability of an event on the basis of instances that come most readily to the mind of the knower.
Anchoring and adjustment	Estimating probability of an event by adjusting from a value provided to the knower.

System 2: here are a couple of examples of fallacies – can you spot the problem in each case? Not every fallacy is as easy to identify:

Affirming the consequent	Exclusive premises
If Paul predicted a German win, football fans in Germany will be happy. Football fans in Germany are happy. Paul predicted a German win.	No octopuses are fish Some fish are not pets Some pets are not octopuses

While the success of system 2 thinking is limited by our tendency to make logical errors, the reputation of reason as a way of evaluating and producing knowledge remains undiminished. This is an outcome of a close association with the concept of rationality and all of its positive connotations. However, the question remains as to whether the pursuit of rational outcomes always produces the best result.

Krill are small crustaceans found in vast quantities in the Southern Ocean. Their economic value stems from their use as animal and fish feed, and increasingly to provide ingredients such as omega-3 fatty acids in health products. Their ecological value derives from their key niche in the overall Antarctic marine ecosystem. Unfortunately, the economic value has been allowed to undermine their ecological value as overfishing of krill has accelerated. This is a classic 'commons tragedy', in which self-interest (in this case, that of national fishing fleets) trumps the common good. Extracting ever more krill from the ocean by any one fleet leads to the degradation of an ecosystem that has to be shared by all. If rationality is understood to mean reaching a logical but self-interested decision on the basis of the local situation of the participant, then this individual rational choice does not seem to produce the best result for all in situations where resources are jointly owned or not strictly owned (or recognised as being owned) by interested parties at all. Can you think of other real-life examples of commons tragedies?

Figure 15 Commercial krill fishing

Figure 14 Antarctic krill

You will no doubt see that situations such as these have an ethical dimension, and hence can provide a connection to the next element of the knowledge framework, ethics.

Are there viable strategies for enhancing the performance of our cognitive tools or the behaviours that arise from them? Daniel Kahneman is not entirely confident that awareness of biases and fallacies can help us to avoid them, but an awareness of errors that arise from the activities of both systems 1 and 2 may help. In addition, taking care with the construction of logical arguments and engaging in extended practice might have some impact. Hence, remedy through education could be one successful approach but it is unlikely to be sufficient when it comes to resolving issues where self-interest is involved, such as overfishing. The best outcome might be reached only by coercion of some kind, such as legislation, although several additional challenges emerge here, such as the need for acceptance not only of this approach among all parties, but of the body whose job it is to police it and sanction those who flout it.

Another type of intervention is to accept the existence of cognitive biases, but arrange the contexts in which decisions are made in order to minimise or counteract any negative effects. In this way, behaviour can be 'nudged' towards better outcomes. This strategy of adjusting the world rather than cognitive performance or applying coercion is sometimes labelled *choice architecture*. One example that demonstrates how a systematic bias towards the status quo can be exploited, rather than left to undermine outcomes, concerns organ donation permissions. Simply changing the wording on the permission form, as has been done in some countries, so that the citizen has to make an active choice in order to opt out rather than to opt in results in far more organs potentially becoming available. This is because a systematic bias favouring the default option means that most people do not take the deliberate purposeful step needed to remove themselves from the register.

As we shall see later in this book, the production of knowledge in the various areas of knowledge depends for the most part on tried and tested methods. These methods are often expressly designed to counteract or minimise limitations of the human 'toolkit'. For example, scientific methods contain protocols for how to make observations, and narrow the number of variables under investigation as far as possible in order to sharpen the conclusions that can be drawn.

If preoccupied with the exploration of propositional claims, it would be easy to overlook the development and maintenance of procedural *knowing how* knowledge. Acquiring skills involves observation and attempted imitation of those who have already mastered them, and retention and further refinement is a product of practice. It is obvious that these are requirements for excellence in fields such as the arts and sports, but subsequent chapters will show how there can be very little *knowing that* without any *knowing how*.

Things to think about

- Find out about *Haliphron atlanticus*. Can you make any connections to inductive reasoning and expectations?
- Alfred Russel Wallace, co-founder of the theory of evolution by natural selection, got himself involved in an ill-tempered and extended dispute with several individuals who claimed that the Earth is flat. This was in the 19th century when the shape of the Earth was long established beyond reasonable refutation. How can we know when to tackle the falsehoods promoted by others and when to ignore those who are doing the promoting? Consider here what is known as the 'backfire effect'.
- Some 'conspiracy theories' have survived for long periods. Consider the assertions that have been offered to support the view that the Apollo Moon landings never happened. Are these views best tackled by trying to refute individual claims or by challenging more fundamental beliefs arising from the underlying perspectives?
- Investigate the **prisoner's dilemma** – what are the formal similarities and differences with respect to commons tragedies as exemplified earlier by krill fishing?
- Try out the **ultimatum game** with a partner. Consider what the rational choice might be for the recipient of the deal. Did you accept or reject the offer made to you strictly on this basis? If not, why not? What might we learn from this about human motivation?
- As a child, Tiger Woods was drilled in very specific skills applicable to golf, whereas, at a similar age, Roger Federer was encouraged to accumulate a much wider range of sporting experiences. What can we learn from this?

Knowledge questions

- How do we acquire knowledge?
- What constitutes a 'good reason' for us to accept a claim?
- Are intuition, evidence, reason, emotion, consensus, and authority all equally convincing methods of justification?
- Does knowledge always require some kind of rational basis?
- How do our expectations and assumptions have an impact on how we perceive things? How can we know when our expectations and assumptions are impacting our perceptions?
- What are the advantages and disadvantages of requiring that all knowledge is verified by a group?

Ethics

Huntington's disease is a neurogenerative genetic disorder caused by a faulty version of a single gene. Symptoms typically begin in middle age. A dominant version of the gene is responsible – so anyone who has a parent with the disorder has a 50 per cent chance of inheriting it. In 2017, a woman won the right to sue the doctors who had earlier tested her father and found him positive for the disease but had not informed her. Their inaction arose from the father's insistence that the test result be kept confidential. What kinds of questions might you ask? What can we conclude about any responsibilities that accompany knowing?

In many countries, confidentiality is a key to the relationship between a doctor and patient. There are practical reasons for this – notably that patients will be less likely to share knowledge with doctors unless the patient is convinced that this knowledge will not be passed on. Again, in some places, this understanding is so important that it is enshrined as a legal duty as well as a moral one, and the patient has a right to insist on it.

But what about the harm that might be inflicted if medical knowledge is not shared with those who are vulnerable to that harm? Given what has been written above, what is your personal point of view about whether the father's condition should be disclosed? On what basis can you support it?

Faced with the nature of the disease, there might be those who would prefer not to know – either for their own piece of mind or simply because you cannot share what you don't know and therefore may feel absolved of responsibility. But, in the case described here, the woman was pregnant at the time that her father was tested. How, if at all, does this impact the balance between rights, duties, and knowing?

The father claimed that he withheld his knowledge about his condition in order to protect his daughter from distress and from terminating the pregnancy. Accepting his motivation at face value, do you think it has any impact on what was the right thing to do? In the end, the daughter submitted to the test and was also found to be positive. Does this subsequent event influence your own view about the issue as a whole? In the end, the court found in favour of the woman on the basis that there are situations in which a duty of care for others outweighs the right of the individual to confidentiality. Would you agree with this? Can you identify any aspects of your own perspective that shaped your responses as this case study unfolded?

Abstracting from this example, we might reflect on the roles played by the outcomes of, and intentions behind, decisions concerning the sharing or withholding of knowledge to or from others. We should consider here not only factual knowledge but also knowing how to do things (think about the call for a doctor to attend to a fellow passenger on a commercial flight, for instance). In this book you will find numerous examples of ethics in action in various domains of knowledge. This is only an introduction to some of the approaches that might be adopted in order to reach at least tentative answers that may be useful in such a contentious field.

Activity 15

The case study above is clearly concerned with extreme and traumatic circumstances, but the moral dimension of knowledge can also be found in much more everyday scenarios. Think of three instances from your own personal experience in which controversy arose from decisions you, or others around you, made to share or not share knowledge. On what basis have you formed your personal point of view in each case?

In the previous section, we have explored a few types of errors that creep into human reasoning, and some tensions that can occur between what might be considered the rational choice and the best outcome in certain situations. These scenarios have been presented as potential weaknesses in human thinking that may to some extent be offset through awareness of their nature, or by adjustments to the world in which we live in order to minimise their negative effects. Sadly, it is only a short journey from 'honest' misjudgements to malevolent intent on the part of individuals and groups with agendas to promote. Some distinctions are in order, so let's start with the common-sense view that a true statement is one that corresponds accurately with the aspect of the world that it sets out to describe. A falsehood, then, is a statement that has no such accurate correspondence. So far, so simple – these definitions concern only the relationship between knowledge and the world, are independent of the knower, and morally neutral.

But for someone to utter a lie, there are psychological conditions attached, such that the knower must know the truth and assert something different (false) with the intention that others will believe it. We are all familiar with the role that lies play in everyday life, but the concepts of truths, falsehoods, and lies do not cover the whole spectrum of claims to which we are exposed. What do we get if we drop the requirement that the knower is attentive to the truth in order to try to obscure or subvert it? The American philosopher Harry Frankfurt has explored the nature and consequences of claims of this kind – let's call them 'humbug' – characterised by 'an indifference to how things really are' and stimulated 'whenever a person's obligations or opportunities to speak about some topic are more excessive than his knowledge of the facts that are relevant to that topic' (Frankfurt, 2005, p. 19). It must be pointed out that this indifference means that humbug need not always be false – whereas truth and falsehood are concerned solely with the status of claims, an appraisal of lying and humbug require a consideration of the intentions of the knower:

- **true:** close correspondence between claim and world
- **false:** poor or no correspondence between claim and world
- **lie:** falsehood delivered in awareness of the truth with the intention of subverting it
- **humbug:** claim delivered without awareness or regard for the truth.

Activity 16

Identify instances of true statements, falsehoods, lies, and humbug from current affairs. Are there any tangible differences between the impact of the last two categories in public discourse? Do they have different motivations? Are they the stock in trade of different types of people? Which should we be more concerned about?

Frankfurt's view is that the production of humbug is a greater moral transgression in that it signals a total lack of respect for the truth, while lying involves at least an act of recognition that truth is something that people value. As such, the former shows a disdain for the value of knowledge, and undermines a principled approach to civic life. If humbug highlights vices detrimental to social interaction, it might be worth trying to identify some of the virtues that guard against it. How can we ensure that we respect the autonomy of the individual knower and treat knowledge conscientiously, regardless of its origin? Further exploration of these issues can be found in Chapter 2.1 **Knowledge and politics**.

Things to think about

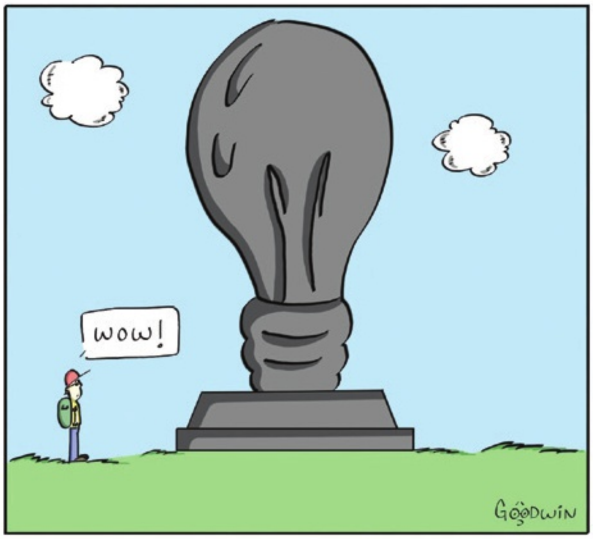
- Under what circumstances might the withholding of knowledge be justifiable? Consider films, video, and other media in relation to children. What about situations of war or civil unrest, or the knowledge needed to build weapons?
- Do you think that 'humbug' is a good name for the category of claims identified by Harry Frankfurt? How easy is it with real examples to distinguish this category from lies? Do you think there might be more humbug around today than in the past? If so, why?

Knowledge questions

- Are there responsibilities that necessarily come with knowing something or knowing how to do something?
- As knowers, do we have a moral duty to examine our own assumptions and biases?
- Under what circumstances, if any, do we have a moral duty to share what we know?
- In what ways do ethical judgements differ from other kinds of judgements?
- Is there knowledge that a person or society has a responsibility to acquire or not acquire?
- If moral claims conflict, does it follow that all views are equally acceptable?
- What personal traits (such as taking seriously the knowledge of others) do we need in order to be ethical knowers?
- How might science or any other area of knowledge depend on truth-telling?

Conclusion

In this chapter, we have explored some different ways of thinking about knowledge and what it might take to become a thoughtful and principled knower. We have tried to apply these conceptions in order to gain some understanding of the architecture of knowledge that we find in individuals and groups – from isolated claims to overarching perspectives. Perhaps you feel a sense of awe when contemplating the great edifice of human knowledge that has been constructed and renewed throughout history. We have pointed to some of the human weaknesses that can hinder the quest for knowledge, and indicated some of the methods at our disposal for overcoming them. As is the case across all of human activity, our relationship with knowledge cannot be value-free, and hence often exhibits a moral dimension that must be addressed. It is hoped that the issues raised here will find resonance in the chapters to follow.



Perhaps you feel a sense of awe when contemplating the great edifice of human knowledge.

At the start of this chapter, we mentioned the IB learner profile and picked out 'knowledgeable' as an attribute that IB learners strive to develop. In TOK, we are in the business of examining knowledge itself – we might say to become knowledgeable about knowledge – and so our course offers us a double dose here! Go back over the chapter and look for references to other learner profile attributes. Reflect on the extent to which they (a) relate to the conceptions of knowledge that we have explored, and (b) might be useful to you in your TOK journey. In this way, we can evaluate the roles of the learner profile attributes in not only the processes of knowing, but also in the enterprise of learning about them. This is consistent with the essence of TOK as the ability to take a step back and shift the focus of inquiry from the acquisition of knowledge itself, to a 'second-order' investigation into the nature of knowledge and the basis on which we can claim to know things. This chapter is an attempt to set the scene for this grand enterprise.

Things to think about

- Given the aims of TOK, the IB philosophy of education itself should not be immune from scrutiny and challenge. Are you convinced by the contribution that each attribute of the learner profile offers to everyone involved in the TOK course? Do you think the learner profile itself is well balanced or is there is any characteristic or aspiration that is superfluous, or has been overlooked?
- What do you think the group who discussed this list and finally agreed on it talked about for the weeks it took to work it out?

Exhibition thoughts

- As we shall see in detail in Chapter 3, **Assessment – Exhibition**, the internally assessed exhibition task in TOK invites you to identify three objects that provide opportunities to respond to a knowledge question selected from a prescribed list of 35. In this context, these knowledge questions are called internal assessment prompts (IA prompts for short). Each of the chapters in this book that is dedicated to a theme offers examples of how this task might be approached.
- The three objects offered in the **Scope** section of this chapter could provide the basis for an exhibition on prompt #1: *What counts as knowledge?* What three objects would you choose in relation to the prompt? What are your reasons for choosing them? How do your objects answer the question in the prompt?
- Further thought and development of the **Perspectives** element of the knowledge framework might yield successful entry points for prompt #14: *Does some knowledge belong only to particular communities of knowers?* What would it mean to say that knowledge 'belongs' to certain people? Can this be reconciled with the dynamic membership of various communities? Which objects would you choose in order to launch a consideration of these questions?
- The treatment of **Methods and tools** might lead to prompt #5: *What counts as good evidence for a claim?* You might take a broad view that evidence can take many forms – not restricted to what is directly and empirically observed but including other types of support, many of which have been outlined in this chapter. Would you select objects with the purpose of illustrating this diversity or take a narrower approach focused on observation and empirical knowledge?
- The **Ethics** element seems connected to prompt #27: *Does all knowledge impose ethical obligations on those who know it?* How would you distribute your choice of objects in order to posit different answers to this question?

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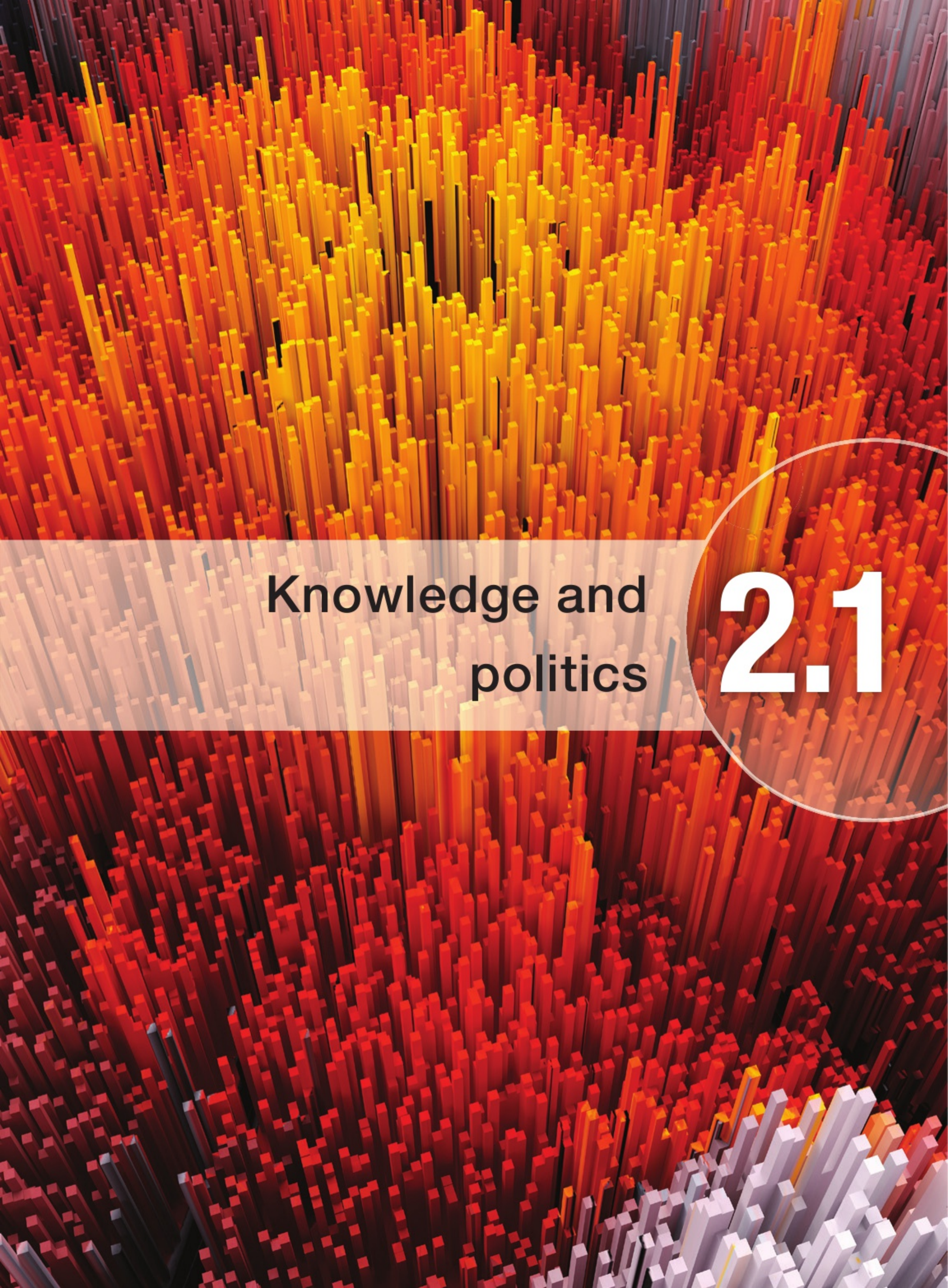


2.1 Knowledge and politics

Introduction

Sotobanari is an uninhabited island in the East China Sea, belonging to Japan. Uninhabited that is, except for a period of almost 30 years, during which Masafumi Nagasaki was in residence. Nagasaki's intention was to take a break from society for a while, but he grew to like his isolation and became a long-term recluse – foraging for food and collecting rainwater. Certain aspects are unclear, but it seems that in previous chapters of his life he was married and had children, worked as a photographer, and may have been motivated to follow his path to solitude by a personal concern for environmental issues connected to the effects of industrial society.

Figure 1 Sotobanari

Stories such as this are intriguing because they are set in situations which most of us find strange, and they fire our imagination as to what such an unusual life might be like. There is also the added dimension in this case that the withdrawal from civilisation was a voluntary act. We humans are social animals, and a lifestyle such as that which Mr Nagasaki chose seems an extraordinary one for anybody to adopt.

However, he did not renounce the social world entirely – he is said to have received some basic possessions from his sister (a watch, sandals) and used money she gave him in order to purchase food items on a neighbouring island that supplemented his meagre diet. And in the end, in 2018 at the age of 82, Sotobanari's sole resident left his island home and returned to the world of transactions and mutual support as his health deteriorated.

Given our human nature, we need at least some basic form of social organisation to make life tolerable. More ambitiously, we seek ideally to create social arrangements that prevent or manage conflict, and allow people to fulfil their potential. And because creation and maintenance of these arrangements calls for some form of governance in society, from these circumstances, politics is born.

Scope

In this chapter we will consider the concept of politics from several points of view and explore the roles that knowledge plays in each of them. We will take a focused view of politics, looking at how society as a whole is organised through political institutions and methods. But whatever way a society is organised, the outcome involves the exercise of power by some people over others, so we will try to address this more inclusive meaning with respect to the presence or absence of knowledge as we go along.

While at first glance Mr Nagasaki appears to have succeeded effectively in removing himself from the political sphere, his actions might be interpreted as expressing a point of view about political arrangements in the society from which he distanced himself. One benefit to the ordinary citizen of a well-functioning system of governance is the freedom to indulge in a private life by handing over political responsibility to others, but even the attempt to disengage and become apolitical can be seen as a statement of acceptance or protest with respect to the way society is arranged. Either you want to change it or you accept the way it is. Although we are unlikely to follow in the footsteps of Mr Nagasaki – sandalled or otherwise – it may be the case that politics is our constant companion, and hence worthy of some detailed study.

Despite these remarks, take a moment to imagine a society lacking any coherent system of governance, consisting of autonomous individuals not answerable to any political authority. Such a thought experiment is not a new idea – it was famously developed by the 17th-century English political philosopher, Thomas Hobbes:

> In such condition there is no place for industry, because the fruit thereof is uncertain, and consequently no culture of the earth, no navigation nor use of the commodities that may be imported by sea, no commodious building, no instruments of moving and removing such things as require much force, no knowledge of the face of the earth; no account of time, no arts, no letters, no society, and, which is worst of all, continual fear and danger of violent death, and the life of man solitary, poor, nasty, brutish, and short.
>
> (www.bartleby.com/34/5/13.html)

Hobbes argued that any form of government would be better than the circumstances he outlines here – what he called 'the state of nature'. It might appear from this short passage that he took a rather dim view of human nature, although there is evidence from his writings that this is not an entirely accurate portrayal of his position. Either way, what characteristics of humans might contribute to the nightmare scenario presented in the passage above, in the absence of authority? Could it be that individual behaviour is dominated by selfish calculations that do not extend to a consideration of the health of society as a whole? Perhaps that people are incapable of exerting the willpower needed to resist temptations as they arise? Or maybe in any group of people there are always 'bad eggs' that disrupt the functioning of the group as a whole? These are questions that interest psychologists and anthropologists, and you might consider them more rigorously when the area of knowledge of the **Human sciences** is addressed in your TOK course.

In any case, the state of nature provides a useful benchmark against which the effectiveness of various political arrangements can be measured. If you agree with Hobbes, even just to some extent, then some kind of political system starts to look not only desirable but essential.

What connections with politics have you experienced in your life so far? It is possible that you are following the IB course in global politics. You may be studying history or economics. From each of these academic experiences you will have had opportunities to learn and reflect on some of the models societies have adopted for governance. Perhaps the most prominent of these models is what we call *democracy*, in which government is directed in some manner by the people, and we will have much to say about it in due course. While the study of politics can be pursued in academic institutions through the discipline of political science, we are more concerned in this TOK theme with your everyday and ongoing contact with political matters, and with your experiences and responses as a participant in them. For instance, depending on the particular laws where you live, you may already have voted in a local or national election. Even if you have not, you have been witness to political developments of some kind wherever you are resident. Your involvements with CAS (or interests unconnected to school life) may have brought you into contact with initiatives designed to improve living conditions, or have provided the means by which you can contribute to causes that are considered to be worthwhile. Such experiences illustrate how meaningful political activity extends beyond those who choose to follow politics as a career.

Your school may well have a students' representative council (SRC) or similar body. In some schools, there are class representatives and an executive committee. There are annual elections involving a range of events and measures concerning rules for nominations and what constitutes acceptable campaigning behaviour, limits to promotional resources, publication of manifestos (candidates' declarations of intentions), hustings (where candidates meet voters), and so on; all overseen by an electoral committee.

These observations lead us to a consideration of the role of knowledge. In the case of the SRC, how best can candidates for office gather important knowledge possessed by electors? Does the school prepare electors to use their votes responsibly? Under what circumstances should office holders act directly on knowledge or pass it on to school management? What knowledge should an effective office holder have in order to be successful? How best should decisions be communicated to the student community? Any attempt to construct a democratic system which functions as intended must deal with issues to do with the possession of knowledge, how to increase it, and how to ensure that every stakeholder is treated as a legitimate participant in the political process.

In a nutshell, then, what has politics got to do with knowledge? Perhaps we could keep in mind three strands.

1. **Knowledge in politics:** what knowledge is accessible to participants in political activities?
2. **Knowledge of politics:** what knowledge is desirable or necessary for citizens and leaders?
3. **Politics of knowledge:** how knowledge is involved in wielding power.

These three strands all seem relevant to IA prompt #7: *What are the implications of having, or not having, knowledge?* Let's adopt this knowledge question as a possible nucleus for a virtual exhibition.

Knowledge and the ordinary citizen

Virtual exhibition object 1

Our first object is the science-fiction novel by the American author Ray Bradbury called *Fahrenheit 451*.

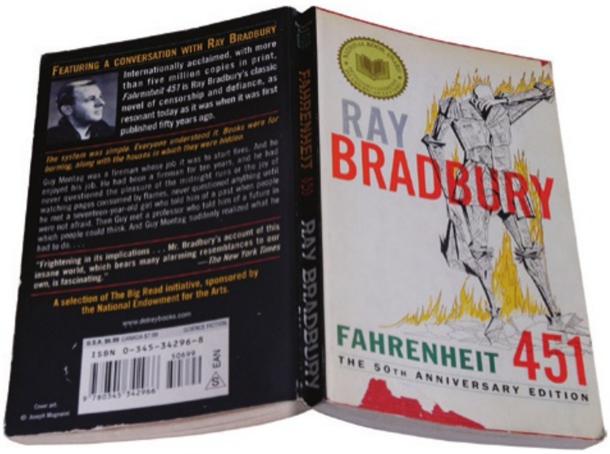


Figure 2 *Farenheit 451* by Ray Bradbury

The novel is set in a future United States (from Bradbury's perspective of the 1950s when he wrote it), in which books are banned commodities. The knowledge archived in literature has withered, and citizens spend their disposable time entertained by in-house televisual programmes of a shallow nature. Advances in technology and engineering have reached the point where building materials are entirely fire-resistant, and so the vocation of fireman has evolved from extinguishing fires to burning books; their hoses containing fuel rather than water (the title of the book is a reference to the temperature at which paper spontaneously ignites). In the following passage, the local fire chief, Captain Beatty, visits the main protagonist of the novel, Guy Montag, when he realises that the latter's commitment to the book-burning cause is wavering. Beatty tells Montag:

> Picture it. Nineteenth century man with his horses, dogs, carts, slow motion. Then, in the twentieth century, speed up your cameras. Books cut shorter. Condensations. Digests. Tabloids. Everything boils down to the gag, the snap ending. Speed up the film, Montag, quick... Uh! Bang! Smack! Wallop, Bing, Bong, Boom! Digest-digests, digest-digest-digests. Politics? One column, two sentences, a headline!... Whirl man's mind around about so fast under the pumping hands of publishers, exploiters, broadcasters that the centrifuge flings off all unnecessary, time-wasting thought! [...] Ask yourself, what do we want in this country, above all? People want to be happy, isn't that right? Haven't you heard it all your life? I want to be happy, people say. Well, aren't they? Don't we keep them moving, don't we give them fun? That's all we live for, isn't it? For pleasure, for titillation? And you must admit our culture provides plenty of these.

Although not much is said about it directly in the novel, the uninformed condition of the population must make the task of governance much easier. This circumstance has been brought about through the systematic eradication of knowledge as contained in books. There are strong echoes here of the celebratory book burnings carried out in Nazi Germany in the 1930s. But that destruction was targeted selectively at publications authored by particular despised groups such as Jews,

Eradication: destruction of knowledge

Censorship: restriction of the availability of knowledge

V

pacifists, communists, and so on, so there was a symbolic dimension – a means of expressing hatred towards certain elements in society, rather than merely the destruction of their work.

Nevertheless, strenuous political attempts at complete eradication of bodies of knowledge have happened. When the Khmer Rouge came to power in Cambodia in the 1970s, institutions of education beyond a very basic level were dissolved and a concerted attempt was made to achieve almost total control of the pool of knowledge available to the population – not only to stifle opposition but to support the spread of a revolutionary ideology. As we shall note later in this chapter, it is instructive that the leaders of the regime chose the name Democratic Kampuchea for the country. This was an extreme example, but many countries – such as the Soviet Union and those in eastern Europe during the Cold War – experienced widespread censorship of knowledge and the introduction of systematic falsehoods rather than attempts at its complete eradication.

It is interesting to contemplate why such repressive regimes usually seem to end in failure. A focus on ends regardless of the means by which they are achieved stimulates dissatisfaction and unrest, and the central planning that is necessary to drive extreme policies tends to create stubborn economic problems. Perhaps a certain resilience of human spirit is also involved in undermining the worst forms of political organisation. These are further issues for human scientists to examine.

Returning to the novel, one intriguing aspect is that Bradbury never makes entirely clear whether the descent into ignorance was instigated and deliberately engineered by the political leadership, or that knowledge was elbowed out of society by a growing addiction to mindless entertainment. This ambiguity in *Fahrenheit 451* bridges the distinction between what are probably the two most famous dystopias of the 20th century: *Nineteen Eighty-Four* by George Orwell, which describes the ultimate totalitarian state where Big Brother controls everything, and *Brave New World* by Aldous Huxley in which the populace is paralysed by entrancement with trivia and pacified by drugs. The key difference has been elegantly articulated by the American social commentator Neil Postman:

> What Orwell feared were those who would ban books. What Huxley feared was that there would be no reason to ban a book, for there would be no one who wanted to read one. Orwell feared those who would deprive us of information. Huxley feared those who would give us so much that we would be reduced to passivity and egoism. Orwell feared that the truth would be concealed from us. Huxley feared the truth would be drowned in a sea of irrelevance. Orwell feared we would become a captive culture. Huxley feared we would become a trivial culture, preoccupied with some equivalent of the feelies, the orgy porgy, and the centrifugal bumblepuppy. ... In short, Orwell feared that what we hate will ruin us. Huxley feared that what we love will ruin us.
>
> (www.goodreads.com/author/quotes/41963.Neil_Postman)

Postman was writing about the impact of television as the dominant medium of the 1980s, but many would suggest that his insights here have been remarkably farsighted given developments in our digital age. Some would agree that our age is characterised by an unhealthy engagement with trivia in contemporary culture – obsession with celebrities, the spread of mindless forms of entertainment – and that time spent on such matters detracts from the acquisition of knowledge of civic value. Others might protest that such views are unbalanced and take notice only of contemporary examples of long-established pursuits. What is your view?

Wherever the truth may lie, there are many ways in which the knowledgeability of the general public, and hence the flow of knowledge in politics, can be affected. As some of our real and fictional examples have shown, this ranges from direct attempts to destroy knowledge, through efforts to control it, to replacing it with lies or flooding it with trivia.

What happens when knowledge cannot, or is not allowed to, flow? The public is unable to appraise leaders, it becomes easier for those leaders to manipulate the public, and 'bad politics' is the outcome. Are we living in the world of Orwell or Huxley? Which of their warnings should we worry about more?

Having explored our first strand of knowledge *in* politics by considering how knowledge is distributed in society, we can now move on to look at the second strand – knowledge *of* politics as required by political leaders.

Activity 1 The political leader profile

Create a political leader profile using the same ten-attribute structure (but not necessarily the same content) as the IB learner profile. Which attributes would you include and why?

Now create a profile for the ideal citizen. Again, note down some justifications for your choices.

We will address your responses to these tasks later in the chapter.

Knowledge and political leaders

Virtual exhibition object 2

George Weah is a Liberian former footballer who pursued a highly successful career in Cameroon, France, Italy, England, and Abu Dhabi. In 1995, at the height of his sporting prowess, he was named FIFA World Footballer of the Year, but one price he paid for his journey from modest origins to global superstardom was limited education. In 2005, he tried and failed to become president of his country, and a contributing reason for this setback was considered to be his lack of educational achievement – particularly in contrast to his Harvard-qualified, World Bank-experienced opponent, Ellen Johnson Sirleaf, who accordingly became the first elected female head of state in Africa. By 2018 for his second shot at the presidency, much had changed – by the age of 40 he had a high school diploma, and then a degree in Business Administration and Criminal Justice from DeVry University, Miami, USA. This time he was successful, and even had the support of outgoing President Johnson Sirleaf. Our second object with respect to the IA prompt is George Weah's DeVry degree.

> There are lots people that went into leadership and they don't even have a college degree, but because people believe in them, they show good leadership skills. So, it's left with the Liberian people [to determine] whether, because I have a college degree, I can be leader of that country. But, I know that I am a good leader, and I am waiting for the opportunity to one day lead that country.
>
> (www.voanews.com/africa/liberian-politician-george-weah-graduates-us-college-degree)

Figure 3 George Weah

Activity 2 Knowledge for leadership

1. What knowledge is essential for an effective political leader to possess?
2. Is there a convincing argument that can be advanced that a political leader does not necessarily need formal qualifications?
3. Is there a distinct body of knowledge that is particularly useful? If so, is this knowledge best acquired through an academic institution or through some other kind of experience? Should that other experience be from prior political involvement or from elsewhere?
4. Should the focus be on knowledge that is directly applicable to local circumstances, or should it be on knowledge that is transferable?
5. Should it follow traditional disciplinary lines or take an interdisciplinary shape?
6. What do you make of the often-heard phrase: 'It's not what you know; it's who you know'?

DeVry University says that the Business Administration bachelor's degree at DeVry covers the following topics.

- Critical Thinking: Identifying the strengths and weaknesses of alternative approaches to problems using logic and reasoning.
- Mathematical Reasoning: Solving problems using mathematical formulas.
- Judgment and Decision Making: Making appropriate choices by considering relative costs and benefits of possible actions.
- Administration and Management: Understanding management theories and developing skills such as planning and resource management.

Do you think these topics are necessary preparation for political leadership? Are they sufficient?

Where does the optimum balance lie between *knowing that* and *knowing how* in essential preparation for political leadership? (see Chapter 1.1 **Knowledge and the knower**, page 14)

What relevant knowledge might a previous career at the highest level of sport provide as preparation?

In the United Kingdom, not only is the roll call of politicians who attended the universities of Oxford and Cambridge extremely long, but the dominance of one course – Politics, Philosophy, and Economics (PPE) at Oxford – is even greater. There is a range of opinions about the impact that this experience might have on the political leaders that it generates.

> [Banging] out ideas with barely a moment's thought is exactly what PPE students do. They study three separate disciplines yoked into one course. In the first year, they must produce essays on John Stuart Mill one minute and parliament the next; on microeconomics, modern French history, Rousseau, Marx, formal logic, the US Congress and whether it is better to be Socrates dissatisfied than a fool satisfied. [It is] the perfect preparation for politicians who will distil a complicated society down to a few slogans.
>
> (Nick Cohen – www.spectator.co.uk/2014/09/the-politics-of-ppe/)

> The breadth of the subject matter covered and the fact that students are constantly challenged to justify themselves prevents any danger of 'group think'. It's fundamental to the teaching method to be Socratic – it's our job to ask questions and encourage analytical thinking. It was designed to be deliberately broad. Because it's interdisciplinary, we can speak across subject boundaries.
>
> (Professor Iain McLean – www.bbc.com/news/magazine-11136511)

As an IB diploma student, where does your opinion lie? Consider the structure of the diploma and the mission statement. With which of the commentators quoted above would the founders of the IB have had more sympathy?

A significant number of IB schools have missions or mottos that speak about developing 'leaders of tomorrow'. Some of these future leaders will presumably operate in the domain of politics. If your school has such a mission or motto, how does it live up to the claim that it makes? Or is it an empty set of words?

We might consider here not only the practical impact of academic learning on the effectiveness of political leaders, but also the relationship between the experience it provides and individual perspectives. A study was undertaken immediately prior to the 2016 (Brexit) referendum in the UK concerning membership of the European Union, as to the possible correlation between the subject specialisms of politicians and their public stance on whether the UK should remain or leave.

> Classicists were the most pro-Leave, while Psychologists, Sociologists and PPE graduates were the most pro-Remain. It is perhaps noteworthy that the four most pro-Remain subjects were all social sciences [...]. An important qualifier is that our results are of course purely associational. While it could be that studying PPE actually makes you more pro-Remain, it is equally possible that those with a pro-Remain disposition were simply more likely to choose the subject at university.
>
> (blogs.lse.ac.uk/brexit/2018/11/14/mps-who-studied-ppe-at-university-are-among-the-most-pro-remain/)

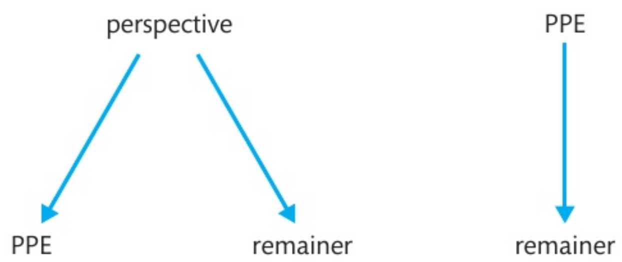
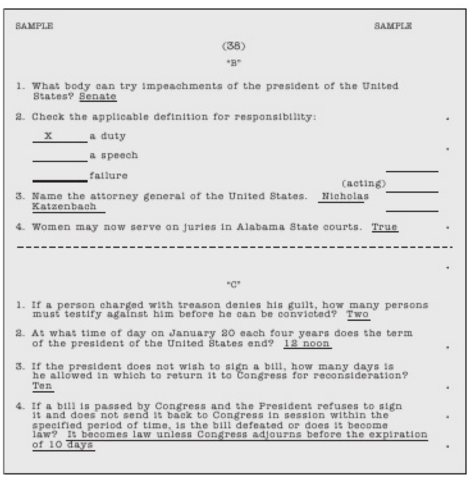


Figure 4 Does your perspective guide your choice of academic experience irrespective of your opinions about specific issues, or does the academic experience govern those opinions? Is it possible to resolve this sort of 'chicken and egg' situation?

Knowledge and power

Virtual exhibition object 3

Finally in this section, we move on to think about the third strand labelled on page 46 as the politics of knowledge – to do with how knowledge or its absence can dictate power relationships between people. Our last object is the **1965 voter test from the US state of Alabama**. Such tests were apparently designed to ensure that only those citizens who possessed appropriate knowledge could register to vote. In part A, the applicant had to read out an excerpt from the Constitution, and then answer a set of questions in parts B and C. Two examples of parts B and C are shown in Figure 5, with the correct answers indicated:



SAMPLE SAMPLE

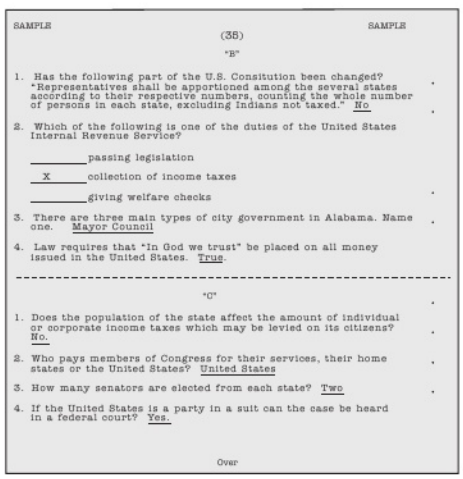
(38)

"B"

1. What body can try impeachments of the president of the United States? Senate
2. Check the applicable definition for responsibility:
   X a duty
   ___ a speech
   ___ failure
3. Name the attorney general of the United States. (acting) Nicholas Katzenbach
4. Women may now serve on juries in Alabama State courts. True

"C"

1. If a person charged with treason denies his guilt, how many persons must testify against him before he can be convicted? Two
2. At what time of day on January 20 each four years does the term of the president of the United States end? 12 noon
3. If the president does not wish to sign a bill, how many days is he allowed in which to return it to Congress for reconsideration? Ten
4. If a bill is passed by Congress and the President refuses to sign it and does not send it back to Congress in session within the specified period of time, is the bill defeated or does it become law? It becomes law unless Congress adjourns before the expiration of 10 days



SAMPLE SAMPLE

(38)

"B"

1. Has the following part of the U.S. Consitution been changed? "Representatives shall be apportioned among the several states according to their respective numbers, counting the whole number of persons in each state, excluding Indians not taxed." No
2. Which of the following is one of the duties of the United States Internal Revenue Service?
   ___ passing legislation
   X collection of income taxes
   ___ giving welfare checks
3. There are three main types of city government in Alabama. Name one. Mayor Council
4. Law requires that "In God we trust" be placed on all money issued in the United States. True.

"C"

1. Does the population of the state affect the amount of individual or corporate income taxes which may be levied on its citizens? No.
2. Who pays members of Congress for their services, their home states or the United States? United States
3. How many senators are elected from each state? Two
4. If the United States is a party in a suit can the case be heard in a federal court? Yes.

Over

Figure 5 1965 voter test from the US state of Alabama

A parallel strand to our enquiry into political leadership would therefore be concerned with the knowledge that would assist the citizen in participating effectively in political life. Should all voters be able to read? Should they have an understanding of the constitution and the institutions related to it? What knowledge will help them to appraise the claims of those who aspire to office? And crucially, who is to decide the answers to these questions?

In reality, like similar tests in other places, the Alabama voter test was not a fair examination. It was never intended to be. The person administering the test had wide leeway in the choice of the passage in part A, while the questions set for parts B and C varied significantly in difficulty. (Do you think this is illustrated by the two samples provided in Figure 5?)

Factoring in these circumstances, we can appreciate how the test was not a legitimate means of ensuring that voters knew what they were doing, but rather a mechanism for excluding black citizens from the democratic process.

While we are dealing with a scenario from the narrower conception of politics here, the issue fans out into the exercise of power more broadly. The voter test exploited knowledge in order to oppress people. More generally, power relationships can be seen in the connection between group membership and the knowledge possessed by the members of the group. In the Alabama example, a subset of the general public is disenfranchised by exploiting the limitations of their knowledge. In other words, their knowledge, or lack of it, is the vehicle by which the aim of exclusion is achieved. Similarly, knowledge possessed by children, women, or a particular ethnic or social layer of society, is often downgraded or dismissed by those in a more dominant social position. Furthermore, experts are sometimes dismissed on the grounds that their knowledge is 'not speaking for itself' but is rather an indicator of their status as experts, with all the privileges that might accompany it. In all of these scenarios, knowledge is involved in establishing or indicating some sort of power relationship or position.

Although the US Voting Rights Act of 1965 put an end to voter tests, the issue of voter suppression has never gone away. Aspects such as inconvenient polling hours and changes in acceptable forms of identification have replaced the overt demonstration of knowledge as factors that can skew the demographics of electoral participation. (www.americanprogress.org/issues/democracy/reports/2018/11/20/461296/voter-suppression-2018-midterm-elections/)

Activity 3 Personal experience of knowledge and power

Take a few moments now to identify and reflect on situations from your own experience where your knowledge has been disrespected or used against you in some way. On what basis? How did you feel? How did you respond? When is it legitimate or right to submit to the knowledge of someone else?

Things to think about

- Compare the backgrounds of the following political leaders: Robert Mugabe, Volodymyr Zelensky, Evo Morales, Václav Havel, Lech Wałęsa, Laurent Gbagbo, Andrej Babiš, Rodrigo Duterte. Can you identify any correlation of background with success in office? (You can add to this list as you see fit.)

Do these case studies throw any light on what knowledge is desirable for successful performance in office? If not, what should we conclude?
- Perhaps you have read *Lord of the Flies* by William Golding, or *High Rise* by JG Ballard. What can we learn from these novels about the way human nature might shape the development of political arrangements? Should we regard failures to achieve a flourishing community as inevitable outcomes of our nature?
- What does it say about politics and knowledge that no woman had ever become a head of state in Africa until 2005? Or indeed at all so far in the United States?
- Watch the 2018 film of *Fahrenheit 451*. Which discussion points in this chapter are recognisable there? Is there a knowledge question here about the arts concerning the effects of changing the medium?

Knowledge questions

- How is the practice of politics distinct from the discipline of political science?
- In what ways is factual evidence sometimes used, abused, dismissed, and ignored in politics?
- What can 'alternative facts' mean in the context of politics?
- Is being knowledgeable an important quality in a political leader?
- Why have political leaders sometimes tried to control or eradicate specific bodies of knowledge?
- With regards to politics, do we know as much as we think we know?
- How might knowledge reflect or perpetuate existing power structures?

Perspectives

Most of us will be familiar with the sight of politicians in heated disagreement with each other. You will also have witnessed political arguments among the general public, and probably there have been occasions when you took part in discussing political matters with friends or family. Not only do political opinions vary, but the differing perspectives with which each of us is endowed guarantee that there is no place from which those opinions can be viewed with complete neutrality. All potential contributions to perspective that are made by social, family, gender, ethnic, or religious circumstances, and life experiences in general, may influence the landscape as we appreciate it. How then can we form a meaningful response to questions about whether some political arrangements are better than others?

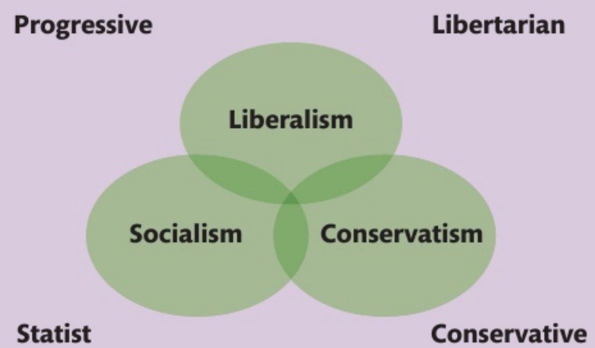
Despite this, we can at least identify a few familiar ideologies within the political field – each of which claims to represent a coherent interpretation of events and a set of ideas that its supporters think ought to shape political decision making. (In this sense, ideologies are both descriptive and prescriptive. We can also try to uncover the foundations of each ideology in terms of the values to which its supporters adhere or express.

Activity 4 Values and ideologies

Consider the political values in diagram A. Try to link each of them to one or more of the political ideologies in diagram B so that you end up with three sets. Are the values you have assigned to a particular ideology coherent as a whole, or are any of them mutually incompatible? Overall, how distinct is each ideology with respect to the others?

A

B



Do you detect allegiance on your part to any of these ideologies? What about alignment with the IB mission statement, the learner profile, or the philosophy of your school?

As the briefest of outlines (and at risk of caricature), conservatives prefer to stay close to the tried and tested, whereas the socialist is concerned in particular with collective outcomes, and the liberal puts a high premium on individual agency. Some political positions (social democratic, Christian democratic) draw from two or more basic ideologies, whereas others seem more like extensions (communism, libertarianism). Some test the very extremes of the political field (anarchism, fascism) which most people find unpalatable. We might acknowledge here that some values that attach to religions can influence political affiliation – more on this in Chapter 2.4 **Knowledge and religion**.

It is worth noting that parliaments around the world take different architectural approaches to the relationships between political ideologies, as illustrated in Figure 6.

To what extent do you think these spaces simply reflect these relationships or shape the behaviour of those who work in them? The examples provide visual representations of political orientations typical of the Western world.

Figure 6 The National Assembly, Paris (top), and the House of Commons, London (bottom)

It should be borne in mind that a label such as 'liberal', for example, can take on a variety of meanings. In other parts of the world, local or regional circumstances can be conducive to the appearance of different political ideologies, such as *pan-Africanism* as a response to the histories of Africans and people of African descent. Concepts such as cultural unity and solidarity play prominent roles in these ideologies. Ideologies with Western roots have been adapted, such as *ujamaa* in Tanzania: here, socialist ideas were fortified with ideas of citizen participation and loyalty to the country in order to drive a policy of agricultural collectivisation, in which small-scale farmers were forced to work together in large state-owned farms. Sometimes such ideologies fail to survive the political demise of their originators, prompting the questions of what is it that renders an ideology robust, and whether ideology plays an important role in forming opinions about practical political issues.

Activity 5 Policies and opinions

Consider the following policy proposals. In each case, record your response to it (for/against/not sure):

1. Death penalty introduced/maintained.
2. Secondary school education free for students.
3. All semi-automatic weapons banned.

4. Utility services privatised.
5. Taxation increased to raise funds in order to counter climate change.
6. All forms of euthanasia made illegal.

Now consider the extent to which your response was the product of (a) a process of thinking through to the likely consequences of implementation, or (b) connecting the proposal to political values you hold. For (a), consider also whether the likely consequences you identified related to you personally or to the wider society.

What are the relative contributions of emotion and reasoning to your reaction? Can they be separated? Are there important implications for the practice of politics? Does attachment to a political ideology have an emotional basis, while our appraisal of policy proposals is a matter of reasoning from that ideology? Perhaps this is too neat...

(news.stanford.edu/2019/05/15/political-messages-values-matter-policy/)

Recent research in the USA has suggested that the popularity of policy proposals can be enhanced when framed around conservative values, regardless of the content of the proposals. If this conclusion is correct, what might it tell us about how political opinions are formed?

Do you think social media and other forms of modern communication promote or diminish the influence of values and ideologies on political opinion formation?

It has been claimed that one notable effect of social media has been to embed people more thoroughly in like-minded communities, sometimes called 'bubbles', while at the same time sharpening disagreement with those affiliated to other communities. The result may be groups of people who no longer dispute the correct interpretations of facts but rather live in different 'fact worlds'. What might the future look like if we have a kind of politics in which there is no foundation for knowledge on which everyone can agree?

Peering into the future in this way is fraught with difficulty. American political scientist Francis Fukuyama stimulated an extensive debate immediately after the collapse of European communism and the end of the Soviet Union. His key claim – writing in 1992 – was that:

> What we may be witnessing is not just the end of the Cold War, or the passing of a particular period of post-war history, but the end of history as such... That is, the end point of mankind's ideological evolution and the universalisation of Western liberal democracy as the final form of human government.
>
> (en.wikiquote.org/wiki/Francis_Fukuyama)

Events have undermined Fukuyama, and we can easily point to advances in extremism, authoritarianism, and populism in the world that has emerged since he wrote the passage above. While applauding him for stimulating important debate, can we identify any clear reasons why he appears to have been wrong? More exploration of the efforts by historians to divine trends and the shape of the future can be found in Chapter 4.5 **History** as an area of knowledge.

Things to think about

- Use the QR code to visit the political compass website. Track your own political views on two axes and compare with plots for various prominent political individuals. Do you recognise an affinity with those located near you on the graph?
- In his book *A Conflict of Visions*, American social theorist Thomas Sowell tackled the question as to why the same groups of people tend to disagree on a wide range of issues. He claimed that the origins of ideological conflict lie in contrasting views of human nature – namely a *tragic vision* of humans as self-interested and requiring constraints on them in order to compensate, and a *utopian vision* of humans as intrinsically good, such that we are limited only by our currently imperfect social arrangements [these are Steven Pinker's labels rather than Sowell's]. Can you relate this distinction to what has been said about values, ideologies, and politics in general? Is Sowell's scheme a convincing explanation for the roots of political disagreement?

Knowledge questions

- Is there ever a neutral position from which to write about politics, or from which to judge political opinions?
- What kinds of knowledge inform our political opinions?
- To what extent are our political views shaped by society, family backgrounds, education, or social class?
- When exposed to numerous competing ideologies and explanations, what makes an individual settle on a particular framework?
- Why do facts sometimes not change our minds?
- Given access to the same facts, how is it possible that there can be disagreement between experts on a political issue?
- What impact has social media had on how we acquire and share political knowledge?

Methods and tools

Methods of organising political activity

Earlier in this chapter, we explored how the possession of knowledge by political participants might influence political developments; now we need to take a closer look at the methods and tools that shape the ways in which that knowledge is manifested.

We have seen how lack of knowledge, deceitful manipulation of it, and disruption of its flow, all tend to make for what we might call 'bad politics'. The ideal political arrangement is likely to be one in which these circumstances are avoided. An approximation would be a system in which the people can take responsibility for their own government because they have the means for instructing it and receiving transparent feedback from it. Such an arrangement would ideally be found in a *democracy*. The fact that almost every country in the world claims to be a democracy tends to support the idea that the label describes a favourable state of affairs.

Democratic systems vary, but two are worth a brief comparison here. In *direct democracy*, people are involved in day-to-day political developments by having a say on the adoption of policies – often through referendums. However, in a *representative democracy*, people elect representatives who are thus empowered to make decisions about policy on behalf of the people. This system relies on potential representatives to make clear their views before submitting to an electoral process; usually involving their membership of a political party.

What are the requirements for the success of each of these variants of democracy in terms of the possession of knowledge? Who is likely to be in the better position to steer the process of governance – the ordinary citizen or the elected representative? Think back to the section of this chapter on **Scope**.

An array of political institutions support democratic systems, with ideally a clear separation of functions for making (legislature), enforcing (executive), and interpreting (judiciary) the law. This is a recognition of the dangers of power becoming concentrated in the same hands. Independent media facilitate the distribution of knowledge and its flow between citizens and leaders. Ideologies and policies are articulated by distinct political parties that compete for public approval. Despite this optimistic view of democracy, it is easy to find comments that express a more nuanced view. For example, this from Winston Churchill: 'No one pretends that democracy is perfect or all-wise. Indeed, it has been said that democracy is the worst form of government except all those other forms that have been tried from time to time.'

What then are the shortcomings of democracy? In comparison with Hobbes's terrifying 'everyone for themselves' state of nature (no politics), not to mention totalitarian nightmares such as Kampuchea (very bad politics), we might reasonably expect a system that provides for everyone to contribute to organised governance to generate better results. And so it does; but the fact remains that democracies often disappoint in their achievements. Perhaps the public or the people they elect cannot be trusted to make good decisions. Maybe collectively they do not have the requisite knowledge. Perhaps a good and knowledgeable elected official is a complex mixture of good and bad, wise and foolish.

If democracy fails to meet our expectations, what is the reason? An obvious answer would be a failure of education – either in general civics or in the specialised knowledge of economics, diplomacy, ethics, and so on. Maybe the state is itself responsible for these shortcomings, or maybe the public has just become entranced by trivia (the riddle of *Fahrenheit 451*). But the problem might lie not with ignorance at all, but rather with rationality. Given that a citizen has only one vote, the chances of that vote making a difference to an electoral result is minuscule. Under these circumstances, the cost to that citizen of educating themselves outweighs the potential benefits of making a more informed voting decision. This motivation deficit for knowledge might be a recipe for apathy, or at least the degree of detachment from politics often seen in democratic societies.

In any case, one possible remedy is to place stricter limits on citizens' contributions, and goes under the name of *pragmatic authoritarianism* – a kind of paternalism in which leaders may consult the people from time to time but reserve a great deal of power to themselves in a sort of limited democracy. There are various versions of this approach to be currently observed in the world.

Another scenario to consider is the possibility of restricting voting rights to those who can demonstrate the level of knowledge deemed necessary in order to use their votes wisely. A society that decides on governance in this way would be described as an *epistocracy* (rule by the wise). Several warning bells may be ringing in your head at this prospect; we have already looked at the dubious outcomes of voter testing in the chapter section on scope. But let's give this proposal a fair trial.

Activity 6 Designing epistocracy

Design a test for discriminating between those who have sufficient political knowledge to be allowed to vote, and those who do not. Provide justifications for the questions you ask, the form in which you ask them, the way in which the test will be administered, and how responses will be assessed. What measures could be put in place in society in order for citizens to prepare for this test? How could citizens be motivated to become better informed?

As a result of your efforts to find answers for these questions, what is your opinion as to the viability of epistocracy?

Disinformation: knowledge distorted so that it is no longer true

V

At face value, the merits of an epistocratic system might extend to a reduction in ignorant or incompetent input into politics. Perhaps it might protect against the influence of the charlatans and conmen who seem so prevalent in the modern world. But psychologists and life experience tell us that education provides little protection against cognitive bias and perhaps even susceptibility to disinformation. And certainly very little shelter from the privileging of personal interests.

Activity 7 Voting rules

For each of the following scenarios, consider its effectiveness in accumulating the most effective pool of knowledge for democratic governance.

1. Individuals with professional qualifications get two votes each.
2. All citizens aged 16 and over get a vote.
3. Each citizen who is a parent gets an extra half-vote for every dependent child (proxy voting).
4. All new residents arrived within last five years are excluded from voting.
5. All citizens aged six and over get a vote.
6. Citizens with a criminal record are excluded from voting.
7. All adult citizens are required by law to vote.

Considering your proximity as a young adult to the experience of childhood, what is your view as to the minimum age at which children are capable of understanding and responding to political circumstances? Could a defensible case be made for disenfranchising citizens who exceed a certain age?

On what basis, if any, can proxy voting on behalf of someone else be justified?

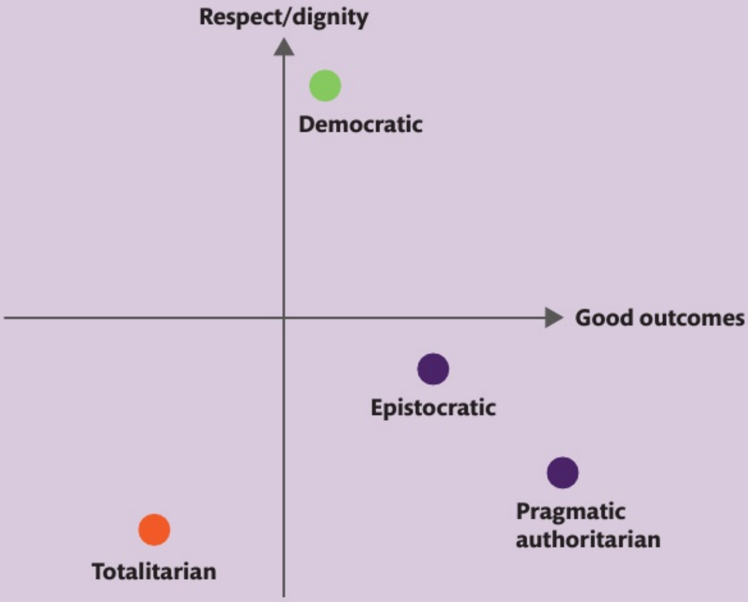
In 'Considerations on Representative Government', the 19th-century English philosopher John Stuart Mill proposed that those in professional occupations would have six votes, farmers three, skilled labourers two, and the unskilled one vote. Such a scheme never came to pass, but many of the alternatives in Activity 7 either exist or have been given serious consideration. For example, the minimum voting age has been reduced from 18 to 16 years for all Scottish elections. The half-vote system for dependent children is called *demeny voting* and was recently discussed in Japan as a counterweight to an ageing population. In Australia, voting is compulsory. Countries have widely varying policies on voting by prisoners or the mentally infirm.

Although the exclusion of small children from the franchise is widely accepted, full-blown epistocracies seem to belong to a world before democracy gained traction. For example, ancient Athens was ruled by a restricted group of voters who also happened to be the most educated people. In our time, they seem tied up with issues of discrimination and claims of elitism. Although Francis Fukuyama's thesis about the 'end of history' turned out to be deeply flawed, it does not mean that we cannot reason our way towards some conclusions about the likely evolution of political systems, and it seems unlikely that the transition from epistocracy to democracy can be reversed because of the reaction it would provoke.

Epistocracy is just one rather extreme circumstance that is vulnerable to charges of elitism. It is common to hear criticism of politicians who are accused of personal self-interest or of acting on behalf of the privileged layer of society to which many of them belong. This is fertile ground for the *populist*: someone who claims to know what 'the people' really want and to know how to provide it. Populists tend to be charismatic characters who project a high level of confidence in themselves, and encourage people to invest in 'conspiracy theories' in which the leader is a victim. Despite sometimes being career politicians, they seek to distance themselves from 'the establishment'. Populism is more of a political strategy than an ideology, as evidenced by the fact that populists can be found loosely attached to almost any of the ideologies discussed earlier.

Activity 8 Outcomes and respect

The American political philosopher David Estlund has claimed that good outcomes from a political system (e.g. material prosperity and safety of citizens) need to be balanced against the degree of respect that the system affords to citizens by listening to citizens and taking their knowledge into account. Focusing on either of these two factors tends to limit the other. Hence, there is a tension between utility and values or rights. We can explore this model in graphical form as illustrated below, with some very tentative suggestions (not from Estlund) as to where various systems might be placed:



Can you support these placements, or do you have alternatives? Justify your responses. You may wish to sketch whole areas of the chart with overlaps rather than 'spot plots'. If so, why?

Economists are used to measuring good outcomes using various quantitative economic indicators. Could respect or dignity be measured in a similar way? Are there actually similar challenges in measuring outcomes that economists are ignoring?

What effects might each scenario in the previous activity on voting rules produce with respect to the axes of outcomes and respect/dignity in the graph?

On the basis of contemporary examples, how do you think a populist approach to politics is likely to fare on this chart?

Estlund's conclusion is that democracy provides the best balance between the protection of desirable values of respect and dignity, and the (admittedly flawed) empirical outcomes that it produces.

Political tools

While periodic *elections* are central to representative democracy, the *referendum* is a political tool of choice in direct democracies. However, there are sometimes dilemmas involving single issues of great importance that need to be settled in isolation from the broader sweep of policies, and then referendums may find their way into the representative model.

Case study: 1946 Faroese independence referendum

A consultative referendum took place on 14 September 1946 in the Faroe Islands in order to decide whether the islands should remain united with Denmark or become an independent state. The questions and results were as follows.

1. Do you want the government's proposal established? [the proposal was home rule within Denmark]
2. Do you want separation between Denmark and the Faroe Islands?

Place an X next to one of the questions.

Result: Votes in favour of 1: 5,499; Votes in favour of 2: 5,660; Spoilt ballots: 481; Turnout: 67.6%

Due to the consultative status of the referendum and the close result, there was argument as to how to proceed. Eventually, a general election was called, the parties opposing independence won a majority, and within two years home rule was declared within a union with Denmark.

What lessons can be learned from this case study about the advantages and limitations of referendums as a political tool?

What might be the problems with calling a referendum within the context of a representative democracy?

Figure 7 Tórshavn, Faroe Islands

In this referendum, the word used in Faroese for 'separation' translated into English as 'to untie'; the equivalent in Danish is 'to tear loose'. Both languages appeared on the ballot paper. We should not underestimate the power of language in the field of politics. Rhetoric may no longer feature as a mainstream curricular option in most educational systems, but the ways in which messages are packaged are crucial to acceptance of, or acquiescence to, the messages themselves. A gifted speaker may move his audience in ways that are beneficial, but he may also be viewed with suspicion and accused of base intentions disguised by his skills of communication and persuasion. Propaganda, lies, and 'spin' have been with us forever, but recently emerged modes of communication have provided powerful new means for distorting the information environment, including 'firehosing' supportable facts with a torrent of irrelevant or misleading claims (a rather different meaning from what it might have meant in *Fahrenheit 451*).

In recent years, there has been increasing interest in *citizens' assemblies* as an alternative to referendums. A group of citizens is selected at random, after controlling for demographics and range of opinion, and an outcome is reached through a deliberative process of discussion. This method of decision making has been used in the Republic of Ireland in order to address suggested policies on topics such as abortion, climate change, and the use of referendums themselves. To what extent do you think a citizens' assembly can mitigate the disadvantages of referendums that you have identified?

At the same time, the digital age has offered astonishing possibilities for the collection of more accurate information through data analytics and surveillance technologies that can be used to target individuals and groups, and then provide them with disinformation that can influence their voting intentions; for example, by smearing preferred candidates or encouraging people not to vote at all. Facebook had well in excess of 2 billion users (more than a quarter of all of humanity) by the end of 2018 – and hence had a massive store of data that was illegally acquired by the now-defunct company Cambridge Analytica and used to 'microtarget' voters with personalised messages designed to influence their political preferences.

Whereas unconstitutional changes in leadership used to take place by military coup, nowadays there often seems to be little requirement for tanks and troops when well-placed interventions in the information environment can produce results by stealth. These practices must also be counted in the category of political methods. There are rich links here to Chapter 2.2 **Knowledge and technology** and Chapter 2.3 **Knowledge and language**.

Things to think about

- It was Cambridge political scientist David Runciman who suggested that children as young as six years old should be given the vote. Can you construct a plausible argument in favour of this proposal? Do you think this was a serious suggestion or intended merely as a stimulus for discussion?
- By what rules do you think that a citizens' assembly should (a) be set up, and (b) conduct its business in order to ensure that it does not result in a form of epistocracy or authoritarianism?

Knowledge questions

- What role do reason and emotion play in the formation of our political affinities or in our voting decisions?
- To what extent can polls provide reliable knowledge and accurate predictions?
- In what ways may statistical evidence be used and misused to justify political actions?
- What role do political authorities and institutions play in the creation and distribution of knowledge?
- Why are referendums sometimes regarded as a contentious decision-making tool?
- How might emotive language and faulty reasoning be used in politics to try to persuade and manipulate?

Ethics

As with any other human activity that involves decision-making, politics inevitably possesses an ethical dimension. Because politics has a great impact on everyone in society, the moral imperative in this domain carries a great deal of weight. For political leaders, there are obligations that come with the job. Given what has been discussed earlier in this chapter, what might some of these obligations be? Then we need to consider the ethics of the policies that politicians enact. We could start by trying to identify the qualities politicians might possess that would incline them towards recognising those obligations and towards making the best choices. What personal attributes are best suited in these matters?

Revisit the 'political leader profile' activity (Activity 1) in the **Scope** section. What were some of your answers? Perhaps they included honesty, compassion, prudence, foresight, or self-discipline. Or maybe you selected some attributes from the IB learner profile and suggested that successful leaders ought to be knowledgeable, principled, or inquiring (you may have noted that some of the other attributes, such as good communicator or risk-taker, might in isolation work well for those with good and bad character alike). The focus here on personal attributes is about *virtues*, where a virtue is a lived value. For instance, while we might all value a concept such as compassion, not all of us are compassionate. The virtue approach to ethics is very much in line with the learner profile as examined in Chapter 1.1 **Knowledge and the knower**.

As we have seen, the practice of politics necessarily involves the exercise of power, and this is the main reason why it attracts not only those well equipped to wield it, but also those who crave it – with its attendant prestige and privileges – for their own personal or parochial purposes. It is a short step from here for some people outside of office to perceive the entire political profession in a negative light. Can you name one or two politicians that you respect and admire in order to dispel this generalisation? Are you identifying them on the basis of their character or simply because you agree with their views?

Political leaders make deliberate decisions, so what are their obligations that arise from them? One is to strive to make good decisions on behalf of others. Earlier, we explored the issue of competence to participate in political activity, but in a representative democracy those who get elected are expected to strive to know what will be best for citizens. This point was summarised by the 18th-century Anglo-Irish statesman Edmund Burke:

> [I]t ought to be the happiness and glory of a representative to live in the strictest union, the closest correspondence, and the most unreserved communication with his constituents [the people who have elected him]. Their wishes ought to have great weight with him; their opinion, high respect; their business, unremitted attention. It is his duty to sacrifice his repose, his pleasures, his satisfactions, to theirs; and above all, ever, and in all cases, to prefer their interest to his own. But his unbiased opinion, his mature judgment, his enlightened conscience, he ought not to sacrifice to you, to any man, or to any set of men living. These he does not derive from your pleasure; no, nor from the law and the constitution. They are a trust from Providence, for the abuse of which he is deeply answerable. Your representative owes you, not his industry only, but his judgment; and he betrays, instead of serving you, if he sacrifices it to your opinion.
>
> (press-pubs.uchicago.edu/founders/documents/v1ch13s7.html)

This description of the job of a *representative*, who is chosen for their abilities to exercise judgement on behalf of their constituents, stands in contrast to that of a *delegate*, who is expected to follow through on exactly what their constituents have instructed. It could be argued that the distinction has become harder to maintain in a world in which communications take place at a fevered frequency and there is a heightened expectation for politicians to react to 'real time' opinion. In these circumstances and under the added pressure they exert, those who are obliged to exercise good judgement on behalf of others may need to call on extra reserves of courage and resolution.

Members of the public generally have no choice about being a citizen of their country, but nevertheless have certain obligations. Do these obligations include engagement in political processes such as voting? Does the voter have an obligation to use their vote wisely – so as to prevent harmful outcomes rather than have to live with them and correct them at the next opportunity? Obligation or not, this is a fundamental feature that makes democracy work – eventually you can vote out those who do not deliver (sometimes called 'retrospective voting'). But how fundamental is this feature? If members of your SRC at school are not eligible for re-election the following year, does this undermine the democratic credentials of the system?

American philosopher and professor of business, Jason Brennan, has claimed that it would be better for a citizen to abstain from voting if they are not knowledgeable about the issues at stake. Brennan, as a strong advocate of epistocracy, has raised the opposite of compulsory voting; here the citizen has an obligation not to vote. Would this be a more acceptable strategy than withdrawing the franchise from citizens? Would it work?

If you have assembled a 'citizen profile' from earlier in the chapter, revisit it. What qualities comprise a virtuous citizen?

Activity 9 Combining virtues

Das Leben der Anderen (*The Lives of Others*) is a 2006 German drama film about Georg Dreyman – a fictional playwright in East Berlin who is placed under close surveillance by the secret police (Stasi) of the German Democratic Republic (DDR) during the Cold War in the 1980s. This character is portrayed as honest, intelligent, and sincere in support of the regime. In a critique of the film, the Slovenian philosopher Slavoj Žižek observed that, under an oppressive political regime, one can fulfil any two of these three descriptions, but not all three; hence he felt that Dreyman's character was not credible.

(inthesetimes.com/article/3183/the_dreams_of_others)

Follow through the logic of this argument and respond to it. What might be the implications?

Are honesty and intelligence virtues that deserve a place in the top ten of the citizen profile? Under what circumstances could the 'support of a regime' be regarded as a virtue?

With the rise to prominence of a number of politicians whose popularity seems impervious to events that would destroy the credibility of others, there is a renewed interest in attention to virtues. Did your profile contain anything similar to tolerance or restraint? These are the qualities recommended by commentators such as Harvard political scientists, Steven Levitsky and Daniel Ziblatt, as defences against the rise of populism. Do you think these qualities are necessary or sufficient for improving the quality of political debate in your country?

Did your 'citizen profile' include obedience? Or loyalty? If so, presumably you were thinking of obedience to the law rather than to individual politicians. If not, perhaps you were thinking of situations where the law is bad, or about circumstances that many people consider urgent but where there is no appetite among leaders for change. Or where an unpopular change is imminent.

'If standing up against the climate and ecological breakdown and for humanity is against the rules then the rules must be broken.' So claimed Greta Thunberg, Swedish environmental activist, during her campaigning in 2019. But how can we know whether this is an ethically justified line of action? The situation seems to invoke a tension between the consequences of environmental inaction and the obligation not to break the law. If so, rival approaches to ethics based on *outcomes* and *duties* come into conflict. We can try to resolve this dilemma by focusing on one approach throughout – do we have a duty towards the environment, or perhaps to unborn generations of humans, or life in general? Alternatively, we could assess the likely results of policies towards the environment and weigh them against the sanctions that might apply for lawbreaking. In TOK, it is important to justify how we arrive at a decision as to which approach to ethics to favour, so that the choice does not remain merely an unjustified opinion.

Figure 8 Greta Thunberg striking outside the Swedish parliament

Calculations are further complicated by the choice of means by which desired outcomes are pursued. Do these means incapacitate people with no stake in the matter? Is violence considered a legitimate resort? Is it civil disobedience? In theory, there is a spectrum of options from peaceful civil disobedience to active armed engagement against authority. Can you think of examples that lie at different points on this scale? How do the activists involved justify their actions, and are these justifications recognisable in the context of the ethical approaches mentioned here? There is the further problem of language here: Thunberg spoke of *ecological breakdown* whereas others might choose a different phrase. Furthermore, general language usage may very well shape reactions – witness the shift in the media from *climate change* to *climate emergency*.

It is also worth noting that Greta Thunberg was a schoolgirl in 2019. Some of the backlash that she received for her political interventions seemed to be connected to this fact. Is it reasonable to downgrade or dismiss the views of children on the basis of their relative lack of life experience? (Think back to voting franchises in different places.) Or is the knowledge possessed by Thunberg being swept aside simply because of her membership of a particular subset of society? Adults are often irritated or even intimidated by precocious or opinionated young people.

The unfolding of the digital age has provided new possibilities for political influence (as outlined in the last section) and, as with all new technologies, it takes time for those steeped in earlier practices to react. It is a matter of debate as to whether existing ethical norms will drive responses to these kinds of challenges (through regulation or education, perhaps) or whether technological change, as it has done in the past, will force us to accept a new consensus about our right to privacy, for instance.

It seems as if one of the major challenges facing humanity in the next decades is how to reconcile the fact that finance and technology have become globally integrated, with the continued political importance of the nation state. There is a danger that our parochial political arrangements will no longer be competent in this globalised environment. New methods and tools, and perhaps new ethical consensus, may be needed to negotiate the rest of the 21st century.

Things to think about

- Use the QR code to visit the site by the British journalist Peter Oborne concerning claims made by Boris Johnson, who became UK prime minister in 2019. Can you connect the content to the distinctions made by Harry Frankfurt in Chapter 1.1 **Knowledge and the knower** (page 38)?
- Can you think of examples of political leaders who have been destroyed by their own behaviour that was deemed unethical? And others for whom similar behaviour seems to leave them unscathed? What might be some of the factors that make the difference?

Knowledge questions

- Do political leaders and officials have different ethical obligations and responsibilities compared to members of the general public?
- Can the ethical behaviour of leaders and citizens be guided or measured by adherence to a set of virtues?
- On what grounds might an individual believe that they know what is right for others?
- On what criteria could we judge whether an action should be regarded as justifiable civil disobedience?
- Are new ethical challenges emerging from the increased use of data analytics in political activity and decision making?
- Can knowledge be divorced from the values embedded in the process of creating it?
- When the moral codes of individual nations conflict, can political organisations, such as the United Nations (UN), provide universal criteria that transcend them?

Conclusion

While Mr Nagasaki's experiences on Sotobanari were apparently not nasty, brutish, or short, avoidance of such qualities of life must be set alongside his solitude and material poverty. The fact that most of us would be reluctant to emulate him has led us to a consideration of the various ways in which we may wish to organise the governance of society and manage the power relationships among people.

We might conclude that a healthy flow of knowledge across society and between citizens and leaders is a prerequisite for a healthy functioning of politics. There may well be different views as to what kinds of knowledge equip leaders to execute their duties well. And we would do well to remain vigilant as to the ways in which knowledge can be used to establish and sustain power relationships between different groups.

Exhibition thoughts

- In the section on **Scope**, we identified objects that might underpin an exhibition organised around IA prompt #7: *What are the implications of having, or not having, knowledge?*

- Under **Perspectives**, we wrestled with the claim that people tend to show great allegiance to their own long-standing opinions, and the implications that arise if the claim is true. You might decide to explore objects that address IA prompt #11: *Can new knowledge change established values or beliefs?*
- In the **Methods and tools** section, the discussion on who should belong on the voter register brings to mind IA prompt #14: *Does some knowledge belong only to particular communities of knowers?*
- And our exploration of the responsibilities of citizens and political leaders in the **Ethics** section, can be connected to IA prompt #27: *Does all knowledge impose ethical obligations on those who know it?*

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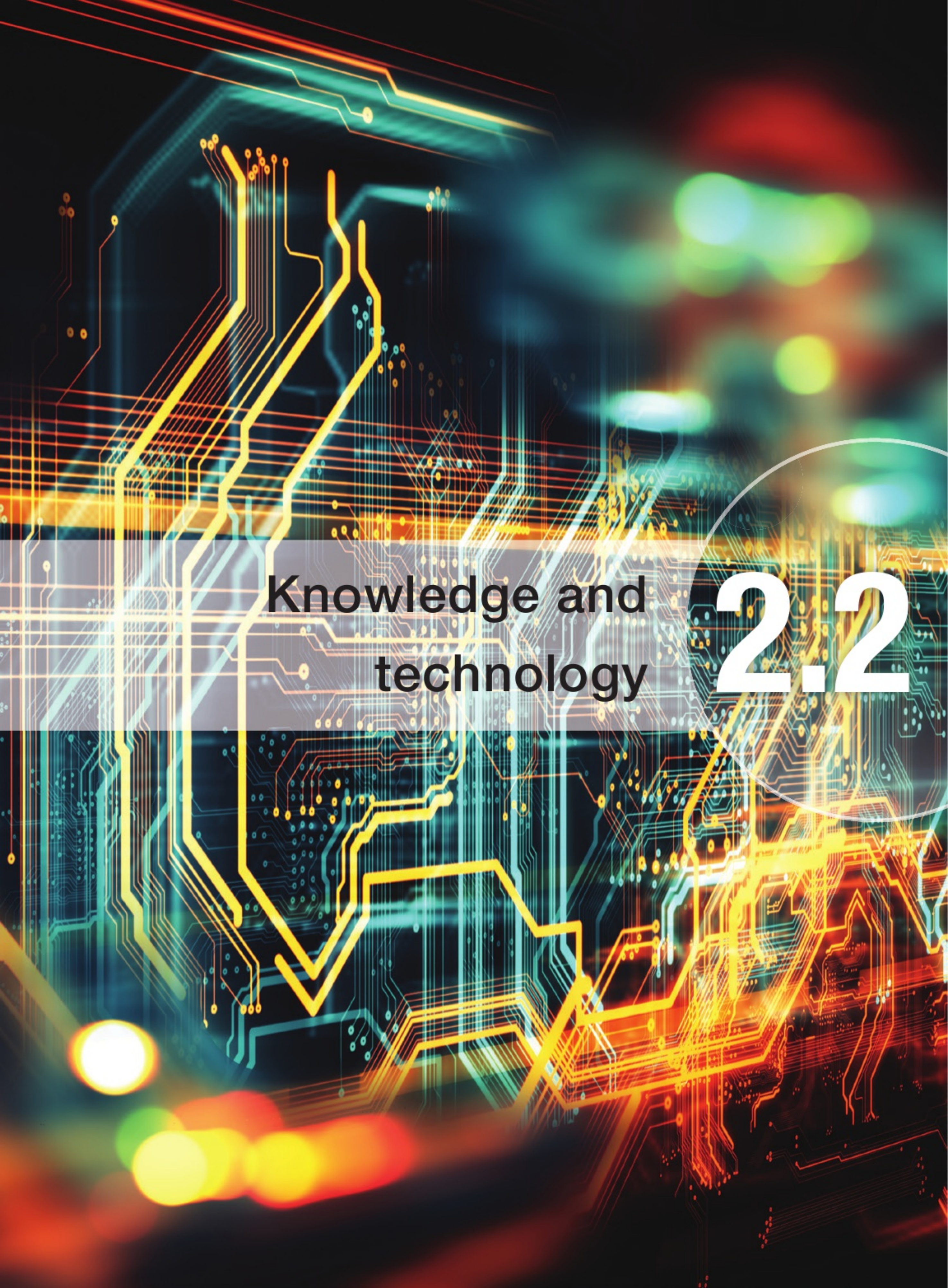


2.2 Knowledge and technology

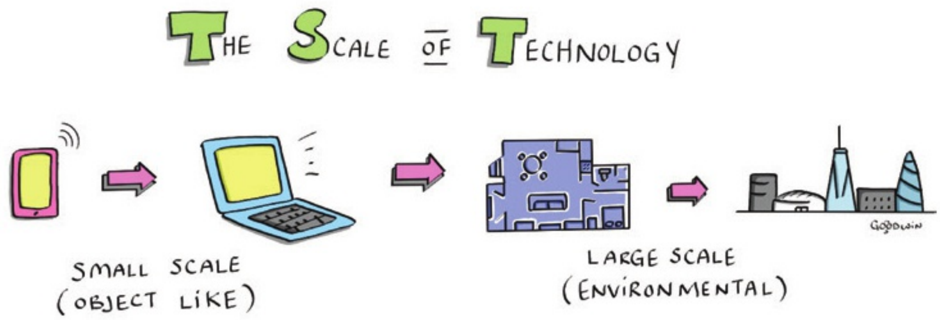
Introduction

The word 'technology', from the Greek stem *techne* meaning 'craft' or 'art', suggests a material product or process that has an impact on our everyday lives. Technology as an end product is found in a work of art or a building. These are things that, in a direct manner, make a difference to the quality of life. But technology can also take part in a larger process of change. Consider a telescope or a harp. The telescope is instrumental in knowing about the heavens and the harp is part of a process of making music. They are means to an end rather than an end in themselves. Seen in this light, there are two strands to the intimate connection of knowledge and technology. Knowledge that we already have can be applied to solving the practical problems of life such as building somewhere to live. But, perhaps more interesting from a TOK point of view, technology often plays a central part in the process of making new knowledge. These strands are linked to make a dynamic circle – technology in the second sense helps to produce more knowledge that produces technology in the first sense and so on. We shall consider both strands in this chapter.

Let's build on these two aspects of technology. First, the word 'technology' names something physical in the world, such as phones and computers, that helps us navigate our way through everyday life. Such objects are relatively small in size and enable us to cope smoothly with the world. On a larger scale, technology can be found all around us in our material environment. Look around you now. You might be sitting in a classroom with geometrically ordered space, reached through ordered corridors with numbered doors. You might be in another type of building overlooking other buildings organised in a line along a street. You might be in a car travelling along a road with traffic signs to help navigation. These are all examples of how human beings impose a vast amount of structure on their material environment in order to ease the cognitive effort of everyday life.

The second aspect is that technology is basically social. It is created and used within a social setting and, in many cases, the use itself originates in the social world. A mobile phone is not much use in a world such as that of *Le Petit Prince* where there is only one person. A car is not much use in a world where society has not built roads. In the main, the tasks that technology helps us to perform only make sense in a social setting – they are important and significant because they contribute in some way to living together. Technology is produced by society because of a social need and its use is regulated socially; that is, society confers value, meaning and significance to its use. Think again of the mobile phone as an example. There is more about this in the sections that follow.

Technology can be small scale and object-like or it can be large scale and environmental. Technology can also help with creating knowledge in the context of academic subjects – it can help with *knowing that*. But of primary importance in this chapter is the role of technology in helping us to solve the basic problems of living in society. In other words, in helping us with *knowing how* to live socially. The knowledge in this chapter is more to do with successful action in the world than about justifying true statements.



This chapter is structured according to the knowledge framework: scope, perspectives, methods and tools, and ethics.

- The section **Scope** examines in detail what could be meant by technology. Inspired by the TOK exhibition, we look at three objects that exemplify different aspects of technology.
- **Perspectives** examines the relationship between technology and the groups that use it and how technology shapes the perspectives of these groups.
- **Methods and tools** looks at technology as a tool for producing knowledge.
- **Ethics** examines the implications of technology in terms of the responsibility for knowledge and its use.

Scope

In the introduction, we took technology to be something material, either object-like or large and environmental, that enables us to do things in the world – including producing knowledge. In this section we explore the *scope* of Knowledge and technology as one of our optional themes. We do this by taking a close look at three objects that in their different ways make knowledge possible. Our starting point in this virtual exhibition is not the extraordinary achievement of modern digital technology but something with a history that goes back 3,500 years.

Technology is as old as human civilisation. Archaeology tells stories about the roles of natural materials such as stone, iron, and clay in shaping human knowledge. There is evidence of stone tools used by our hominin ancestors 3.4 million years ago. Clay is particularly useful because it is plastic when wet but rigid when dry. It has, of course, been used for millennia to make useful and decorative domestic things. The same qualities make it a suitable material for making digital technology – what we might these days call read-only memory (ROM). When the clay is wet and soft, marks can be made on its surface. Later, after it has dried in the sun, it is hard and preserves the marks as a permanent record that can be read at a later date. Marking clay in this way makes it possible to store information over time and to move it from place to place. It reduces the burden on human memory: once the marks are made, humans can get on with other tasks but consult the exact details of the record when necessary. Therefore, clay tablets can be seen as an extension of human memory. The human brain, sometimes called 'wetware', can be supplemented with the tablet, 'hardware'.

Virtual exhibition object 1

Figure 1 is an example of this technology and is the first object in our virtual exhibition. It is a sample from the Linear B tablets found in Knossos, dating from 1400 to 1200 BCE. The script is Mycenaean Linear B script, comprising 89 syllabic signs and more than 100 ideograms (Malafouris, 2013, p. 68) that show numbers representing quantities of significant goods in and around the palace. The tablets found record everything from numbers of bovine, pig, and deer hides to shoe and saddle-makers; Figure 1 below documents a list of male names. The Linear B tablets seem to function as an inventory of goods and labour.

Figure 1 3,500-year-old digital technology: an example of ROM in the form of the Mycenaean tablets at Knossos

The type of clay used dried rapidly and no additions or corrections could be made after the clay dried. This had implications for the size of the tablet. Large tablets would dry before all the information could be written on them, so the Mycenaeans used smaller tablets. These were arranged a bit like an old-fashioned card-index system in a library. Not only were the inscriptions significant but also the tablet's position in the pile gave important information. The record-keeper filed them meticulously to be able to extract information quickly.

The use of space was also part of the storage and retrieval system. Just like modern files, each of the tablets had a standard format to aid information retrieval. The first word was inscribed in large signs, presumably to act as a sort of index for the filing system. This suggests that the tablets were physically arranged and manipulated by the records clerk. This is typical of the use of technology in a knowledge context. Physical objects do not merely hold information, they are manipulated in order to solve problems and answer questions. One way to think of this is that technology relieves the human mind of some of its burden. We can offload some problem-solving tasks to the environment itself. There are two necessary conditions for this offloading to take place:

- we need to produce the technology (that is, to structure the environment in the right way)
- we have to practise the use of the technology so that it becomes second nature.

Virtual exhibition object 2

Let's move forward in time by over 3,000 years to a mathematics class in a large school in the south-east of England in about 1973. At the back of a class, a 12-year-old boy is working hard on a calculation. In his hand is a plastic instrument that looks like Figure 2. It is called a slide rule.

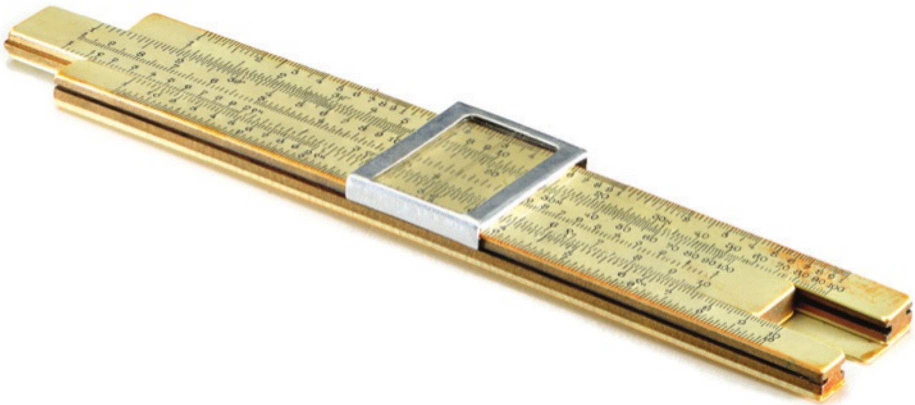


Figure 2 An ingenious piece of analogue technology from the 1970s: a slide rule

A slide rule is essentially an analogue calculating machine. The tablets of Knossos are an example of digital technology because their meaning derives entirely from the symbols written on them. But a slide rule is analogue technology because the crucial feature is a physical distance between the symbols arranged to give the device its function. The carefully calibrated scales enable the operator to perform multiplication, division, powers, roots, logarithms, and trigonometric calculations to around three significant figure accuracy (but it cannot add or subtract). The boy in the maths class is solving trigonometry problems. He does not know it yet but in two years he will start using an amazing new invention called an electronic calculator. For the time being though, he is happy manipulating the plastic slide rule with his hands. In 1970s London, slide rules were everywhere: in schools and universities, in science labs, in the pockets of engineers and surveyors, on the bridges of ships, and in aircraft cockpits. The device had a cursor and sliding middle section which enabled the user to exploit the mathematical principle, $\log(ab) = \log(a) + \log(b)$ that numbers can be multiplied by adding their logarithms.

There are similarities between a slide rule and the Linear B tablets. The slide rule is a physical object that extends our human mental capabilities; the tablets are a sort of structured database. Just like the tablet file, the slide rule is manipulated by a skilled operator and relies on representations – marks that stand for something else. The marks on the tablet mean chariot wheels or swords; the marks on the slide rule stand for numbers. Just as the tablets extended human memory, the slide rule extended human calculating ability. In the Mycenaean case, the technology shaped the structure of society: there was a quite high social class of scribes or administrators who could read and write to the tablets. In 1970s England, there was a technically able class who could manipulate slide rules to solve certain knowledge problems encountered in the everyday world. In both societies, mastery of a technology led to social mobility.

Info box

Digital and analogue

You need to be aware of a distinction between **digital** and **analogue** technologies. Despite the familiarity of these terms, they are remarkably difficult to define precisely. This is largely because they are examples of questions of *representation* which still evade the best thinkers. Perhaps the best way to understand the distinction is to consider examples. The discrete 1s and 0s of computers and mobile phones are digital. The continuous voltage changes powering a loudspeaker are analogue. The discrete symbols of an English sentence (words and punctuation) are digital, while the depiction of a river on a map is analogue.

Virtual exhibition object 3

The third object in our virtual exhibition is a satellite navigation system for a car (Figure 3).

Figure 3 Satnav: digital technology from the 2000s. Outsourcing the taxi-driver's knowledge – but is it robust?

First, we need to consider a particular part of the world without satnavs. Since 1865, London taxi drivers have had to take a test, described as the 'hardest exam in the world', in order to qualify for a licence to drive one of London's famous black cabs. They have to 'do the Knowledge'; that is, learn the exact street plan of the city within 6 miles (10 km) of Charing Cross. This involves learning 25,000 streets and how to drive them, the direction they run, one-way systems, dead-ends, where to enter and exit roundabouts. They also need to know everything on the streets: the location of all restaurants, pubs, shops, landmarks, flower-stands, laundromats, and so on, no matter how obscure. Examiners expect the would-be cabbie to know anywhere that a passenger might want to go. On average, it takes three years of full-time study to achieve the required standard. Trainee cabbies walk the streets on foot or use a motor scooter, usually devoting a day to a particular small area.

The Knowledge illustrates the construction of personal knowledge. It also highlights an important feature of technology: we embrace technology so readily because it allows us to access shared knowledge without the production of our own personal knowledge. The London cabbie must painstakingly construct knowledge of how to navigate London. In contrast, a rideshare app driver relying on GPS, has only to know how to operate the device that accesses the central system.

Of course, the difference between production and access raises questions about ownership and robustness. The London cabbie can be rightly said to own the knowledge that took three long years to achieve. This knowledge of the city is also personal: there will idiosyncratic features that belong only to the cabbie, certain details that enlivened the learning – a decoration here, the colour of a wall there, the smell of the river in Docklands. The rideshare app driver, on the other hand, has access to someone else's knowledge or knowledge that exists as part of a technological system, something centralised and standardised. This driver may have difficulty with non-standard requests like, 'take me to a Hawksmoor church' or 'take me to a fine example of early Victorian architecture'.

The London cabbie relies only on memory. The only thing that will affect performance is the gradual degradation of memory over time. The rideshare app driver, on the other

Info box

Robust

Knowledge is **robust** if it can withstand change. The London cabbie's knowledge is robust because short of a bad head injury or a missile attack on London the cabbie's knowledge can get a passenger from A to B. The rideshare app driver's knowledge of London depends critically on a complex system being in place and functioning correctly. If the system changes, the rideshare app driver may not be able to get a passenger from A to B. The rideshare app driver's knowledge is easier to come by but at the cost of robustness.

hand, is entirely dependent on the GPS system. If the satellite goes down, driver and passengers could be completely lost. On the plus side, the rideshare app driver did not have to undergo the hard work of learning the city, but on the minus side the accessed knowledge is dependent on others and lacks robustness.

These two knowledge systems illustrate some deeper questions about the differences between making knowledge and accessing it, about local knowledge and global or centralised knowledge, about ownership and power, and about how robust knowledge is when the system is disturbed. We examine some of these questions in the sections to come.

Things to think about

- To what extent do you think the tablets of Knossos allowed the Mycenaeans to extend their thinking capabilities? Can you come up with other examples of objects that extend our thinking capabilities? Do painters think with their brushes and musicians with their instruments? Do you ever think on paper by writing something down? Do you ever use mindmaps or other visual tools for thinking?
- In July 2019, a news item was published about a failure of the Galileo satellite navigation system that affects the GPS technology. This leads us to ask: How should we define robust knowledge? Is the cabbie's knowledge more robust than that of a rideshare app driver using a satnav? Is robustness a question of how many other people or how much technology is involved?
- For the Knossos tablets to function as part of the knowledge process, a number of other social practices had to be established. Try to think of three activities that people had to perform as part of the tablet record-keeping system. Then, consider the role of language and social hierarchy in making the system work.
- **Challenge** London taxi drivers are of interest to cognitive scientists and neurologists because the structure of their brain is somewhat different from the brain structure of non-cabbies. In particular, the taxi drivers have a bigger posterior hippocampus – an area of the brain known to be involved in spatial memory. This is an interesting case of a cultural phenomenon – learning the Knowledge changes neural structure and circuitry suggesting that the evolution of human thought processes is parallel to the evolution of culture (and is not driven primarily by genetics). Do you think this idea is plausible? Investigate this issue by checking out some of the sources at the end of the chapter). What are the implications if it is true?
- There are computer programs called 'expert systems' designed to diagnose illnesses from a description of symptoms. In some parts of the world (such as Scandinavia) these 'expert systems' are replacing the knowledge of human doctors. Does the 'expert system' have the same sort of knowledge as the doctor? A recent TV programme in Sweden pitted the skills of three doctors against three people who were experts in using the internet but were not medics. Each team had to diagnose the illnesses of real patients by asking them questions. The team of doctors won the competition convincingly. What are the implications of examples like these for 'expert systems'? What conclusions can we draw about the differences between human knowledge and machine intelligence?

Knowledge questions

- How has technology had an impact on collective memory and how knowledge is preserved?
- How does the use of technology shape the sort of knowledge we seek?
- To what extent is the internet changing what it means to know something?
- In what sense, if any, can a machine be said to know something?
- Does technology allow knowledge to reside outside of human knowers?
- Have technological developments had the greatest impact on what we know, how we know, or how we share knowledge?

Perspectives

This section develops the social aspect of technology – that is, that technology emerges from particular views of the world and also shapes those views. In TOK, the word 'perspective' is used to describe the point from which we view the world. It is a general feature of our whole outlook rather than a particular opinion or point of view on a specific topic. Two people may share perspectives but nonetheless disagree. Perspective is shaped by the network of concepts, practices, values, and norms that make sense within a particular culture. It is also shaped to an extent by our own history and biography, including our gender, religion, political affiliation, socio-economic status, and so on. We view the world from a particular point historically and culturally, and to a greater or lesser extent, our knowledge and our technology reflect this.

A word of warning here: it is tempting to think that because aspects of technology are social, it is somehow subjective or that 'anything goes'. This does not follow. Technology has a social dimension – as does much of our knowledge – but that does not mean that it is radically subjective. Think back to the map metaphor (Chapter 1.1). Maps are the product of social factors such as the interests of the mapmaker and the purpose of the map. But maps are objective in that they are primarily about the territory, not the mapmaker. And as we all know, maps can be wrong.

The three objects discussed in the previous section illustrate the importance of the social aspect of technology. In each case, the object is situated within a framework of social practices and norms, without which it could neither function nor make sense. The tablets at Knossos played a role in an elaborate social structure that coordinated and controlled the demarcation of tasks and duties. Building wheels for chariots or textile production are highly specialised jobs performed by skilled craftsmen that need to be coordinated with other tasks and with the needs of the society as a whole. Moreover, the operators of the tablets were highly skilled in the 'social technology' of a sophisticated written language. Similarly, in the case of the slide rule, the use of the device required skill and a certain amount of physical dexterity. Its manipulation required technical mathematical knowledge and also a physical ability that was achieved by practice like mastering a craft, a sport, or a musical instrument. These practices were reinforced by schools and universities and regulated by clear norms and standards of correct usage. The same is true of the taxi driver who engages in a series of practices relevant to driving a taxi in the metropolis. Taxi driving only makes sense in

Info box

Objective and subjective

Something is **objective** if it does not depend on the observer. It is an objective fact about the world that atoms are made up of electrons, protons and neutrons. It does not matter who is observing them, or if there is anyone around to observe them at all. The taste of honey is **subjective**: without a 'subject' there to do the tasting it doesn't exist. There is a spectrum between these two extremes. A football referee might rule that a goal is scored. Hopefully there is an objective component to this. The ball actually crossed the line. However, the call did depend on the referee's subjective perception of the ball crossing the line. There are objective and subjective elements to the call.

a particular kind of society – one with cities, roads, people who need to move around and, of course, an available mode of transport. In the case of the rideshare app driver reliant on GPS, society has arranged an elaborate physical infrastructure – satellites sending specific signals to be received by the GPS unit and converted into positional information. In all these cases, the use of the technology is regulated by an equally elaborate set of social structures; society adopts various methods for technology use and creates structures to support these methods.

These ideas have interesting implications, not least the idea that, as a social phenomenon, technology is also arguably a historical one. You can only understand the current state of a technology and the social practices it supports with reference to its historical background. The clay tablets *made sense* because of the history of the political and social organisation of the Mycenaeans, the history of their language, and the history of the social practices (such as chariot making and textile manufacture) that the tablets coordinated. These histories flow together and converge in the technology of tablets. Similar histories can be cited in the case of the slide rule and GPS. Social history provided the need, and a history of knowledge production made the technology possible. Both streams of history are necessary. Even if Mycenaean civilisation had somehow mastered the mathematics of logarithms there would be no slide rules at Knossos because Mycenaean society did not require the sort of calculation that slide rules make possible. Similarly, in an imaginary society that lived underground, while it might have developed the knowledge to build a GPS system, the concept would not have made any sense given that it could never be used. The two historical strands, technology and culture, converge to ensure the emergence of a specific technology at a given time.

These strands might not be so easy to separate. It is completely conceivable that technology breeds technology: that a particular technological environment calls for the development of new technologies to service it. 20th-century Britain required the services of the slide rule because it was needed for engineering and scientific applications – in other words – other technology. The practices that were made possible by knowing how to operate a slide rule were involved in producing other technology such as buildings and machines. These would produce further new knowledge practices, and so on. A good example here is the Guggenheim Museum in Bilbao. The architect Frank Gehry has produced a strikingly innovative design for a building that houses an art collection. It creates a novel space that changes the way we view and reflect on the artworks displayed. Again, cultural knowledge and technology are intertwined. And if they are intertwined, so are their histories.

The intertwining of knowledge and technology has implications in terms of power. Technology empowers some groups – and disenfranchises others – through the knowledge required to produce it, control it, and operate it. Consider how technology divides society broadly into three different groups:

- the owners and controllers of technology
- the operators or technicians who have the specialist knowledge required to produce the technology, change it, and operate it
- a third group who are affected by the technology but do not have the technical knowledge to change it.

In the time of the Mycenaeans, the textile workers and chariot makers presumably belonged to the third group. While they were undoubtedly skilled craftsmen in their own domain, from the point of view of the tablet administration, they were the subjects of the system. The tablet operators were the civil servants and belonged to the second group. They were supervised, no doubt, by members of the first group who owned and controlled the technology. There are no prizes for guessing which social group had the higher social status (and whose knowledge was valued and taken seriously by society). The keepers of the tablets had control over the information encoded in them, in the sense that they, or their civil service bosses, could decide who else had access. The first two groups therefore acted as *gatekeepers* for this information. They had the skills to decode it and integrate it with other information to produce knowledge that had an immediate bearing on action. Day-to-day decisions regarding the running of the palace would depend on the entire knowledge system built from the tablets – 'more elm chariot wheels are needed because the stocks are running low – we need to ask the suppliers for more'.

Technology divides society into groups such as owners and controllers: those who have the specialist knowledge to produce or change technology and those who use it. It is entirely plausible that these groups tend to have different perspectives on technology and its relationship with knowledge. These perspectives emerge when technology changes, as it inevitably does.

How does change affect the value of the knowledge held by each of the groups? The end-users – those who have little say in the technology being used – may welcome technological change especially if, like GPS, it makes everyday life easier. The first group of owners and controllers welcome the possibility of enhanced ownership and control offered by more advanced technology. But the middle group of technicians might be adversely affected. The value of their specialist knowledge is under threat and they might resist the introduction of new technology. The London cabbie belongs to this group. Doing the Knowledge is part of the tradition of taxi-driving. The instinct of many (if not all) cabbies is to resist the introduction of new GPS technology. One way of resisting is to argue for barriers to its introduction, perhaps by not licensing rideshare app drivers. Another is to devalue it by arguing that GPS means a reduction in the quality of service for the user group (passengers) because rideshare app drivers may not be able to give historical or architectural advice or information. On the other hand, a cab fitted with GPS can, if everything is working as it should, navigate to anywhere in London, possibly anywhere in the country or even the world.

Different technologies produce different expectations, different sets of norms and values, and ultimately different social practices. We can see the same pattern in the value of traditional knowledge in making textiles over the course of the industrial revolution or horsemanship skills after the introduction of the car. Technology empowers some groups and marginalises others. Changing technology alters this distribution of power, which in turn changes the value society places on knowledge held by different groups; this, of course, changes their power. The intertwining of technology and society is reflected in a parallel intertwining of technology and power. Could it be that conflicts such as the Luddite rebellion or the protests against the rideshare app are conflicts about whose knowledge is valued and ultimately about which group has power?

How might membership of these groups affect perspectives in relation to modern digital technologies? Most people are in the third group – they are the users of technologies. They do not own or control the companies that provide the services they use, nor are they able to change substantially what the technology does. End-users benefit from digital technology but only on the terms set by operators on behalf of owners and controllers. So how are these perspectives dependent on the technology they use? One view could be that it makes no difference to perspectives if one is a user rather than an owner. Surely, the great benefit of the internet is that it is egalitarian and makes information open to all, rendering the owner/operator/user distinction invisible. However, this view is increasingly difficult to defend. Search engines are designed on commercial principles rather than on principles that are friendly to balanced knowledge production. Newsfeeds are tailored to generate 'page hits' and so are likely to present content that is in keeping with the views of the user. People could end up seeing only one side of a current event based on their viewing choices. Analytic tools are reaching the point where the only advertisements that appear on the screen are for items related to existing personal interests. If a user supports one side of a political debate, the danger is that the online world acts as a sort of echo chamber to reinforce prejudices and shield the user from contrary evidence and multiple viewpoints. There is plenty of evidence in the discussion about 'fake news'. This is the worrying bit: technology can create perspectives *of which the individual is not aware*.

Are we sure that these perspectives are brought about through technology and not through other things like human nature or interactions? Well, certainly technology plays a central role in the examples above. Google® has an algorithm that determines the order of search results – which is likely to be based on commercial considerations rather than knowledge factors. What about social media technology? Does it create its own perspectives? What about ordinary human conversation – does it not produce a similar echo chamber? What difference does the technology make?

Consider Twitter®: it allows users a maximum of only 280 characters. What picture of the world can we have through such an abbreviated medium? Does that compression mean that we are pushed towards thoughts that can be expressed only within that limit? Are more subtle arguments that capture the essence of a complex world ruled out? Marshall McLuhan said more than 50 years ago, 'The medium is the message'. What are the implications for the perspectives from which we view the world if he was right?

Things to think about

- This discussion has centred on terms such as *knowledge, skill* and *information*. Take a moment to think about how these concepts fit together. Think of examples of information and knowledge from your own day-to-day life. Information, say, in a contact list, does not seem to be the same sort of thing as knowledge, say, in a science book, which does not seem to be the same as a skill like playing the piano.
- Why is it better to use library databases rather than Google when researching an extended essay? List three other ways in which digital technology changes the way we think about knowledge acquisition.
- What is the difference between contrasting perspectives with regard to technology and a difference of opinion? What is the difference between a perspective and a prejudice? How might this difference play out in terms of technology?
- Find out all you can about the concept of net neutrality. What are the implications of the challenges to net neutrality (in countries such as the USA) regarding the relationship between internet-based technology and knowledge?
- Investigate a political issue of interest in your local area. Are there different perspectives on the issue (rather than different points of view)? What role might technology play in establishing or maintaining such perspectives?
- Technology often provides metaphors for structuring our thinking when pursuing knowledge. The brain was likened by Leibniz to a mill, which in the 18th century was one of the most complicated things made by humankind. In the early 20th century the brain was thought to be like a telephone exchange. Now the metaphor is a digital computer. Can you think of other technological metaphors that we use to structure knowledge? What are the advantages and dangers of using such metaphors?
- The word-processing package used to write this chapter sometimes alters the style adopted and underlines certain phrases in red. The author is annoyed by these interventions but invariably takes their advice. To what extent does the programming of widely used applications shape our thinking or our knowledge? What are the implications in terms of power and diversity?
- Technology has shaped the way human beings live their lives. How have TV, Netflix®, and computer games changed the way humans spend their leisure time? Is there any truth in the idea that technology has transformed the nature of leisure from 'doing things' to 'watching other people doing things'? What are the implications for knowledge if the only channel for staying informed about the world is TV news/news feeds/news websites/social media?

Knowledge questions

- How are online or virtual communities similar to and different from traditional communities of knowers?
- Do social networks reinforce our existing perspective rather than boost our engagement with diverse perspectives?
- What impact has the fact that English is the primary language of the internet had on knowledge sharing?
- Is big data a radically new method of producing knowledge?
- How does the history of technology influence its current states?

Methods and tools

Technology can be used to produce knowledge. This section discusses the role of technology within the areas of knowledge and then extends these notions to knowledge outside an academic context.

Let's begin with the arts. Music is organised sound produced by physical instruments; visual art needs a medium that is altered by human design; dance is the organisation of the movement of physical bodies in time. The arts are to do with making material alterations to the world. As such, they are dependent on technology for their form and indeed their existence.

The aulos (Figure 4) is an ancient Greek example of arts technology. It consisted of two oboe-like tubes with reeds at one end stuck together. Each tube made its own sound, so the player could play a tune and an accompaniment at the same time. Each tube was controlled by one hand. The instrument was capable of producing five basic tones (but by blowing harder the player could probably achieve an upper octave). The two voices were not entirely independent because the player's breath controlled both tubes simultaneously. The double reed gave it an oboe-like quality. Thus, the sound of the instrument was determined by its particular physical arrangement. It defined the form of musical expression and its physical structure placed strict constraints on the sort of music that was possible. The instrument constrained the musical conventions that could be employed and therefore determined to a degree the whole art form.

Figure 4 Ancient Greek artistic technology: the aulos

Now consider present-day musicians using computers. The music they produce reflects the tools they use – complex sounds that are literally unplayable on traditional instruments. This is reflected in the skill set required – the manual dexterity of the traditional instrumentalist is replaced by the ability to work with and program complex computer packages. But musical creativity, talent, and a good ear are still required.

The history of painting gives other examples of technology defining the artform. Painters had to work with the available pigment technology. Changes in this technology produced changes in the art. Johannes Vermeer was famous for a shade of blue called *ultramarine* that was little seen in painting before his time because it was difficult to make and astonishingly expensive (Figure 5). Changes in technology made the production process easier. Arguably then, changes in technology produced changes in the nature of artistic knowledge – not just in terms of the skills needed to produce the art but also in terms of the nature of the work itself and the knowledge that it embodies.

Figure 5 Johannes Vermeer's painting took advantage of a new technology for producing blue colour.

The use of technology in the sciences is often taken for granted. Science, as understood since the 1600s, is traditionally associated with technology in the form of instrumentation. Tycho Brahe's astrolabe, Galileo's telescope and Hooke's microscope are usually described in science textbooks as instruments for extending human sense perception. But there is also science that depends on the existence of a particular instrument: spectroscopy relies on the spectroscope, X-ray and radio-astronomy rely on the appropriate detectors and radio telescopes. There are devices for creating very high- or very low-energy situations not usually encountered on Earth – for example, particle accelerators, vacuum chambers, deep refrigerators. There are also devices for bringing together and integrating a vast amount of data from disparate sources. Examples here include the computers that gather data from the detectors at the European Organization for Nuclear Research (CERN) and those that collated data from telescopes spread across the world to produce the first ever picture of a black hole (Figures 6 and 7). These machines and instruments play diverse roles in the production of scientific knowledge; roles that include data collection, data transfer, data analysis, and even automation of the experimental procedure itself. In some cases, technology is so central that it is tempting to ask what role human beings play and whether it is necessary to include a human element in scientific knowledge production at all.

Info box

CERN

Today, mention of **CERN** usually conjures pictures of the huge particle accelerator ring underneath an area straddling France and Switzerland, north-east of Geneva. It is a joint European project dating from the early 1950s with the aim of discovering what the universe is made of and how it works. It is usually associated with the large hadron collider (LHC) – a tunnel 100 m underground forming a circle 27 km in circumference. Elementary particles of matter (such as protons) are accelerated in magnetic fields to speeds approaching that of light and are then made to collide with other particles. The products of these collisions are detected by giant detectors and analysed by a sophisticated computer program. Over a long period, this accumulated data tells us about the fundamental constituents of matter in the universe, such as the Higgs boson discovered at CERN in 2012.

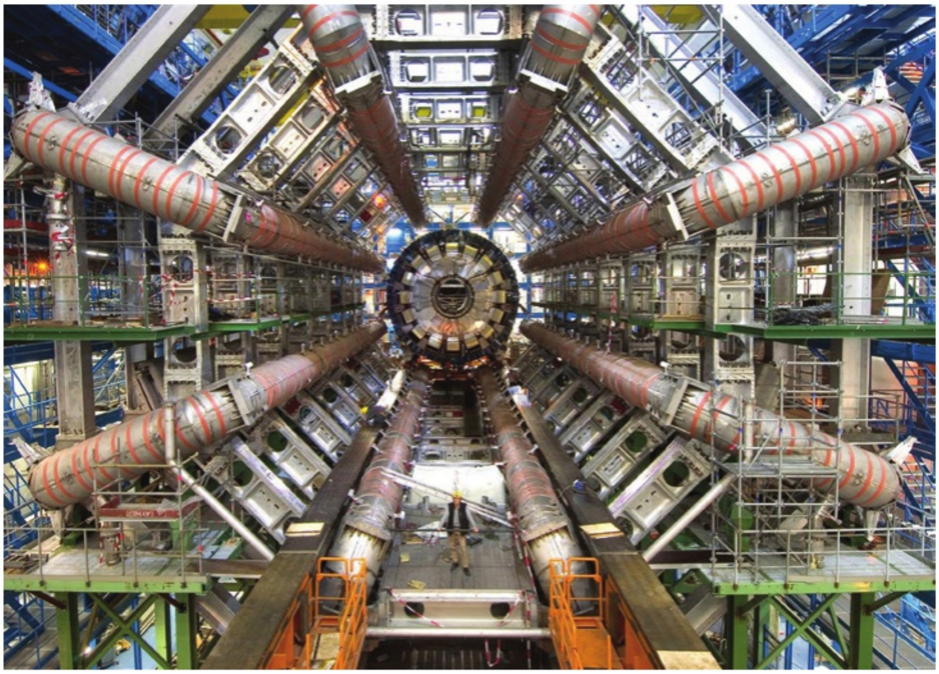


Figure 6 The Atlas detector at CERN

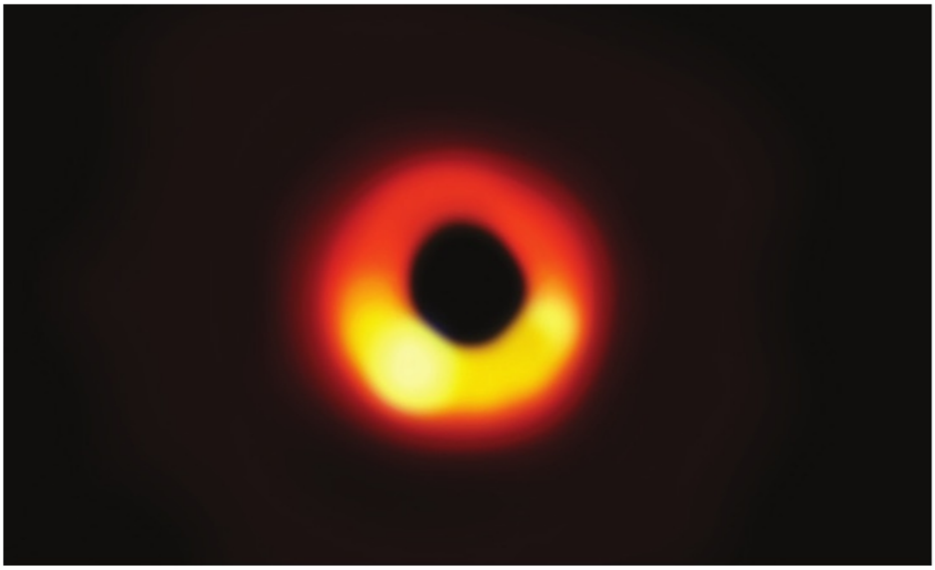
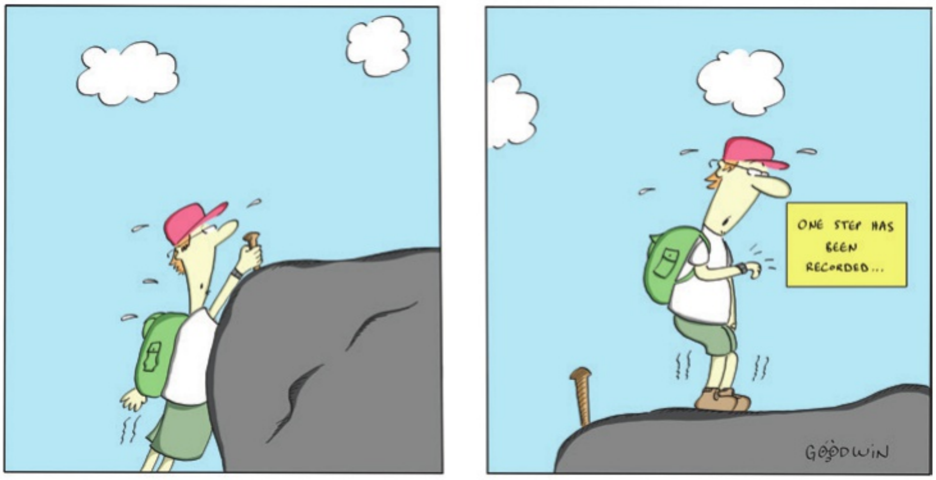


Figure 7 This picture of a black hole is not visible from any single telescope. It is compiled by putting together the data from the whole array and running a sophisticated computer program.

Technology has also transformed the way in which we gather evidence outside established areas of knowledge. CCTV plays a role in crime detection and prevention in many of our cities and when linked to digital facial recognition technology, it (controversially) allows security forces to gather data about our everyday activities. Such possibilities are inherent in smart devices such as speakers with voice-controlled assistants to respond to our every musical whim. These devices might also gather data about us that could be passed on to a third party. Our smartwatches can not only track our exact position but also make available information regarding our heartbeat and the nature of our physical activities; if this worries you, then think – so do smartphones! DNA technology is often used as evidence in criminal investigations and ensuing legal cases. Devices that give us detailed information about ourselves can also be used to give others that same information.



The use of technology in sport is also controversial. There are two main categories to this usage:

- helping to ensure fair play and good decision making by the referee or umpire
- helping to gather data for teams to monitor performance of individuals and decide strategy.

Figure 8 In football, a VAR can be used to ensure fair play and good decision making by the referee.

Examples of the former are the video assistant referee (VAR) in football, digital ball-tracking that is standard in international cricket, and electronic line judges such as Hawk-Eye in tennis.

Formula 1 motor racing is a sport that depends on technology for its existence. It is not surprising that it also employs technology for ensuring rule compliance, while in-car telemetry relays information relevant to team tactics such as which tyres to deploy and the timing of pit stops. In professional basketball, each player's physical performance is micro-monitored in real time and integrated with statistical graphics regarding the progress of the game. This allows real-time tactical decisions to be made by the off-court team. The controversy surrounding aspects of the use of technology in sport stems from the same basic concern: is the 'magic of sport' diminished by an overly precise and rational scientific or engineering approach? In terms of the sporting performance, will it boil down to which team has the best algorithms? Has the knowledge of the referee or umpire been devalued, and that role changed from making judgement calls to something like a technician making scientific observations? Have actions in the sport been reduced to physics? If the answer is 'yes', does it matter?

As well as being a tool for producing knowledge in the first place, technology can also be a tool for storing knowledge and moving it from one place to another. We saw how the simple act of making marks on a clay tablet caused a revolution in knowledge making and sharing in Mycenaean times. Similar revolutions, though perhaps not so remarkable, have accompanied other technological advances in communications technology: the invention of papyrus, the printing press, and the internet. While the first innovation was a game changer, the later advances are, perhaps, important step changes. Yet what they all have in common is that they make shared knowledge possible and more widely available.

With the greater possibility of technology used for sharing knowledge comes the question of who gets to use this technology and who controls this use – who the *gatekeepers* are. There are groups of people who have privileged status regarding the technologies that support our own integrated knowledge systems. The owners of the physical internet, for example, have an ultimate say about which organisations may run their systems on it. The internet is owned by relatively few private companies with often unknown names such as Equinix®, PAIX®, MAE-East®, DE-CIX®, LINX®, and AMS-IX®. This is in contrast to the familiar networks that connect to an individual's systems such as Google®, Facebook®, Netflix®, and Instagram®. In the language of the **Perspectives** section, these are groups 1 and 2 – the owners and the operators. Shared knowledge requires technological infrastructure that is owned by someone and immediately raises questions about the way the infrastructure shapes the knowledge shared and about who is permitted to access this knowledge. We examine and develop this idea in the next section.

Things to think about

- Has the introduction of technology in science and art made it easier to do things that were done previously, or has it transformed the things that we do in these areas?
- Does it make sense to say that science is based on sense perception when observations are performed entirely by machines?
- The author of this chapter witnessed thousands of paper copies of scientific journals being pulped as part of a university library adopting an exclusively digital policy. One argument was that digital journals require less space and offer wider access. But it is not clear that online journals do offer wider access and there has been a recent campaign against the policies of journal publishers in their bid to further their business interests. What online resources can you access through your school library? Discuss the question of hard copy *vs* digital from the point of view of a user thinking about the *gatekeeper* question.
- Find out about the use of DNA evidence in criminal trials. The probability of a correct identification depends on which database is being used. The probability of misidentification might surprise you. What problems are associated with using this technology in criminal trials? How could these problems be solved?
- Chimpanzees are known to use tools to solve problems (the famous example is using sticks to get at termites in their mounds). Tomasello (1999) describes how chimpanzees can learn to use tools by watching other chimpanzees. But it turns out that they learn from the changes in the environment rather than the deliberate action of the other animal. Human beings, on the other hand, seem to have a better grasp of intentional action: that the other person did something specific in order to achieve a particular goal (for example, using a tool with the intention of reaching the food). To what extent do you think that it makes sense to talk about the relationship between knowledge and technology and animals? How different is human knowledge from animal knowledge?
- **Challenge** Does thinking about technology expose a tension in the concept of shared knowledge? Shared knowledge could be thought of as individual knowledge that is the same as that of others – knowledge in common. But it can also be thought of as knowledge that is distributed across many people (and technologies) in such a manner that no one person has access to all of it. Which sense of 'shared' seems to fit best with knowledge in the modern world?

Knowledge questions

- How does technology extend or transform distinctively human mental capacities such as language use, abstract thinking, memory, communication, and problem solving?
- To what extent are technologies like the microscope and telescope merely extensions to the human senses, such as sight or hearing? Or do such technologies introduce radically new ways of sensing the world?
- Is artificial intelligence, such as facial recognition software or the control systems in self-drive vehicles, restricted to processing information or can it also allow machines to acquire knowledge?
- How do the tools that we use shape the knowledge that we produce?

Ethics

Finally, we turn to the ethical dimension of knowledge and technology. Ethics here means questions about responsibility to oneself and others regarding the use of technology in connection with knowledge. By implication, this includes the long-term effects of the use of such technology. The previous sections have emphasised the power of technology to transform our lives through changing our fundamental relationship with knowledge. Technology changes how we produce knowledge and how we share it; it also changes our conception of what counts as knowledge and what we consider to be known or what can be known. Given that technology has such power, it is crucial that we think about the responsibilities accompany using it.

What responsibility do the producers, owners, and operators of technology bear to those of us using the technology? The idea of responsibility is familiar to students of TOK. It takes the form: person X bears a responsibility to Y by virtue of Z, where Z is a reason connecting X and Y. For example, the pilot of a plane bears a responsibility to the passengers by virtue of their official position as pilot and the trust passengers have in them because of this official position. Underlying this is a second issue of trust: the passengers trust that the airline company has ensured that the pilot has sufficient knowledge to fly the plane and the pilot trusts that the technology of the plane will do what is required of it. Questions that link responsibility to knowledge form the basis for the ethical part of the TOK course.

There are, of course, subsidiary questions linked to the production of knowledge in our example of a commercial flight. We trust that the engineers who designed and built the plane had the requisite knowledge of the physical principles of aeronautical engineering. These principles of aeronautical engineering are ultimately based on principles of physics. When we step into the plane, we are literally betting our lives on these principles. So, the responsibility for our safe air travel rests not only on the pilot, the airline, and the engineers who applied the theoretical knowledge to a practical problem, but also on those who produced the theoretical knowledge in the first place. Responsibility is no longer a singular noun; there is a whole system of interrelated responsibilities at work and they are all based on relationships between different kinds of knowledge.

Figure 9 Can modern technology be programmed to make ethical decisions?

Modern technology takes this web of responsibility and adds a new twist. Human beings have responsibilities in carrying out everyday tasks such as driving a car along a public road. It therefore follows that a driverless car performing the same function must be expected to make the same 'ethical decisions'. A human car driver would have a responsibility for ensuring the safety of those in the car and other road users. This usually means adherence to traffic rules. This is great for automation – machines are good at following rules. There are occasions, however, when a driver might be expected to break a traffic rule in order to avoid a greater harm: for example, driving onto the pavement to let an ambulance through. There are also difficult situations where a driver must choose between the lesser of two evils: for example, to avoid hitting a child running into the road, a driver steers the car to one side and hits a dog. You can make up your own examples to think about here. Self-driving car technology must respond to this type of scenario. This suggests that the writers of the software would have to think about the ethics of the situation and make decisions about the set of preferences adopted in these cases. Since self-driving car technology follows a complex set of rules, the writers of the software would have to encode the rules for this type of moral problem into the software. Of course, this assumes that moral questions can be settled by a set of rules – which is itself up for debate. In any case, the programmers of the control system of the car suddenly have a new set of responsibilities because of the decisions they must make regarding how the car should react in critical cases. Technology raises new questions about the relationship between responsibility and knowledge.

The *gatekeeper* question discussed earlier is profoundly ethical in its nature if those denied access to a particular technology are thereby disadvantaged in some manner. In many situations, this is the case. The term 'digital divide' is often used to describe the difference between those people who have access to the internet and those who do not. Remember, we are not necessarily talking only about people living in remote areas far from internet provision. There is a debate in Sweden about the impact of internet technology on the lives of ordinary people. Over recent years, many physical branches of banks, station ticket offices, and ticket offices in theatres and cinemas have closed down as their services are transferred to the internet. An increasing

Figure 10 Might physical ticket offices become a thing of the past?

number of shops no longer accept cash. In a newspaper interview, Niklas Arvidsson of the Royal Technical University in Stockholm predicted that Sweden will be a largely cashless society by 2021. But there are many (predominantly older) people who do not use the internet and complain about being prevented from pursuing a normal active life. (Ironically, we are rapidly reaching the point where such complaints stop being recognised because local government and newspapers only accept electronic communications!) Technology changes the demand for knowledge for producers, operators, and users. It also comes with deep responsibilities.

Finally, what are the ethical implications of the notion that technology really does extend or supplement our perceptual and mental powers? According to some studies, blind people really do 'see' with their cane (Maravita and Iriki, 2004). Their body schema, the inner psychological map of the limits of their body, includes the cane. To deprive them of the cane is to deprive them of their means of seeing – it is tantamount to removing their eyes. If we accept that the mobile phone is an extension of our mental powers of memory, our ability to navigate, and our access to our social worlds, how ethically acceptable is it for the phone to be removed?

Things to think about

- How do we decide where the responsibilities lie regarding the knowledge invested in the following technologies?
  - self-driving cars
  - the possibility of enhancing human cognition through neural implants – also known as 'cyber-cognition'
  - the addictive effects of certain apps and games on their users
- Information and communications technology, generally known as social media, can be used to give people access to family and friends, and others with the same interests. It can also be used for online bullying. According to the website www.dosomething.org, 43 per cent of school-age children have been

bullied online, and in some cases bullying has led to death. What policy does your school adopt towards this problem? The problem is by no means restricted to school communities. Politicians, academics, and work colleagues have been subject to online 'pile-ons'. You might want to investigate the cases of Gina Miller, Kathleen Stock, Diane Abbott, and Rebecca Tuvel. Where does the responsibility lie in cases like these? What measures can be put in place to prevent online bullying?

- Find out about the Cambridge Analytica scandal. Where does the responsibility lie in questions about online interference with democratic processes?
- *Epistemic injustice* is the idea that the knowledge of some marginalised groups is not taken seriously. For example, epistemic injustice occurs in a meeting where male members do not listen when a female member is speaking. Discuss the ways in which the internet can be used to promote epistemic justice. Is there a danger that we build epistemic injustice into our digital technologies?
- Should internet speech such as posts to forums, social media contributions, tweets, and so on be more strictly regulated by hosts and moderators? Should contributions always be attributable to an identifiable author? Would this undermine key advantages of internet speech, such as the protection of anonymity for marginalised groups?
- What responsibilities do we have for the use of the data of others? Is it OK to put up a photograph of another person on Instagram, for example, without the subject's express permission? What are the implications of cases like this for data protection legislation?

Knowledge questions

- How might technology exacerbate or mitigate unequal access to knowledge?
- Does the existence of the deep web influence our view on whether or not some knowledge should remain secret or largely inaccessible?
- Should we hold people responsible for the applications of technologies they develop or create?
- On what criteria could we decide if activities such as 'hacktivism' are morally justified?
- To what extent have technological developments led to an increase in data being collected without people's consent or when they are unaware that it is being collected?

Conclusion

The dynamic intertwining of technology and knowledge runs like a unifying thread through this chapter. Wherever we look there is a loop: technology shapes knowledge and thereby shapes the structure of society itself, which in turn provides both the need for technology and the context of its development. In the broadest sense, technology and knowledge cannot be separated. They are two different aspects of something else – the self-organisation and self-sustainability of human culture. This is borne out by the virtual exhibition case studies: the Mycenaean tablets, the slide rule, and the GPS system.

In the larger picture, technology could be seen as transforming the nature of knowledge itself. In John Locke's time in the 17th century, knowledge was thought of as a personal possession – it seemed appropriate to speak of knowledge as a species of belief. In the 21st century, knowledge seems to be more like a possession of a group – it is distributed dramatically across vast distances and, with the help of large data stores, over time. Nowadays, it makes sense to think of knowledge as distributed across many people and things in the environment. These two notions of knowledge are in tension. It is difficult to think of the situation at CERN in terms of someone's beliefs. We need to adapt our understanding of knowledge to deal with the case where knowledge is distributed over people and things, and where knowing means not just believing but acting in harness with technology. And, as is often the case with actions, there are responsibilities too. But if knowledge itself is distributed across people and machines, how is responsibility distributed?

Oh, one more thing, but you knew this already, the young boy at the back of the classroom with the slide rule was the author of this chapter.

Exhibition thoughts

- There were three objects chosen in the **Scope** section to illustrate the idea that one way of thinking of technology is as something that extends human capabilities for knowledge through its physical manipulation. This is linked to IA prompt #23: *How important are material tools in the production or acquisition of knowledge?* What three objects would you choose in relation to the prompt? What are your reasons for choosing them? How do your objects answer the question in the prompt?
- The Linear B tablets can be thought of as part of the knowledge system of the Mycenaean civilisation. The knowledge that they made available was an integral part of the culture but also the culture made possible certain social practices that allowed the tablet system to work in the first place. This meant that the technology of the tablets and Mycenaean culture were intertwined. Think of another situation in which a technology produces knowledge useful to a culture, but also the culture develops in a way to make use of the technology possible. Choose three objects that make this argument for you. This is related to IA prompt #21: *What is the relationship between knowledge and culture?*
- It is easy to think of technology that serves the production of, say, scientific knowledge. In this question, think about the role technology plays in artistic and cultural terms. Choose a hobby: this could be a sport, art, craft, cooking, gardening, and so on. Choose three objects that show how technology has shaped knowledge in relation to your chosen hobby. Explain how your objects might help understand IA prompt #20: *What is the relationship between personal experience and knowledge?*

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2.3 Knowledge and language

Introduction

We are born into a world held together by language. Our culture is transmitted to us by language in its various forms. We use it to communicate ideas, thoughts, emotions, to signal our intentions, negotiate agreements, make promises, and create friendships. Language gives us access to some of the knowledge of other people. It gives us the power to ask questions, make promises and write poetry. It is language that orders much of our thinking and it is language that is the raw material of our social world.

Given that language is central in our lives, it is not surprising that language and knowledge are closely connected. The focus of this chapter is to try to unravel this connection and examine it bit by bit. We shall start by trying to understand the concept of language.

The term *language* can be interpreted broadly. Many people speak naturally of the language of football, of music, of cooking, of agriculture and of medicine. It is common to think (whether true or not) that a cat uses language when mewing loudly in front of the door, or that a dog barking when the car turns into the drive expresses greeting. While this broad notion of language is perfectly legitimate, it will be useful to start with a somewhat narrower understanding. Notice how the IB diploma programme devotes two subject groups specifically to language: mother-tongue language (linguists call this L1) and an additional language, L2. What is studied in these groups is natural language, understood as a system of symbols used in combination to express meaningful ideas whose meanings are *conventional*. The word 'dog' means what it does because of a complex history of human usage; it could have been different – and indeed in some parts of the world other signs are used such as 'chien' or 'Hund'.

The use of symbols used in combination enables language to pull off a clever trick: it allows us to express an unlimited number of ideas with a finite set of signs. These features of language – convention and combination – distinguish this narrow sense of language from other types of communication, such as the sounds of animals. Included in this narrow category are natural languages like English and Chinese, artificial languages like Esperanto, and computer languages like Python, Javascript and C++.

Activity 1

What language interactions have you been involved in today? Which of these involved symbols used in combination (the narrow notion of language)? Which of these interactions were broader uses of language?

In the first section we shall consider three objects that illustrate the wide scope of our inquiry. These can be thought of as objects in a virtual TOK exhibition illustrating some different and important aspects of the connections between language and knowledge.

Scope

Virtual exhibition object 1

The first object in our virtual exhibition is the following conversation between Joyce and Stan. This is a real conversation that took place between a brother and a sister. It may look strange because it is notated by linguists (people who study language and its use) who want to capture the fact that in everyday life we do not talk in precise grammatical sentences. We pause, interrupt each other, leave sentences unfinished, change intonation, change the speed of our speech, and emphasise words and syllables (compare the real use of language to the dialogue in a film or the script of a play). By transcribing these conversations precisely, linguists try to understand what goes on in everyday language use (see the box explaining the symbols). What they find is a set of patterns that tell us a lot about how we use language to negotiate, to promise, to tell jokes, and how power plays a role in conversation. In short, how our social lives are constructed through language.

Joyce:	[°Mm,
Stan:	[hhhh We:ll okay: at's about all I wannid tub
	(0.7)
Stan:	bug you with. (tod[ay).
Joyce:	[uhhahhahh hh Okay Stan:,
Stan:	So are ^you okay?
Joyce:	Yeah, (0.4) um: (0.2) whatta ya doing like: s: late
	Saturday afternoo:n.=
Stan:	=hhhhh Well late Sa- I pra- a friend a'mine just
	called me a little while ago: an' he: uh:
	(0.7)
Stan:	he wannid'a do something.<so I said well:, it's a
	() Saturday night why donjn't we go: uh: you know
	(le's:)/(us:) catch a movie: er: ge[t something
Joyce:	[Mm Stan:
Stan:	to ea:t er: ballgame >er somethin' like tha[t<
Joyce:	[°Mm
Stan:	.hhhh but S:aturday a:fternoon if it's t's not too:
	la;te I don't think [I ( )
Joyce:	[No it'll it'll be like six.
	o'clock.
Stan:	Oh: why what's happening¿
Joyce:	Because I'm going down to San Diego.
	(0.3)
Joyce:	An' I'm gonneh- fly:
	(.)
Joyce:	And so I need somebody'ta drive me to the airport.
	(0.4)
Joyce:	And uh: Ma said she might but ^yihknow,
	(0.9)
Joyce:	She'll tell me [la:ter;
Stan:	[Oh I might be ableta manage it
	I'll see:, but don't count on me, yih[know.?

Joyce:	[Arright well
	I'll try an[d get someone else.
Stan:	[Av: I wouldn' I wouldn' have a really
	good idea until: uh timorrow or Saturday.
Joyce:	Yeah, o[kay.

(Sidnell, 2010, p. 100)

Key to transcription symbols

[	overlapping utterances
(0.5)	silence, in tenths of a second

Punctuation marks are not used grammatically, but to indicate intonation.

.	falling, or final, intonation contour, not necessarily the end of a sentence
?	rising intonation, not necessarily a question
,	'continuing' intonation, not necessarily a clause boundary
::	prolongation or stretching of the preceding sound
-	cut-off or self-interruption
<u>Word</u>	Underlining is used to indicate some form of stress or emphasis, by either increased loudness or higher pitch.
> <	talk is compressed or rushed
<>	talk is markedly slowed or drawn out
=	there was no discernible break between these two lines
°	talk following was markedly quiet or soft
^	there is a sharp rise in tone
¿	rising intonation sharper than ^ but less than ?
Hhh	aspiration
(word)	uncertainty in transcription

Activity 2

What do you think is going on in this conversation? Is this typical of how everyday conversations work?

In this extract, Joyce and her brother Stan are reaching the end of their conversation. What is interesting about it is that the conversation uses language not so much to impart knowledge and information, although it certainly does this, but rather to ask questions, make requests, and extract promises. Is it possible that conversation is mainly about social cooperation?

This small fragment shows us what happens during most of our everyday conversations. In lines 7 and 8 Joyce introduces a topic that she hopes will lead the conversation towards the request in line 27 for a lift to the airport. It seems reasonable to assume that in this social situation it would not be acceptable for Joyce to blurt out at the start, 'Stan can you drive me to the airport on Saturday afternoon?'. Being so direct might not have been seen as polite and might simply be refused with a silent vow to restrict future cooperation. No, requests such as this one need to be set up properly, in this case by being preceded by a motivating explanation and questions about the availability of the other person. Stan, because of his other commitments, effectively refuses the request in line 33, although he leaves open the possibility that the negotiation can be resumed later. Notice that once Joyce has asked the question in line 7 there is an unfulfilled set of commitments. Stan is obliged to answer the question about what he is doing, but Joyce also is required to make clear the context for the question. Joyce's simple question places a set of obligations on both speakers. This is how the dynamics of conversation are regulated through the expectations of the participants. Questions normally require responses. But requests also normally assume sufficient background information so that the request makes sense. Both speakers contribute to the conversation, which itself makes demands of the speakers. There is a real sense that the conversation is greater than the sum of its participants.

Activity 3

Are the conventions for conversation similar in your mother-tongue language? What are the main differences?

The idea of conversational rules was first developed by the philosopher Paul Grice in the mid-20th century. He proposed that there are sets of social norms that regulate conversation – unwritten rules that we apply in our daily life. We are conscious of them only when a rule is broken; for example, when someone talks too much in a conversation or if what they say does not fit the current topic. If a rule is broken the offender risks a social penalty, such as being ignored or deprived of future cooperation. Since the consequences are severe, people try to adhere to the rules.

Grice put forward the following cooperative principles.

- **Quantity:** the information content should be appropriate to the context
- **Quality:** the contribution should express true beliefs
- **Relation:** the contribution should be relevant to the context
- **Manner:** the contribution should be clear, short, and orderly

Grice's *quantity principle* expresses the idea that contributions to the conversation have the right information content and do not place excessive demands on participants; for example, a casual conversation between school friends is likely to be disrupted if one of them started giving a lecture on nuclear physics. The *quality principle* refers to a reasonable expectation in a conversation that what is being said is true, or at least that it is what the speaker believes. False statements can often be repaired in a conversation – an untruth can be corrected by other participants. (See page 38 of Chapter 1.1 **Knowledge and the knower** for a discussion of the difference between stating an untruth and lying.) Conversations tend to move dynamically from one topic to another; however, Grice's third principle about *relevance* ensures that these movements are gradual. Imagine a conversation in which each participant introduced a different topic every turn – there would be no coherent conversation at all, hence the need for this rule. Finally, according to the *manner principle*, it is expected that the contributions made by each participant are well organised, clear, and are relatively short. What 'short' means depends on the context of the conversation and its dynamic, but other participants will seek 'interruption points' to cut short a contribution that is deemed too long.

The people who study how we talk to each other use the structure of real conversations to understand how language functions in our social world – how we construct knowledge together through language, what power relationships exist between people, and the extent to which each participant's contribution (or knowledge) is taken seriously. For example, it might not surprise you to learn that, on average, men interrupt a conversation at an earlier point than women and that they phrase their contributions in more absolute terms; women tend to use more tag phrases like 'isn't it?' and 'do you agree?' to build consensus (Thorne and Henley, 1975). There are also ways in which conversations can marginalise participants. The failure of a conversation to include ideas of one of its participants indicates a type of *epistemic injustice* where the speaker and their knowledge are not taken seriously. In this sense there is a strong connection between language, knowledge, and power.

Activity 4

Have you experienced situations in which there has been epistemic injustice – where someone's knowledge has not been taken seriously by others? Describe the situation and what could have been done to prevent the epistemic injustice taking place.

Homo sapiens' domination of planet Earth has a lot to do with cooperation. The philosopher David Hume suggested that the act of promising lay at the heart of human cooperation and told a story to illustrate this: Farmer Giles asks Farmer Smith to help him with his harvest on Monday. Farmer Smith agrees but only if Farmer Giles returns the favour by helping Smith with his harvest on Tuesday. That way both farmers achieve an outcome that was not possible without cooperation. Hume reasons that, to an extent, promising is self-policing. In the long run it is better for us to meet our obligations made in a promise. The benefits of cooperation usually exceed the costs. If we fail to meet our obligations we will be excluded from future cooperation and will miss out on its benefits. This back and forth arrangement is called *reciprocal altruism* – the idea that it is good to be nice to the neighbour because the neighbour will then be nice back. Such promise making forms the basis of our social world – from simple situations such as that of Joyce and Stan to complex legal agreements and international treaties. Language makes promises possible; they are what we call *language acts*. The powerful ability of language to refer to future or possible states of affairs gives us the power to make promises even if we face an uncertain future. This feature of language makes social life possible.

So, what do we learn about language and knowledge from the analysis of an ordinary conversation? Although language is a primary means of sharing knowledge by communicating it to others, it has other roles to play regarding knowledge. We use knowledge to negotiate our way through a complex system of obligations and norms and make contracts with each other, without which our social world would not function. Language, then, not only encodes formal knowledge such as the subjects we learn at school – what in TOK we call areas of knowledge (AOKs) – it also provides the basis for the sort of knowledge we need in order to live, work, and play together. It provides a necessary ingredient for us to function socially.

Virtual exhibition object 2

The second object in our virtual exhibition is a marriage certificate. Looked at dispassionately, from the point of view of an outsider, a marriage ceremony could seem strange. Two people who are not related enter a special place – either a religious building, a building belonging to a branch of local government, or even a garden or outside area. Certain words are spoken by a special person at the right time and the two people are suddenly related intimately: they are married. Marriage is an objective fact about the world; it is not just a matter of someone's opinion. Therefore, there is something about the use of these words at this place and time that make this objective change to the world. Yet, such transformations are routine in everyday life. When a

Norm:
there are different senses of this word. The first sense is descriptive: a norm is normal – something that usually occurs: 'Having supper at six is the norm in Sweden.' The second meaning, and the one used in the paragraph opposite, is imperative – a norm is something that *ought* to occur: 'It is a norm to drive on the right in Sweden.' A norm in this second sense is a sort of rule and is often used in a social context. The term *normative* is derived from this second imperative sense of the word.


No.

KINGDOM OF SCOTLAND,

COUNTY OF DUMFRIES.

PARISH OF GRETNA.

These are to Certify To all whom these presents shall come, that William Scott from the Parish of Haltwhistle in the County of Northumberland and Frances Bell from the Parish of Haltwhistle in the County of Northumberland being now here present, and having declared themselves single persons, were this day Married after the Manner of the Laws of the Church of England, and agreeably to the Laws of Scotland; as Witness our hands, Allison's Bank Toll-House, this 25th day of August 1849

John Murray William Scott

Witnesses, Frances Bell

Jannett Murray

Jane Murray

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Figure 1 Marriage certificate: using language to change the world judge (or jury spokesperson) says 'the defendant is guilty', at that point the defendant becomes guilty (in the legal systems of many states, they are presumed innocent otherwise); when parents say, 'The baby will be called Y' or a head of state says, 'I name this ship X', that is the moment that the baby or the ship acquires a name. When the Final Awards committee of the IB approves the grades that the examiners have given you in your different subjects, that is the moment that you have (hopefully!) passed the diploma programme. As in the case of marriage, all these are objective facts about the world. We shall call them *social facts*.

Activity 5

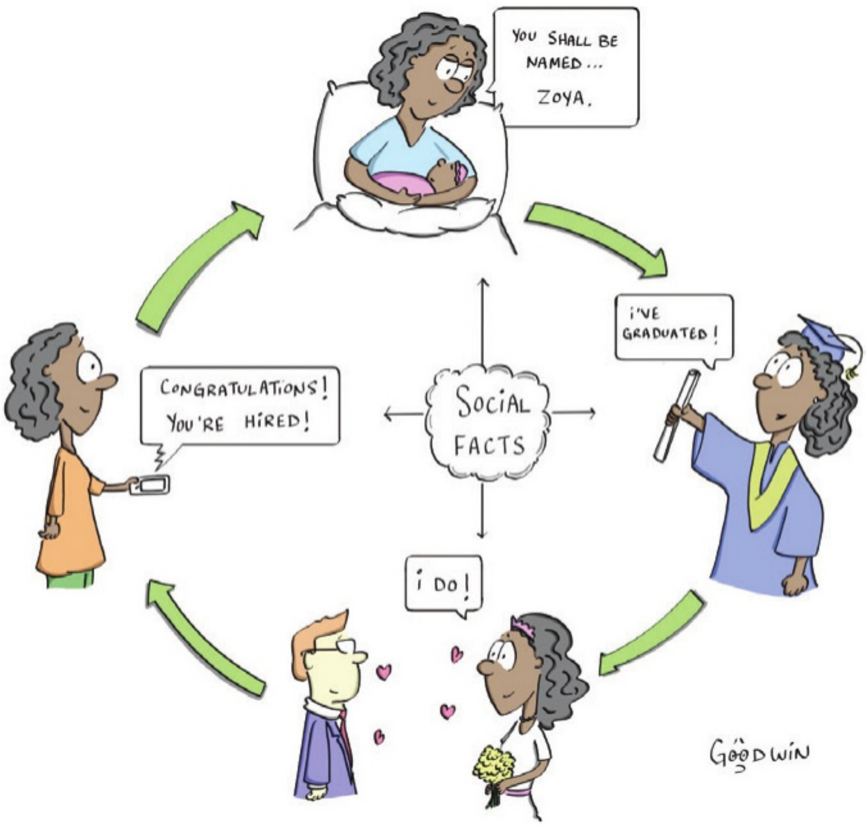
Can you think of other examples of social facts? What is the role of language in establishing these social facts?

Social facts are different from facts about the physical world. Nonetheless, they make a great difference to our lives. Someone found guilty of a crime might have to spend time in prison. Having an IB diploma will almost certainly make a difference to your physical circumstances in time. We say that social facts have *causal power* – they make a difference, even in the physical world. Yet, they are established using language; this is the magic of words!

So, we use language not only in reporting on knowledge that we possess, but we use it to shape the social world in which we live. Knowledge is involved here, too; knowledge of how to find one's way in the social world and how to change that world. This type of knowledge, in keeping with other optional themes, is less about *knowing that* and more about *knowing how* – knowledge relating to action in the world. (See page 14 of Chapter 1.1 **Knowledge and the knower** for an explanation of the difference between *knowing that* and *knowing how*.)

What does it take for language to create social facts? Let us go back to the marriage certificate. On it are written the names of the bride and groom. But there is also the name of an official, in this case a clergyman, who conducted the ceremony. The words that transform two single people into a married couple must be uttered by the right person, in this case the clergyman, as part of an elaborate ceremony. It matters who speaks these words. Suppose that just as the Queen is about to name a ship, a protester grabs the bottle of champagne, dashes it against the side of the ship and proclaims, 'I name this ship the Karl Marx' (Searle, 1995). All the physical parts of the ceremony are duly followed but the words are spoken by the wrong person. The social fact has not been created and the ship has not been named.

Moreover, it seems to be the case that the more significant the social fact being created, the more elaborate the ceremony. Think of the spectacular ceremonies associated with the establishment of a new head of state, the coronation of a new monarch, the swearing in of a new Supreme Court judge, or the appointment of a new archbishop. The different ceremonies and the offices of those who officiate in them are all themselves *social facts*. The social world is a complex fabric woven from social facts created through language used in the right ceremonial and institutional settings (see Chapter 2.5 **Knowledge and indigenous societies**). Language both creates this web of social facts and enables us to trace our precarious way over its threads.



Virtual exhibition object 3

The third object in our virtual exhibition is a defaced road sign in Belgium written in two of the official languages of Belgium: French and Flemish. The fact that the French parts of the sign have been vandalised suggests that the question of official languages is not a politically neutral matter. Let's look at the relationship between varieties of language and **power**.

Figure 2 Language politics – a defaced road sign in Belgium

Activity 6

Think of your mother-tongue L1 language. Can you identify different varieties of it? Is there a more official version and a more informal version? Are there status differences attached to the different types?

As you might have observed in answering Activity 6, there is often considerable variation even in a single language. Take North America as an example. The vastness of its geography produces countless different types of American English. Some of these are variations in pronunciation, such as a Boston accent or a Californian accent. Others are variations in grammar and vocabulary and are called *dialects*. There are some 120 to 187 languages and dialects in the Philippines, depending on the method of classification. Most languages in the world possess accent or dialect varieties.

Not all variants of a language carry the same social standing; for example, in England there is the expression 'BBC English' meaning an English variety associated with the higher educated classes in London and the south-east of England. For many years, the British Broadcasting Corporation (BBC) employed only people whose English language fell into this narrow category, as newsreaders and broadcasters. However, over the last 50 years, there has been an increase in the number of regional accents acceptable for broadcasting jobs. There are clear implications here concerning language and class, which we shall explore in the next section.

Figure 3 Isogloss is a line separating regional variations of a linguistic feature – in this case, a phrase.

In many countries, as the road sign illustrates, regional variation is not limited to different dialects of a single language but can involve two or more different distinct languages. This is called *bilingualism*. Canada is an example of an officially bilingual country. The official languages are English and French, which are equal in rights and privileges for use in all parliamentary and governmental institutions according to Canada's constitution. Bilingualism makes itself felt at the level of state institutions but also at local and individual level. For example, decisions about the language of elementary schooling and so on are deeply significant in terms of cultural knowledge. There are other forms of bilingualism where only one form of the language is official. A common situation is that a 'low' form of the language is spoken at home and among the local community, whereas a second 'high' form is the official language of government. This is called *diglossia*. Examples are found among countries in which, for example, Arabic is the official language and local dialects are spoken unofficially; similar examples are found in countries where Swahili is the official language, although many different local languages operate as the vernacular form – that is the form used in everyday life but not in official communications. These situations are often linked to large-scale political projects linking different peoples through a common, if somewhat artificial, language.

The link between language and knowledge in these cases rests on the tight coupling between language and culture. We discussed the idea that our social world is constructed largely through language and these social worlds combine over time to produce something that might be broadly described as culture. The political debates that surround language are ultimately about cultural dominance – about whose cultural knowledge is valued. We saw in Chapter 2.2 **Knowledge and technology** how changes in technology empowered and disenfranchised people through the ways it led to their knowledge being valued or dismissed. One can think of culture as being a type of super-technology in which we are embedded. Whose culture is valued and whose is left to wither and become irrelevant is a crucial question of empowerment.

Things to think about

- Find an example of a social fact that is produced by a language act (either a spoken phrase or utterance or a written text). Explain how the social fact is typically produced. What function does the social fact have in regulating social life? What is the connection between the social fact and knowledge?
- Record a short conversation between you and your friends (about one minute long). Use the conventions of conversation analysis to transcribe the conversation. What patterns do you notice in the conversation regarding turn-taking, interruption, introduction of new material, obligations made by questions, and so on. Can you identify Grice's principles at work in the conversation? What knowledge is exhibited or produced by the conversation? How does the conversation produce sociality rather than a collection of individuals?
- By definition, as an IB student, you have familiarity with more than one language. Do you have a preferred language? If so, why do you prefer this language? Does it make any difference which language you use to do certain everyday tasks?
- Write a short paragraph on the question of why people may become passionate about issues surrounding the official language of a state.
- **Challenge** Read about Roman Jakobson's list of the functions of language. Think about the structure of a TOK essay. Which parts of the essay play a meta-linguistic function? Why are these parts important?

Knowledge questions

- Can all knowledge be expressed in words or symbols?
- Is it possible to think or know without language?
- Is being able to speak a language an example of *knowing how* to do something?
- What role does language play in allowing knowledge to be shared with future generations?
- Are there differences in how knowledge is conceived of, or presented, in different languages?
- Is it the case that if we cannot express something, we don't know it?
- To what extent does language allow us to make our private experiences public?
- How does language allow humans to pool resources and share knowledge?

Perspectives

In this section we shall explore how language can create and reinforce perspectives. Perspectives are broad ways of looking at the world that are relatively stable over time and are shaped by the social groups that each of us belongs to, such as gender, social class, and ethnicity.

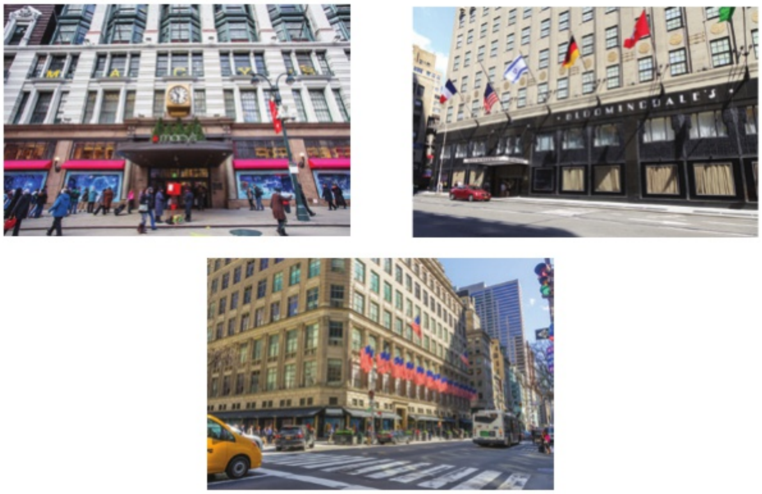


Figure 4 William Labov investigated how class correlates with pronunciation in his research of shop assistants in New York City stores.

Let's return to the conversation between Joyce and Stan in the **Scope** section and ask: what type of perspective is on show here? One way of interpreting this question is not about what is being said, but rather *how* it is being said; precisely which words are used and how they are pronounced. There are large variations in speech patterns across a population and socio-linguists show that these variations are highly predictable and linked to variables such as age, gender and, most importantly, social class. Marx argued more than 150 years ago that social class gives us a particular perspective on the world. Factory owners see the world rather differently from workers; our own material circumstances radically determine our world view.

More recent studies also link how we speak with our social class. Imagine two speakers. Speaker A says: 'I done it yesterday. He ain't got it. It was her what said it.' Speaker B says: 'I did it yesterday. He hasn't got it. It was she who said it.' Who has the higher social status?

If you answered speaker B, you would be right. The linguist William Labov made a systematic study of the relationship between language and social class. For instance, he established a link between pronunciation and social class. He was interested in the pronunciation of the final /r/ phoneme, the smallest structural unit in a word, in words like *car* and *floor*, and carried out research with shop assistants in stores in New York City. The language we use encodes a huge amount of social knowledge – it can betray our social and educational status as well as information about our age and geographical origins. In later studies Labov showed, as the writer George Bernard Shaw noticed in his play, *Pygmalion*, that we can, and do, change our accent to manipulate others' perceptions about our position in the social hierarchy. Language not only carries knowledge about the world but also, whether we like it or not, a lot of knowledge about its users.

There is a second way to understand how language might give a perspective on the world and, in a sense, this is even more significant than social status. Language might actually affect how we perceive, experience, and ultimately know the world. This is the main contention of two important 20th-century thinkers, Benjamin Lee Whorf and Edward Sapir. They were impressed by the fact that we think in concepts and through metaphors and these differ among languages. For example, in Dutch there is a concept *gezellig*; it is difficult to translate into English but means something like (of a café) 'warm and cosy'. In Swedish, *lagom* means not too much but not too little – just right. There is an Inuit word *uggianaqtuq*, meaning the experience of unpleasantness when a friend acts strangely. Maybe there is no simple equivalent concept in English to the Dutch *gezellig*, the Swedish *lagom*, or the Inuit *uggianaqtuq*. This perhaps is to be expected; it is hardly surprising that different cultures produce different high-level concepts. But what about the concept *blue*? There are many languages in the world where there are no clear-cut terms for blue and green, such as ancient Egyptian, Hebrew, Amazigh Celtic, old Chinese, Tibetan, Vietnamese, Tswana, Zulu, Xhosa, Yukatek, Lakota Sioux. Shona has one word for yellower greens and greener yellows and a different one for bluer greens and non-purplish blues. Does this mean that Shona speakers see the world differently to English speakers? Questions such as this led Sapir and Whorf to formulate their linguistic determinism thesis (see Info box).

Info box

Linguistic determinism of Sapir and Whorf

Strong version (**linguistic determinism**): the language we use determines how we think (and therefore how we perceive the world) and how we talk about it.

Weak version (**linguistic relativity**): the language we use influences how we think.

Activity 7

Are there any phrases or concepts in your L1 language which are not translatable? If so, how would you explain these ideas to a friend who did not speak this language?

Here is Whorf justifying the strong thesis.

> We dissect nature along lines laid down by our native languages. (...) [T]he world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds—and this means largely by the linguistic systems in our minds. We cut nature up, organize it into concepts, and ascribe significances as we do, largely because we are parties to an agreement to organize it in this way—an agreement that holds throughout our speech community and is codified in the patterns of our language. The agreement is, of course, an implicit and unstated one, but its terms are absolutely obligatory; we cannot talk at all except by subscribing to the organization and classification of data which the agreement decrees.
>
> (Whorf in Carroll, 1956)

These two theses propose that we describe and package the world using our systems of concepts, and that our thoughts about it and perceptions of it depend on these concepts. How we perceive the world depends on what concepts are available to us. A word of warning here. Sapir and Whorf are not saying that the world is purely a product of human imagination or social construction. There are facts about the world – which we can (and often do) get wrong. Nonetheless, they do suggest that we understand the world by carving it up into meaningful pieces depending on the concepts available in the language we use. This means that people with different conceptual frameworks might, if Sapir and Whorf are right, 'see' the world differently. This reminds us of the map metaphor which TOK uses to understand what we mean by knowledge. The same solid objective world can be mapped in numerous different ways according to our needs and interests and systems of concepts.

Different maps do not necessarily imply different underlying worlds.

So what evidence is there for the linguistic determinism or linguistic relativity theses? They have been the subject of considerable debate. One popular notion supports the thesis that some languages conceptualise the world differently because they possess different words for describing it, such as the examples from Dutch and Swedish. People like to quote the fact that the Inuit language has many words for *snow*, as evidence that Inuit speakers view the world differently from, say, Australian speakers, although this is long regarded by linguists as being an urban myth. A more compelling piece of evidence for the strong thesis comes from an ingenious experiment carried out by Paul Kay and Willett Kempton in 1984 concerning visual perception tasks on the blue-green colour boundary, given to speakers whose mother tongue did not distinguish these colours. They found that possession of a blue-green distinction in colour vocabulary did produce a significant difference in colour judgements about colours on the blue-green boundary. So that is evidence in favour of the strong thesis. On the other side of the argument a more basic question could be asked: what evidence is there that we think in language? If we do, what proportion of our everyday thinking is done using an internal 'mentalese'? Perhaps our internal processes do not rely on an internal language, or if they do it has a different structure from that of natural languages.

Perhaps the answer is that both sides are right in a sense. Language is an external tool for thinking rather than an internal encoding of experience. We manipulate it individually when thinking on paper, when writing an essay, or collectively when brainstorming ideas with our friends. Maybe language shapes our thoughts in this manner without necessarily requiring that internal processes are language dependent.

Things to think about

- Investigate the *Stroop* test. Make some slides with colour words like *red*, *green*, and so on. Make some of the colours correspond to the colour words, so colour the word *red* red. With other words make their colours disagree with the word – say, colour the word *yellow* blue. Make ten slides. Now try a Stroop test on your friends Ask them to observe and remember the physical colours visible on the slides. Gently stress your experimental subjects by showing the slides in a rapid sequence (two slides per second, for example). Afterwards ask them questions like, 'Did you see pale blue?'. Observe that they might report they had seen colours that were not actually shown. What does this experiment tell us about the role of linguistic categories in colour perception?

- Which language do you count in? Play a sport in? Talk to your parents in? What are the implications for knowledge of the fact that we use different languages for different tasks?
- What are the implications of the linguistic determinism hypothesis in the situation of an anthropologist from culture A and language L studying a culture B that speaks language M? Is it possible really to know a culture different from your own? What are the implications for *multiculturalism* – the idea that there can be a society in which all cultures are treated equally.
- **Challenge** Find out all you can about the *fusion of horizons* theory of the thinker Hans-Georg Gadamer. What hope does Gadamer hold out for a truly multicultural society?
- Poetry is sometimes described as 'what gets lost in translation'. Do you agree with this description? What are the challenges of translating poetry? Is prose vulnerable to the same problems of translation? What are reasons for and against holding literary competitions across language boundaries?
- Discuss the difficulties of telling a joke in a different language. Does humour cross cultural boundaries? What type of knowledge is required to make humour work? What is the link between cultural knowledge and humour?
- Read up about the language Esperanto. What were the ideals that motivated the construction of this language? Does Esperanto lives up to these ideals?

Knowledge questions

- Does the transmission of knowledge from one person or generation to another depend on language?
- What knowledge might be lost if the whole world shared one common language?
- If a language dies, does knowledge die with it?
- How do our values and assumptions influence the language in which we express our ideas?
- Is ambiguity a shortcoming of language that must be eliminated, or can it also be seen as making a positive contribution to knowledge and knowing?
- Do all people share some innate linguistic knowledge? If the categories that we use necessarily empower or marginalise, is it ever possible to produce knowledge that does not either reflect or challenge existing power structures?

Methods and tools

Having seen how widely language is used in the everyday world, how it fosters different perspectives, how there are different perspectives on its relationship to thought, and how closely it is tied to culture, this section explores more closely the ways in which knowledge and language are linked. How does language give us knowledge? Is the use of language a type of knowledge? What does it take to share knowledge through language?

Sharing and producing knowledge

Let's start with the use of language to share knowledge. Although it is not the only thing we do with language, one of its functions is to allow us to share knowledge. This sounds straightforward enough. The example of the conversation between Joyce and Stan showed how language can be used to share knowledge of everyday things. But it is not as simple as this. Sharing knowledge between two people requires that they share much more than just linguistic competence. There is a level of background knowledge that is assumed in any use of language. Without it, communication is not possible. To illustrate this, let's go back to the conversation.

The role of background knowledge

What does it take to make sense of the conversation between Joyce and Stan? We claim that a lot of everyday background knowledge is required. For example, to fly to San Diego means getting to the airport first. It is possible to drive to the airport but this involves parking and retrieving the car on return, which could be expensive. Therefore, a cheaper solution is to get a lift with someone else to avoid parking fees. Driving to the airport implies also driving back from the airport. This could mean, say, a two-hour round trip since most airports are situated on the edge of the city. This means two hours away from the usual leisure activities possibly occupying a Saturday afternoon. Therefore, asking someone for a lift to the airport is a favour that can be asked of family members and close friends, but not occasional friends or more formal contacts such as one's boss. All of this is background knowledge needed for the exchanges to make sense.

Linguists study such background knowledge when they are investigating *pragmatics*: how we create meaning using words in everyday situations. Interestingly, despite the best efforts of voice-activated technology to understand normal human speech, it is remarkably difficult to make a machine that can do what we do effortlessly. One of the reasons is that robots and natural language programs do not have the background knowledge necessary to make sense of everyday talk – they can only decode a small, although increasing, subset of all human speech. Moreover, it is a difficult problem to make a machine that can select what background knowledge is relevant to a given conversation. In artificial intelligence research this is called the *frame problem*. To share knowledge using language we need to assume some sort of common background knowledge. Precisely what background 'knowledge' voice-activated technology needs to understand ordinary speech is still an open question.

Activity 8

What background knowledge is required to understand a typical conversation between you and your friends at the school cafeteria?

The role of concepts

The sharing of more formal systems of knowledge, say through a textbook, requires more specific types of background knowledge. To understand a physics textbook, you will need to be familiar with some technical *concepts*. Concepts form the building blocks out of which knowledge is constructed. In the physics book we learn that a falling tennis ball has an acceleration due to the force of gravity. 'Acceleration' and 'force' are important concepts in physics and they are linked by Newton's second law of motion, which states that the acceleration experienced by a body is directly proportional to the net force acting on it. Scientific laws connect concepts. We use language to label these concepts, which enables us to share knowledge with others who share the same concepts. In Chapter 4.2 **Natural sciences**, we also discuss the role played by standards and conventions, such as the units we use to make scientific measurements – metres, grams, seconds, and so on. These same standards enable us to share other types of knowledge; for example, cake recipes, sewing patterns, building plans.

Activity 9

Choose one of your higher-level subjects. Write down five key terms in your chosen subject. Explain how understanding these key terms counts as knowledge in your chosen subject. Explain the general link between specialist language, concepts, and knowledge. Explain why specialist language must be used in the construction of knowledge in your chosen subject. Is this the case for all knowledge? What are the implications for your thinking here when writing the extended essay?

Concepts also underlie an important role for language in producing knowledge: asking questions. The conversation example showed how asking questions plays an important role in everyday life. Questions also make up the backbone of all the areas of knowledge. One view of progress in a discipline is its ability to answer previously unanswered questions. The questions of interest within a discipline make reference to concepts specific to that discipline. 'What is the gravitational acceleration at the Moon's surface?' makes use of the concept of 'gravitational acceleration' for example. This means that questions within a discipline build on the set of concepts that are accepted as being useful in that discipline. But this set of useful concepts changes. This has interesting consequences. As a discipline progresses, certain concepts are abandoned. In chemistry the concept of *phlogiston* was abandoned after Lavoisier's experiments in the 1770s confirmed the existence of oxygen. It makes no sense for a chemist to ask questions about phlogiston, just as it makes no sense for a physicist to ask about the 'ether' or, strictly speaking, about events being simultaneous. So, concepts evolve and this means that the questions using them also evolve.

Let us look at this situation in more detail. The concepts used to make knowledge in a discipline like chemistry fit together a bit like a jigsaw puzzle. We call this a *conceptual framework*. In most disciplines the conceptual framework changes as advances are made. But since concepts are labelled by language, this means that the language of the discipline evolves. Moreover, as the conceptual framework of a discipline changes so does the set of questions that can be asked because these questions are framed using the current set of concepts available to the knower. Advances in knowledge produce changes in the conceptual framework, which drives the evolution of questioning.

The natural sciences are good examples of this process but conceptual frameworks in other areas also evolve. However, whereas in the natural sciences concepts become outdated and are eliminated from discussions, in the arts this vocabulary is retained because artists still want to talk about techniques used in the past. *Sonata form* was a structure used in Western classical music at the time of Mozart. It is rarely used by modern composers. Nonetheless, the concept is useful in discussion of these earlier works. Similarly, techniques used in the literature or architecture of the 18th century, say, still feature in literary and architectural discussions today. These concepts still have currency because, perhaps in contrast to the sciences, meaning in the arts has a crucial historical dimension. In these disciplines concepts change, but the difference is that concepts rarely become outdated because of the continuing interest in past work.

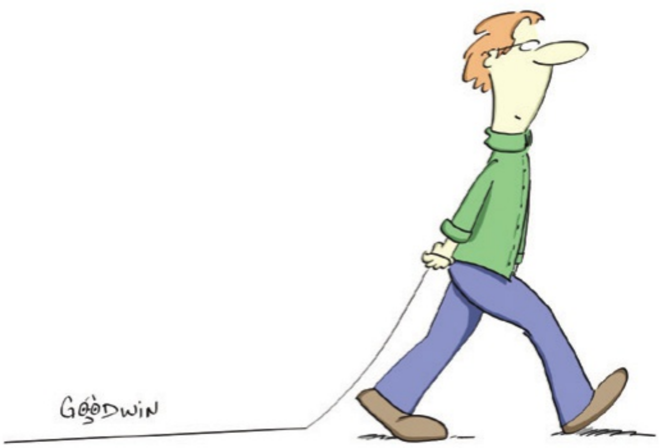
Activity 10

Which areas of knowledge are most vulnerable to changes in their conceptual frameworks? Why?

The idea of a conceptual framework is worth keeping in mind when you write your extended essay. You are told that it is impossible to get high marks in, say, an economics extended essay without using the specialised language of economics. Perhaps, now you can see the reason why this is so. Economics knowledge depends on a specialised vocabulary to name its concepts. If your extended essay does not employ this language then it is making no reference to the concepts of economics and is therefore not about economics. The same considerations apply to written work in other IB subjects.

Language and thinking

Language enables us to think about *counterfactual* situations; that is, situations that literally do not exist just now. We can talk about our plans, what might have happened had we missed the plane, what will happen tomorrow if it is a sunny day, or how it is possible to feel happy with a tinge of sadness. Sometimes we do not know what we think until pressed by a question. As the novelist EM Forster put it, 'How do I know what I think until I see what I say?' Of course, language is not the medium for all our thoughts. Maybe a tennis player thinks in terms of a tennis game, an artist thinks in visual images (artist Paul Klee spoke of 'taking a line for a walk'), or a composer trying out ideas on the piano thinks in sounds. Nonetheless, each of these media have elements that are language-like and can be used for thinking, communication, and making knowledge.



Taking a line for a walk.

Yet, there are features of one's own world that resist language. The character of our sensory experience, for example, is difficult to put into language as are, for many, our emotions. We devise a clever workaround whenever we want to refer to such experiences: 'yes rabbit tastes a bit like chicken', 'when I hit my head, I saw fireworks'.

Such expressions assume that we share a common set of experiences as human beings but, as our more philosophical reflections prompt us to ask: can we really know if our attempts to share these experiences are successful? How do I know that you experience the same thing as I do when we both look at a red object? The great thing about language is that it removes the problem. You and I can happily agree about which objects in the world are red and pick out red objects from a pile successfully, without knowing if the qualities of our subjective visual experiences are the same. Language helps create an objective and public world out of our, possibly, diverse subjective experiences.

We can also think of language as a tool for coordinating and constituting the thinking of a group of people. Imagine the discussions taking place before you put together a play or a group presentation. Language becomes part of the process of thinking *by the whole group* rather than merely a medium for communication. This idea can be developed further. Groups that share aims and methods and work together can become fully fledged agents; that is, collective entities that have their own thoughts, intentions, and actions. Although this idea sounds strange, we are used to it in our everyday life. We talk about the class making decisions, the school having plans for expanding, and companies being responsible for their actions. In some parts of the world commercial groups of people like companies or corporations are regarded as 'legal persons', meaning that they have the same status and responsibilities as individuals do. Language binds these groups of individuals into single agents and allows us to speak of 'America putting sanctions on Iran' or 'Google being hit by EU tariffs'. Language allows the formation of group agents.

The role of metaphor

You will doubtless have come across metaphor as a figure of speech belonging in your literature classes; for example, the song 'Cry Me a River', or 'Juliet is the sun' in Romeo and Juliet. Here the metaphor is used to take a concept encountered in one context and apply it to another. By comparing tears to a river one invokes a powerful idea of a huge body of water. The metaphor works because our own experiences of rivers can be brought to bear on the situation in the text. In this case we are invited to think of the abundance of water in a river and its never-ending stream implying that the tears will be many, and they too will be never-ending. Metaphors play a central role in knowing and making sense of the world around us. They allow us to take the structure of a known situation (called the 'source' of the metaphor) and apply it to an unknown or less familiar one (called the 'target' of the metaphor). For example, we might take our everyday notion such as a pot overheating on the stove and then apply it to the economy. To say the economy is overheating implies that it is somehow out of control and that if no action is taken something catastrophic might happen. In a sense then, a metaphor is a bit like a model except that the model is borrowed from a different field of knowledge. In the example, the model is borrowed from our everyday experience of cooking and applied to an abstract notion like the economy. This not only makes the abstract notion more concrete, but it gives us some predictive power – it hints at what might happen if the situation is allowed to continue.

Lakoff and Johnson in their book *Metaphors We Live By* suggest that almost all our understanding of the world around us is based on metaphors, many of them referring to our bodies and their customary activities. Evidence for this can be found in the words we use to describe the everyday world: the head of the river, the foot of the mountain, moving ahead, putting things behind us, shouldering a burden, seeing things through new eyes, losing one's head, running behind schedule, digesting new information, lying low, walking through something, and common orientation terms such as left and right, forward, behind, sideways; even the terms 'up' and 'down' might derive their meaning through reference to our customary bodily orientation. The list is long. Lakoff and Johnson suggest that the concepts that we use to understand the world are ultimately traceable metaphorically to familiarity with our physical bodies. Were we to have eight tentacles and eyes around our bodies, maybe we would not have a concept for ahead or behind and therefore perhaps conceive of motion and time differently. One need not go (metaphor) as far (metaphor) as Lakoff and Johnson to see (metaphor) that gaining (metaphor?) new knowledge depends crucially on metaphors. As many teachers will attest, the art of teaching could be described as the art of selecting the right metaphor for the right group of students. The atom is a tennis ball in Year 7, it is a miniature solar system in Year 9, and it is a smeared out set of probability waves in Year 12. Could it be that without metaphors there could be no knowledge?

Language and grammar

Language is governed by rules of grammar that specify which of the many combinations of symbols carry meaning and which are meaningless strings. How should we view the rules of grammar? Should we think of them as normative; that is, as rules of correctness of, for example, 'proper' English or correct French? Are the rules prescriptive? Is someone who says, 'I ain't gonna do that' simply using incorrect grammar? Do we feel that we need to correct this person? Or should we think of grammar as a description of how people actually use language in the real world; a set of rules that summarise patterns of speech, in which case there is no judgement of correctness? There is considerable disagreement about these questions among professional linguists and there is much more to be said about this in the next section. However, it is worth pointing out that language does evolve. The English of *Beowulf* is different from that of Chaucer or Shakespeare or ee cummings or *Game of Thrones*. It is constantly changing. 'Their' is moving from signifying plural possession to a genderless singular possessive pronoun. This change in use bypasses having to specify the gender of the subject, for example: *The student should lock their computer in the locker provided*. Within a generation this will be commonplace. Language is living and evolving and despite the best efforts of the Académie Française and the Swedish Academy to police usage, it will continue to evolve.

Activity 11

Do you think that grammar should be prescriptive or descriptive? What are the consequences of your view? Does your English teacher agree with you?

Why do the rules of grammar change? It is often said that human beings are adapted for language, and of course in a sense this is true. There are specialised linguistic areas in the left hemisphere of the brain of right-handed people called Broca's and Wernicke's area (for left-handed people these are found in the right hemisphere), which are the result of an evolutionary process driven to a degree by cultural evolution. But we can look at this the other way around and see how language is doubly adaptive. The philosopher Andy Clark gives us a nice way of thinking about the evolution of language. He thinks of language as being a tool like a pair of scissors. Scissors are doubly adapted. They are adapted to do the task expected of them: cutting

Figure 5 The philosopher Andy Clark (b. 1957) suggests that language is like a pair of scissors – it must be doubly adapted: to the task it needs to perform as well as its human user.

paper. But they are also adapted to the shape of the human hand (this is why right-handed scissors are not useful for left-handed people). If either of these changes then the tool must change. Clark suggests that language is similarly a doubly adapted tool. It has to be adapted to the tasks we require of it – which, as we saw in the **Perspectives** section, are not just limited to communicating knowledge. But it has also to be adapted to the biology of the brain, which is itself undergoing an evolutionary process driven by ongoing evolution of our social world. In other words, our social worlds and our brain biology are co-evolving. Strung between them is language. The social needs of English speakers have changed since the time of Chaucer. For a start, events in the world happen much faster. There is a premium on getting the main point over quickly at the expense of refinement. Grammar has become simpler in English. Nouns have lost their endings (they still retain a trace of them in languages like Swedish and German) so verbs have to carry a lot of information such as number, tense, voice, and so on. It is not clear at this stage what changes the demands of social media will produce in our language.

Language is used for communicating and constructing knowledge, not only the knowledge of formal academic disciplines that are familiar from the chapters on areas of knowledge, but language also constitutes knowledge of navigating the everyday world. To do this well it has to adapt to the changing tasks we expect of it in rapidly developing social conditions. But it also has to adapt to an immensely plastic human brain that itself is adapting to the demands of this same social world. Language adapts to the use, but also to the user.

Things to think about

- Group activity. A useful way to get a feeling for language and its relationship to knowledge is the following activity. This requires groups of five or six people. The first part of the activity takes 30–40 minutes and the second part around 10 minutes per group. The aim of the activity is to learn about language by constructing one. The group will make up a simple language and then perform a short scene in the language to the whole class.

Part 1: In groups select one of these scenarios: cave dwellers, nomads in the desert, air traffic controllers, deep sea divers, arctic explorers. The job of each group is to construct a language for your chosen scenario. Your language must be sufficient for acting out a short scene in your given scenario in front of the members of your class. The maximum number of signs or symbols (words) in your language is 50. You may not use any existing signs or symbols.
Part 2: Act out a short sketch in your language related to your chosen scenario in front of the class. At the end, the other members of the class must try to guess what happened in your sketch. Explain to the class how your made-up language works. Reveal to the class any principles that govern the use of your language. Reflect on the role of grammar in your language. Think about the power of your language – how many different ideas it allows you to express. How have the different scenarios shaped the 'languages' produced? Finally, think about what knowledge your language allows you to have.

- Find out about Washoe and the ability of chimpanzees to use sign language. What do these cases tell us about human linguistic ability and human knowledge?
- **Challenge** Consider the following sentence: *The horse raced past the barn fell.* What did you feel when you read the final word, *fell*? If you felt slightly uncomfortable then you were in good company. The sentence is grammatical. Consider: *The horse raced past the barn fell but the horse raced along the lane did not*. The first sentence is an example of a 'garden path sentence' so-called because it leads you 'up the garden path'. The verb 'to race' requires two slots: a subject (what or who does the racing) and an object (where or how the racing happens). When you read *'The horse raced past the barn'* both these slots are filled, and the language centres of your brain are happy that the clause is complete. Then the word *fell* occurs and the brain has to start the meaning construction process anew. The second time round, 'to fall' is interpreted as the main verb of the sentence and *raced past the barn* is actually a modifier for *the horse,* it tells us which horse fell – it is called an *adjectival clause*. Make up another garden path sentence. Try it out on your friends. Clearly, we have some sort of feeling for correct grammar. Can we think of this as being a particular type of knowledge? Is grammar knowledge about the world?
- **Challenge** Investigate 'phrase structure grammar'. Try making phrase markers (finding the grammatical structure) of the following sentences: *Mary had a little lamb. Spurs will win the premier league*. Explain how grammar makes language comprehension an active rather than a passive process. Some birds, such as parrots, can reproduce human speech. What is the difference between a parrot and a young child speaking English?

Knowledge questions

- If language works according to sets of rules and conventions, how much scope do we have as individuals to break the rules or challenge these conventions?
- How are metaphors used in the construction of knowledge?
- In what ways do values affect our representations of the world; for example, in language, maps, or visual images?
- To what extent do the classification systems we use in the pursuit of knowledge affect the conclusions that we reach?

- In what ways can language be used to influence, persuade, or manipulate people's emotions?
- To what extent do the names and labels that we use help or hinder the acquisition of knowledge?

Ethics

The discussion so far has underlined the strong connection between language and knowledge. Not only do we express our academic knowledge through specialised language suited to the tasks associated with a particular field, but we also carry out many of our everyday social tasks using language. This being the case, what language we use might have consequences for the well-being of others and our own responsibilities. We shall examine these responsibilities in this section.

What are the ethical implications of big decisions concerning official languages? Recall the third object in our virtual exhibition (Figure 3 in the **Scope** section), the defaced road sign in Belgium. The region is officially bilingual but there are clearly people who would prefer a different language policy emphasising just one of the official languages. Official bilingualism is often an attempt to bestow language rights on a minority language group within a community (since the dominant group would not need official protection). Take the example of the language of instruction in elementary school. Some might argue that the matter of which school a child attends is one for the parents rather than the state. But things might not be as simple as that. If the policy of a state is to actively protect a minority language, then people might be forced to attend a school whose language of instruction is this language. Without measures like this, the majority language is in danger of taking over (in economic terms – since more people speak the majority language there is more benefit to be had from learning it and less for learning the minority language). If a society wants to preserve a minority language and culture, it may need to enact non-liberal laws that protect that language – which means removing the freedoms that allow people to choose the majority language in, for example, elementary schools. This was the case in Quebec where elementary schools were predominantly French-speaking to counter the Canada-wide dominance of English. Whether or not radical political solutions such as these are ethically justified is a difficult question. The tension is between large-scale cultural diversity – surely a good thing in terms of a society's robustness and ability to withstand unexpected changes – and individual freedoms which are a good thing for the individuals concerned.

Figure 6 Aimé Césaire and Léopold Senghor realised the importance of having a pan-African language to counter the power of colonial discourse in English.

There are cases in recent history, however, where political and ethical considerations were part of an argument against the official adoption of local languages and in favour of global ones. This is best illustrated by examples from the late colonial period in Africa. At this time, a number of writers, among them Aimé Césaire and Léopold Senghor, suggested that the only way in which the oppressed peoples of Africa's colonial nations could reclaim their freedom was through a realisation of something they all had in common: they were African. But the idea of a pan-African national identity was difficult to sell to a people who spoke, at a conservative estimate, around 2,000 different languages. Solidarity against the oppressors was difficult to organise with such local cultural and linguistic diversity. In contrast, the colonial administration in many African countries were united in having a single language, a language they forced on the local people as an official language. Césaire and Senghor saw a deep need to introduce a pan-African language to go with a pan-African consciousness that they labelled *Négritude* as a political strategy against colonial rule. The adoption of Swahili as a *lingua franca*, that is a common language, in many parts of the Great Lakes region and the east and south-east of the African continent was part of a movement to give an alternative to the language of colonisation: a single voice to oppose the oppressors. There is some irony here since the same strategy – support for Swahili as an official language – was adopted by the colonialists in order to be able to administer national regions that sprawled randomly over ethnic and linguistic boundaries. The Négritude movement had many detractors, among them the writer Franz Fanon, who argued that the struggle against the colonial power was best founded on local traditions and culture that were embedded in local languages. Today Swahili is still one of the official languages in a number of countries in this region. Here the link is between language and cultural identity in the context of unifying and mobilising people towards a common political cause. Language politics is not just about cultural survival of minorities but concerns the rights and political visibility of vast populations.

Activity 12

Are there any examples of language politics within the region of your school? Which groups are empowered by current language policy and which groups are excluded?

So far, the discussion has focused on the ethical implications concerning large-scale choices: the choice of official language within a political or administrative region. There are also ethical questions arising from the local choice of words within a language. This is particularly evident in connection with sexist or racist language. If we are correct in supposing that words help construct the social world and if words, as they seem to be, are carriers of value, then choice of words has far-reaching consequences. The danger is that the words we use systematically construct a social world in which certain groups of people are systematically marginalised. For example, it could be argued that the English language is structurally sexist. Compare the meanings of the following pairs of gendered nouns: master/mistress, bachelor/spinster; of asymmetric gender in terms such as: fireman, manpower, mankind, chairman, and so on. To correct the value-gender imbalance many people resort to gender neutral terms such as 'chairperson' or 'firefighter' or use non-gendered pronoun 'their' instead of he and she. In Sweden there has been talk of introducing a gender-neutral pronoun 'hen' to replace 'han' (he) and 'hon' (she). Words matter, and their use normalises the values they carry. These issues suggest that we have the same responsibilities for our use of language in the construction of our social worlds, as engineers do using their tools in constructing bridges.

We shall end with an observation on the ethics of language acquisition. Throughout this chapter there has been an emphasis on the sociality of language. By being embedded in a social world we acquire language that enables us to participate in the social life and, as we have argued, gives us tools for thinking. It is generally thought that there is a window for mother-tongue acquisition between birth and puberty. During this period, we learn not only the basic forms of our mother tongue, but we also acquire vital tools and concepts including perhaps a concept of self.

In 1970 a girl known as 'Genie' was admitted to a children's hospital in Los Angeles. She was 13 years old and had been appallingly mistreated by her father. She had spent her childhood tied to a chair in a darkened room forbidden to make a sound. The only social contact she had was with her mother for a few minutes each day when she was given food. This treatment of Genie not only amounted to physical maltreatment but also a deep violation of her right to language acquisition. She had no language ability when she was first brought into care. While she was able to imitate sounds and, in time, learned to communicate in English, her grammar remained simple.

▲ **Figure 7** Genie was deprived of social interaction during the critical period and therefore does not have a mother tongue. Her life was considerably impoverished as a result.

It seems then that we have an ethical responsibility to spend a good deal of time talking to young children in order that they develop first-language capabilities during the critical period. But even this basic responsibility raises interesting questions from an ethical standpoint. Studies show, conclusively, that reading to young children is highly beneficial to their subsequent academic progress. This leaves social liberals with another dilemma. Many people accept some notion of equality of opportunity – that a just society should provide equal opportunities to people, independent of their social class or background. But if the research is correct then children who are read to by their families have a significant advantage over those from families where there is no reading. In most studies the former are predominantly middle-class families and the latter are predominantly working class. This situation violates the ideal of equal opportunities. What should be done? Should there be a 'bedtime story police' going out and forcing every family to read to their children? Surely this would violate the ideal that decisions about bringing up children are the preserve of the family and not the state. Should families be banned from reading to their children for the same reason? The principle of equality of opportunity collides here with the notion that family matters should be free from state interference.

Things to think about

- What responsibilities do we have when using everyday language? How important is it that we do not use language that criticises groups in a systematic way? What is the difference between use of sexist or racist language and other ways in which we might offend (such as by espousing a political view that others find offensive)?
- In what ways does language allow us to perfect good habits of thinking and reasoning? What responsibilities do we have for the quality of knowledge that we produce? Do we have responsibilities to others because of the knowledge that we offer to them?
- What responsibilities do we have for taking the things that other people say seriously?
- Ngugi wa Thiong'o is a Kenyan writer, writing for much of his life in English, who decided to 'decolonise his mind' by refusing to write any new works in English

and only to use his native Gikuyu. His idea was that the use of the language of the coloniser internalised the colonial value system, so he wanted to regain his freedom by writing in his local language. A consequence of this action is that many English speakers do not have access to his later work. To what extent do you agree with his view, or do you agree with Césaire and Senghor that in order to get the message across one has to use a world language even if this is the language of the oppressor? To what extent were Césaire and Senghor using the same strategies as the colonisers in their advocacy of a pan-African language?

- With a friend, debate the question of equality of opportunity and the 'bedtime story' problem. One side should find arguments for equality of opportunity that require restricting personal freedoms (such as interfering with family arrangements). The other should find arguments for individual freedom and the prevention of interference in what goes on in the home. Clearly there is a limit to both state interference in private matters and also a limit to what is permitted in families. In most jurisdictions the state can interfere if there is evidence that children are suffering because of strict adherence to a particular method of bringing up children. Similarly, individuals can reject state interference in choosing religion, interests, or other private matters. The question is where do you draw the line?

Knowledge questions

- Does ethical language differ in any significant way from other types of language?
- How can we know if language is intended to deceive or manipulate us?
- Do ethical statements simply convey our feelings/emotions rather than making claims?
- If ethical terms and concepts cannot be easily defined, does this mean that they are meaningless?
- Can we define words such as *good* and *bad* in terms of objective features of the world?
- Do professional interpreters and translators have any special ethical obligations?

Conclusion

In this chapter we explored the way in which language and knowledge are closely coupled. Not only do we need language to communicate knowledge, knowledge depends on language so completely that it may be impossible to separate the two. The everyday conversation between Joyce and Stan showed that we not only use language to communicate our personal knowledge, but that it plays an important part in navigating everyday life. The wedding certificate pointed to the use of language in establishing social facts. The bilingual road sign stressed the relationship between language and power, and the distinction between official language and other languages. Language is essential for a vast array of different knowledges.

We explored the way language produced perspectives but also encoded them. And given that language and society are so closely linked, it is no surprise that language is a marker of social class. This means that language is a carrier of social status; the type of language used conveying information about the speaker. Social knowledge is encoded in language.

Language was discussed rather in the same manner as other technologies – as a tool for thinking. It gives us access to non-existent situations and enables us to explore the 'what-if' questions that count as understanding the way the world works. More radically, language might actually crystallise our thinking – we might only arrive at an opinion after we have been forced to put it into words. This might be familiar to you in preparing for your longer writing projects, such as the extended essay or TOK essay – ideas get developed on the page.

Finally, we explored the responsibilities we might have as language users. If the social world is largely constructed from language and if words carry values, then it follows that the language we use has social consequences. This is true on a small scale – the words we use to describe people and their activities – but also on a large scale concerning whole cultures, ethnicities, nations, and genders. Thus, the old saying is patently untrue: 'Sticks and stones can break my bones, but names can never hurt me.'

Exhibition thoughts

- The Belgian road sign made the argument that the designation of a language as official is an act that empowers certain groups and disenfranchises others. This process might be loosely described as 'language politics'. Find an instance of language politics that is of local relevance to you. Choose three objects inspired by your local situation of language politics that relate to IA prompt #14: *Does some knowledge belong only to particular communities of knowers?* Write short texts describing the objects and linking them to the prompt.
- The marriage certificate was an example of one of a vast range of social facts that are produced using the right language, spoken by the right person in the right place at the right time. The whole set of social facts within a particular geographical domain at a given time might be called 'cultural knowledge'. Select three objects that are linked to the construction of social facts within a particular culture. How are these objects related to the making of cultural knowledge? Write short texts describing these objects and linking them to IA prompt #21: *What is the relationship between knowledge and culture?*
- Alternatively, the term *cultural knowledge* might refer to an individual's grasp of the social facts that make up the cultural knowledge of a given culture. So, the author of this chapter might have some knowledge of Swedish culture, having lived and worked in Sweden for a length of time. Cultural knowledge possessed by an individual allows them to navigate the sometimes complex interactions that make up social life. This might be knowing about whether to bring a gift for the host when invited to dinner (in Sweden 'yes'), whether to keep your outside shoes on when invited to someone's home (in Sweden 'no'), and whether to use the familiar form of 'you' in conversation with a stranger (in Sweden it depends on the situation but usually 'yes'). Think about why we should care about seeking this type of cultural knowledge. Select three objects that are linked to being able to navigate our social world using language. Write short texts describing these objects and relating them to IA prompt #17: *Why do we seek knowledge?*

- The conversation in the **Scope** section illustrated the construction of knowledge by a group of people. Language plays an important role in the construction of the knowledge of groups. Choose three objects that illustrate how knowledge may belong to the whole group while, at the same time, no individual has access to all of it. Write short texts linking your objects to IA prompt #26: *Does our knowledge depend on our interactions with others?*
- If groups can possess, through language, knowledge that is greater than the sum of the knowledge possessed by its members, as implied by the discussion, then what are the implications for the responsibility of groups for the knowledge that they collectively possess? Choose three objects that exemplify situations in which groups, rather than individuals, possess knowledge. Write short texts linking your objects to IA prompt #27: *Does all knowledge impose ethical obligations on those who know it?*

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2.4 Knowledge and religion

Introduction

▲ **Figure 1** Jordi Casamitjana

As an ethical vegan, Jordi Casamitjana, a citizen of the UK, believes that all animals should be valued equally, and that is why he avoids the consumption of all foods and products of animal origin. In 2018, he launched a case against his former employer, claiming that he, Jordi, was a victim of discrimination on the basis of his vegan beliefs. In order to prepare the argument, Casamitjana needed to show that veganism deserves protected status. This dispute raises a number of issues concerning the rights of vegans and the broader nature of veganism.

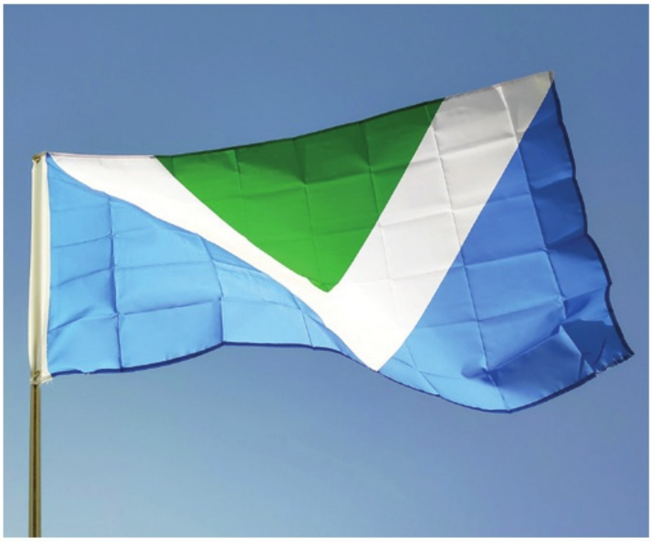


Figure 2 Vegan flag ▶

Ethical vegans claim that they are guided by adherence to the values of kindness, compassion, and the avoidance of suffering; values that shape practices which avoid harm to animals. Although less strict forms of vegetarianism have been followed since ancient times, it was not until 1944 that the basis for veganism was set out by Donald Watson, by forming the Vegan Society as the first organised community of practising vegans:

> We can see quite plainly that our present civilisation is built on the exploitation of animals, just as past civilisations were built on the exploitation of slaves, and we believe the spiritual destiny of man is such that in time he will view with abhorrence the idea that men once fed on the product of animals' bodies.
>
> en.wikipedia.org/wiki/Donald_Watson

In recent times, veganism has enjoyed an expansion of popularity. According to the Vegan Society, the numbers of practising vegans and community organisations in the UK increased by a factor of four to 600,000 over the period, 2014 to 2019.

Activity 1 Veganism and religion

In many countries, it is against the law to discriminate on the basis of such things as age, disability, gender, sexual orientation, or ethnicity. Accepted religious beliefs also commonly belong on that list.

So, imagine that you are charged with the task of convincing people that veganism is a religion and hence worthy of legal protection. You should try to establish that conclusion through comparison with well-known religions. Now consider the weaknesses of your case and what you are up against. Finally, decide on your own view and keep it for reference later. How does labelling veganism a religion change your perspective on veganism? Or on religion?

Changing your diet could save your life.

Although everyone thinks they understand what is meant by religion, on closer inspection some difficulties emerge in pinning down exactly what does and does not belong in this category. Activity 1 should help you to construct a provisional picture of religion so that you can start to explore its relationships with knowledge.

Scope

Religion plays an important role in the lives of most people on Earth. Most reliable sources put the combined population of Christians and Muslims in excess of 4 billion – more than half of the entire human population. Adding adherents of Hinduism, Buddhism, and Judaism may bring the total up to 90 per cent or more, and there are many more than just these five religions. In fact, the world's people who claim affiliation to a religion is increasing rather than declining.

You will have had your own experiences with religion – either as an active participant up close and personal or merely as someone who is aware of the influence of religion on your own life experiences or those of others. You may live in a country where religion has a high public profile. You may belong to a diverse school community in which different religions rub along next to one another. Religion might be an important feature of your family life; or there again it might not. You may have accepted a religion or feel that you want to reject it. Whatever your personal circumstances, the huge influence of religion on what and how people think, and what they take as knowledge and truth, renders it an important theme to explore in TOK. For instance, a particular religion might guide or even mandate how you accept the findings of the natural sciences, how you should treat others, what is acceptable as displays of art or the causes of historical events, to mention only a few.

We can start by asking why religion is such a pervasive feature of human society. What exactly is religion and what is it for? The preponderance of religion in the world suggests that it addresses problems that other areas of knowledge fail to resolve. If religion is the solution to problems, what are these problems? If knowledge is a kind of map or representation, what is the territory that religion represents?

Activity 2 What are the problems that religion addresses?

Consider the following list of problems.

1. The world is a frightening place.
2. In a changing world, we seek permanence instead of accepting change.
3. Humans make mistakes.
4. Terrible things sometimes happen without warning.
5. Many people live lives of material poverty.
6. Many people fear death.
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.

a) Which of these problems do you think religion most closely addresses? Select three of them.
b) Add something you think might have been left out of the list.
c) Share your selection with other students and compare – is there any clear agreement?
d) Reserve your choices for exploration later.

Let's now consider how these problems might be addressed with the help of some diverse views.

View 1: Karen Armstrong

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.'

(TED Talk 2008, Karen Armstrong, blog.ted.com/2008/03/19/karen_armstrong_1/)

Figure 3 Karen Armstrong

View 2: Stephen Prothero

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... [...] 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.

(Stephen Prothero, 2010, pp. 22, 24)

View 3: Sam Harris

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.

(Sam Harris, 2004, p. 43)

Figure 4 Sam Harris

Try to summarise the key differences between the claims of each of these three thinkers. Can you detect any similarities peeping through the disagreements? Which, if any, of these three excerpts seems most convincing to you, and why? Identify the two most important claims that have been made by each author and allocate them to the quadrants in Activity 3.

Activity 3 How distinctive are different religions?

Place the views of each of the three thinkers on page 127 in the most appropriate quadrant below. Is it possible to express a coherent view that would reside in the fourth quadrant?

few differences **focus on practices**	**many differences** **focus on practices**
few differences **focus on beliefs**	**many differences** **focus on beliefs**

Before you read further, return to the table of problems in Activity 2. Which of these problems seem to be addressed by each of the three views of religion presented above? After giving some thought to this question, can you detect any pattern?

Now that we have asked what religion is for and what it involves, we need to connect our provisional answers to knowledge. Can we pinpoint what might be meant by *religious knowledge*? Connecting this question about religious knowledge to the three kinds of knowledge as introduced in Chapter 1.1 **Knowledge and the knower**, we have the following possibilities.

1. Religious knowledge as beliefs supported by evidence (propositional)
2. Religious knowledge as actions – religious practices (procedural)
3. Religious knowledge as a kind of representation – providing maps of distinct territory

- Can you summarise Karen Armstrong's view of religion using these possibilities?
- Is it possible to agree with Sam Harris and still maintain that there is such a thing as religious knowledge? If so, how?
- What are the implications of Stephen Prothero's view of religion for the defence of religious knowledge?

We have made a start in exploring what religion is for, what features religions exhibit, and what kind of knowledge might be involved. Let's put our enquiries into the format of the exhibition. Our guiding IA prompt will be #17: *Why do we seek knowledge?* and we can ask this question specifically in the context of religion.

Virtual exhibition object 1

The first object in our virtual exhibition is a representation of Nairatmya – an embodiment of the concept of *anatta,* or 'no self'. Buddhism proposes that person and personality are made up from five *skandhas,* or aggregates: form, sensation, perception, mental formations, consciousness. While they may appear to be components of a singular self, Buddhism teaches that no such self, or indeed soul, exists. It is attachment (or clinging) to these *skandhas* that is a root cause of suffering, and it is the realisation of their temporary residence in an individual that is the beginning of the process of enlightenment.

Figure 5 Nairatmya statue

Both the denial of a unitary self and denial of the dualism of the body and soul represent a major departure from many other world religions. The Buddhist path from suffering to enlightenment is one of the journeys described by Stephen Prothero as definitive of particular religions, alongside sin to salvation in Christianity and pride to submission in Islam. The seeking of religious knowledge here is directed towards the problems of the human condition and the routes by which the problem can be solved or minimised. And on this interpretation, each religion identifies a different problem and solution.

Virtual exhibition object 2

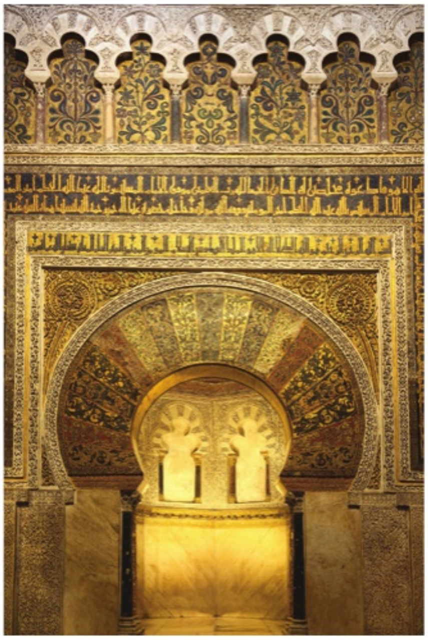


Figure 6 The mihrab points in the direction of Mecca.

The second object in our virtual exhibition is the *mihrab* – a prayer niche set in the wall of a mosque that indicates the direction to the *kabba* in Mecca, and thus the direction in which Muslims should face when in prayer. Islamic prayer (*salat*) is an intricate communal activity that illustrates the importance of ritual and togetherness in religion. There are many stipulations involving, for example, strict timing according to location, the requirements for ablution, specific postures, exceptions to rules, and compensations for error – and the geographical direction of prayer according to the *mihrab*.

The emphasis with this object is on the need to follow protocol in order to participate in a like-minded community; echoes of Karen Armstrong's claim that religion is tightly bound up with *doing* rather than merely believing. While Muslims are seeking knowledge of Allah and purification of the heart, they also must seek at an early stage the knowledge of how to correctly perform acts of worship. This object represents the importance of this kind of procedural knowledge, but other religions also offer prescription, or at least guidance, for this ritual dimension – you may be familiar with, for example, the sacraments of Christianity or the *samskaras* in Hinduism. *Salat* is just one of the five pillars of Islam alongside *zakat*, the giving to others as an act of virtue – here we might draw a distinction between the strict rituals of prayer and way in which they support ethical conduct (see Figure 8).

Virtual exhibition object 3

Figure 7 Roman Catholics congregate three times a year to witness vials of San Gennaro's blood become liquid.

San Gennaro is the patron saint of the Italian city of Naples (Napoli). Roman Catholics congregate in Naples Cathedral three times every year – on his birthday (19 September) and two other significant occasions – in order to witness vials of his blood become liquid. However, the liquefaction is said not to have occurred in 1939, 1940, 1943, 1973 and 1980 – years that correspond to the outbreak of the Second World War, the entry of Italy into that war, the Nazi occupation of the city, a cholera outbreak, and a major earthquake, respectively. On this basis, the failure of the miracle has become associated with adversity. While the Roman Catholic Church generally takes a neutral stance on the veracity of the miracle, Pope Francis was present for the ritual in 2015 and gave a blessing with the relic.

The vials of blood are the third object in our exhibition. They represent the human desire for causes, regularity, simple agency, and the imposing of apparent order on the world as we experience it. In an uncertain world, beliefs in omens or prophesies take on meaning and become convincing. In these circumstances, humans seek knowledge about the world from whatever source is available.

Sam Harris would certainly not be alone in dismissing alleged miracles, such as that of the vials, as products of ignorance that in time become replaced with scientific knowledge. Indeed there are many hypotheses as to how the material in the vials could behave in the way that it does. Perhaps the explanation lies in changes of temperature or as a response to stirring. Investigation of these suggestions would depend on an analysis of the substance in the vials, but opening the containers is strictly forbidden. Here we have efforts to explain religious claims using the tools of science. Some would subscribe to the 'God of the gaps' idea that religious knowledge commands an ever-smaller subset of reality as science displaces it with better accounts and mechanisms.

A common model for the structure of religions puts forward the 'four Cs':

- **creed:** beliefs and values
- **cultus:** ritual activities
- **codes:** standards for ethical conduct
- **community:** institutions.

To what extent have the exhibition objects and their explanations illustrated these four dimensions?

So far, we have talked about religion in terms of beliefs, practices, and so on, and what it actually achieves in a wider sense. We have also considered what might be meant by religious knowledge using the three ways of thinking about knowledge introduced earlier in the book. So here now is an attempt to capture some of these points of discussion in a visual form:

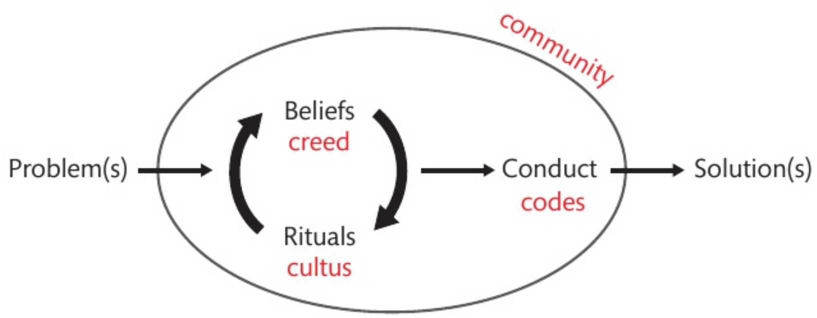


Figure 8 A suggested model for religion

Take a few minutes to critique this diagram. Would you propose any amendments or alternatives? Review the conclusions you made earlier about veganism. To what extent does it fit this model?

If veganism passes this test, what about voodoo or astrology? (Add your own items to this list.) Is there a risk of admitting too many phenomena to the category of religion? Does it matter? Is it possible to be 'religious' without having a religion – for instance, being 'religious' about your exercise routine?

The public image of religion is often associated with certainty – at least in the psychological sense of being sure about something. Perhaps this impression is advanced by too much emphasis placed on creed at the expense of other dimensions. American professor of philosophy Stephen Asma (following terms introduced by Ruth Millikan) promotes a distinction between two functions of knowledge that is helpful here. Knowledge can have an *indicative* function in providing accurate descriptions of the world, but it may also have an *imperative* function in helping us to navigate our personal social and emotional circumstances. To speak of knowledge being 'true' makes sense in the indicative function, but the measure of the imperative is simply how effective the knowledge is under the particular circumstances:

Indicative	Knowledge provides a description of the world	'This is the situation'
Imperative	Knowledge provides guidance in navigating the world	'This is what you should do'

Following this line of argument, we could regard religious creed (as part of the whole religious apparatus) as having a primarily imperative function; about successful navigation of the problems that life throws at us, rather than offering accurate empirical descriptions of the world. In other words, our religion might tell us what to do in this world without giving us a really true picture of that world, whatever it is.

If this is true, it would be ironic that religion, with all of its claims about the unseen and the existence of another world, should really be about dealing with everyday personal anxieties and crises such as some of the problems listed near the start of this chapter.

Religion has probably been around since the origins of our species. If Asma is right about its primary function – that it is about social and emotional management – then it is interesting to speculate about the degree to which this area is the exclusive territory of religion. How successfully do the arts address it? Are they fit to take over the role of religion, or perhaps enhance it? How effective have the findings of psychology been in this area – and might they one day start to replace the effectiveness of religion within it?

Things to think about

- In Chapter 1.1 **Knowledge and the knower**, we met the distinction between *propositional* and *procedural* knowledge (types of knowledge), and also Daniel Kahneman's concepts of system 1 and system 2 (types of thinking). Do you think the *indicative* and *imperative* functions of knowledge might relate coherently to these?

Knowledge questions

- What counts as religious knowledge?
- If knowledge is a map, what is the territory that religion represents?
- Does religion try to resolve problems that other areas can't resolve?
- Is the point of knowledge to produce meaning and purpose in our lives?
- To what extent do scientific developments have the power to influence thinking about religion?
- Do ritual and habit play a special role in the formation of religious knowledge?
- Is certainty any more or less attainable in religion, than it is in the arts or human sciences?
- What is the value of thinking about questions to which there are no definite answers?

Perspectives

'Insiders' and 'outsiders'

The most obvious clash of perspectives with regard to religion is between the religious believer and the outsider. In other fields, there is usually enough common foundation of knowledge for differences of opinion to be understood, if not resolved. But understanding can be particularly difficult to achieve with religion, where a set of claims may be held in the highest regard by one person and dismissed by another; or there can be certain rituals or even food habits sacred to one and meaningless to the other. Yet similar difficulties can emerge even among different denominations of the same religion.

Nevertheless, it is important to try to bridge such gaps in the interests of mutual well-being. If an outsider is going to succeed in comprehending what it is like to have a commitment to a religion, they will need to bring together the two perspectives. Borrowing from anthropology, we can name them *emic* and *etic*.

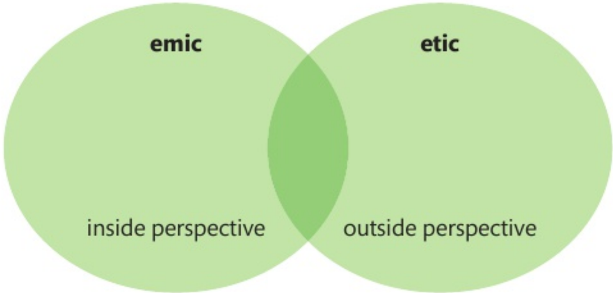


Figure 9 Two perspectives on religion

For an insider, many of the aspects of perspective that we have met in previous chapters are likely to play a role in personal relationship with that religion. Family, community, and culture are all crucial factors that are likely to determine religious affiliation.

For the outsider, there are some challenges in combining the *etic* (scientific) approach with the need to access the *emic*. Anthropologists achieve this by immersion in the culture – called the 'participant observer' – so researchers into religion might take a parallel participatory approach. Most people are of the view that religious affiliation is a personal matter that should be treated with some respect. But outsiders may also feel a need to defend knowledge established by science or other disciplines when religious knowledge is in conflict with it. This tension leads us back to the *indicative vs imperative* distinction introduced in the last section. As an example in Christianity, believers might adopt a metaphorical interpretation of scripture while recognising its value for emotional management, whereas outsiders might take claims found in scripture more literally and seek to refute them. One suggested truce was posited by Galileo, who suggested that religion and science address non-overlapping territories: 'Religion tells us how to go to heaven, not how the heavens go.'

There are other thinkers who take a more assertive approach to knowledge. 'That which can be asserted without evidence, can be dismissed without evidence,' claimed Christopher Hitchens. The English biologist Richard Dawkins has characterised induction of children into the religion of their parents as a kind of brainwashing. It is perhaps not surprising that scientists would focus on the *indicative* function of religious claims.

In 2009, an advertising campaign was launched with the support of the British Humanist Association, and the vehicles that carried the banners around London

Figure 10 Atheist bus

quickly became known as 'atheist buses'. A wide range of contributors supported the initiative – most surprisingly including the Archbishop of Canterbury, who claimed that it was a good way of stimulating discussion about God. Indeed, the inclusion of the word *probably* raised a debate as to whether the claim on the bus was truly atheist (there is no God) or to some extent closer to an agnostic position (nothing can be known about the existence of God).

But the second sentence on the bus also sparked a reaction. Is religion about denying enjoyment? Do religious people spend their lives in a state of worry? Some would retort that this characterisation of religious perspective is a distortion committed by outsiders lacking personal experience of what they are presuming to know about. Some might interpret it as a lack of respect. This is the kind of situation that can contribute to fundamental disagreements that may extend even deeper than those that occur in other fields, such as politics.

The academic study of religion largely comprises two approaches. The *essentialist* focuses on the structure of religions and how they might help explain the world for the believers. The *functionalist*, by contrast, is interested in the wider impact of religion in society.

An example of an early essentialist theory was promoted by the Scottish anthropologist Sir James Frazer, who characterised religion as a stepping stone between magical beliefs and eventual scientific understanding of the workings of the world. Karl Marx, by contrast, took a functionalist approach, regarding religion as a product of material or economic conditions. You may wish to explore the work of Sigmund Freud or Emile Durkheim as further examples of functionalist theories.

Religious concepts and orthodoxy

In the **Scope** section of this chapter, the issue of whether religions have more similarities than differences was raised. Let's look at a somewhat wider range of religions to explore this question further.

Activity 4 Religious concepts

Let's examine some key concepts in different religions to look for patterns or individual distinctiveness:

jannah	nirvana	heaven
grace	karma	kripa
anatta	soul	atman
moksha	salvation	ren
jihad	li	mitzvot
dukkha	shirk	sin

With reference to these concepts, answer the following questions:

1. In which religion is each of the concepts embedded?
2. Do some of the concepts extend across more than one religion?
3. 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?
4. 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?
5. Do you think each of these concepts is open to examination or testing of some kind?
6. Do the results of your research give more support to the views of Karen Armstrong or Stephen Prothero?

Revisit Activity 2 under **Scope** with the ten problems. To what extent is it possible to connect specific religions to specific problems in terms of the importance assigned to them? Use your answers to Activity 4 to help with this.

But religions are not unchanging and eternal. While religions may strive to develop convention in thinking and behaviour, history shows that disputes about creeds or practices or the dynamics of communities tend to deepen divisions rather than encourage compromise – see the accounts in the next section about Constantine and the Council of Nicaea, and Martin Luther and Protestantism, for examples of each process in the Christian religion.

Taking a broader historical view, we see the emergence of Roman Catholicism, Orthodox Christianity, Protestantism, and many other denominations up to the rise of Pentecostalism in many parts of the world today. Then, there is the early split in Islam between Sunnis and Shias, and the varieties of Buddhism from Mahayana to Theravada. Some religions, such as Hinduism, seem particularly adept in accommodating outside influences; it must be said that one reason why Christianity taken as a whole is such a successful religion today in terms of numbers is its ability to absorb beliefs and practices from a wide variety of different cultures. In all of this discussion, we would do well to remember that even denominations of religions are not monolithic and there is great variety of belief and practice at more local levels. This makes it even more difficult to avoid unjustified sweeping statements about religion as a whole.

The recent battle 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 gaining supporters in wide regions of the world.

On the other hand, there have been efforts to construct an inclusive religion that incorporates insights from various religions around the world. Unitarian Universalists align themselves with a number of universal values (dignity, justice, compassion, etc.) and draw on a set of sources (religious, secular, Earth-centred). Do you think this is a worthwhile enterprise or does combining the traditions of various religions and non-religious writings undermine the whole idea of a religion? Mixing traditions that blend disparate religious elements together are in opposition to what is often called *fundamentalism*, where affiliates inflate the importance of specific creed. Such imbalance can give rise to distortions of religions and lead to intolerant or even barbaric acts, such as the attacks and murders of doctors and other staff in the name of Christianity at abortion clinics in the United States, or the many well-documented outrages of so-called Islamic State in Syria and Iraq.

Religions and areas of knowledge

Due to the ubiquity of religion in human societies, it is worth considering the likelihood that some particularities of religions have influenced other areas of knowledge. For instance, Christian origins and eschatology (concerning final judgements on humanity by God) project a clear timeline onto human history, whereas the concept of reincarnation in Buddhism and Hinduism encourages a cyclical view of time. It is easy to see how this difference could have ramifications for the production of knowledge in history. The notion of dominion over the rest of nature simultaneously presents the danger of over-inflating our human importance, perhaps leading to disregard for environmental issues, but also might guide the efforts to restore the damage that has been done.

If religions ask different questions, then are the religions just cultural artifacts? If so, what explains the geographical distribution of religions, their origins, their ability to embed themselves elsewhere? Is chance the explanation, or other deep foundations of culture?

The work of the German sociologist Max Weber provides a specific example of how the nature of a particular religious system might connect to society as a whole. Weber claimed that adherence to Protestant Christianity was strongly associated with individual success in a capitalist environment – a connection that was not obviously the case with Catholicism. For Weber, this was more than a correlation – rather he believed Protestantism had encouraged the application of a strong work ethic that was at least partly responsible for economic success.

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, as different religions develop in different parts of the world, perhaps we need to appraise them only in the context of specific cultures, or even just on the basis of what they do for individual people. Stephen Prothero's view of religion does question whether there are systematic reasons why different religions developed in particular cultures and locations, and at particular times.

Things to think about

- The American theologian Paul Tillich developed a theory of correlation, not far removed from the position of Stephen Prothero described in this chapter – the answers religion has to offer should correspond to the questions a culture is asking. Is religion declining in some countries because the questions have changed and religion has failed to align with them? What might those questions be?
- Do you think it is feasible or desirable to shield children from religion until they are old enough to make decisions about affiliation for themselves? Would it be helpful to provide children with a comprehensive course in world religions so that they would have a sound basis on which to choose?
- There is a Japanese idiom that says, 'Born Shinto, live Confucian, die Buddhist.' What might it suggest about the relationship between religion and culture in that part of the world? Would a similar idiom containing Christianity, Judaism, and Islam make sense?

Knowledge questions

- Are those outside a specific religious tradition really able to understand its key ideas?
- To what extent is it legitimate for a non-believer to criticise the content of a religious belief?
- How has our understanding and perception of religious knowledge changed over time?
- To what extent do you agree that there is just as much diversity of perspectives within individual religions as there is across different religions?
- Can there be religious knowledge that is independent of the culture that produces it?
- What impact has forced religious conversion had on traditional knowledge and cultural diversity?

Methods and tools

Reason and faith

It is common to hear it said that religious people have 'faith', and that this means believing something is true when there is scant or no evidence to support it. Seen from this angle, faith might seem unreasonable, injudicious; a lazy and ineffective approach to knowing.

Evidence in science is always limited to some extent, and there is a need for inductive reasoning to general conclusions. Is this really so different from what is required in religion, where a shortage of evidence is commonly cited? What about the assumptions that natural laws are unchanging? Should we label assumptions of this kind as faith or trust? Is there a difference? Some might say that faith implies the absence of evidence, whereas trust requires going beyond the available evidence. Is this a convincing distinction? Would it be fair to say that there is not as much difference as commonly supposed? Take a moment to discuss this difference or similarity in class.

But faith can also be considered as an attitude of openness to ideas or practices, or an accepting disposition, rather than assent to a particular knowledge claim that lacks convincing support. Karen Armstrong has claimed that the bond between faith and creedal belief is a relatively recent one and is largely confined to Christianity. Perhaps you have the background in order to appraise this assertion. Is it true that Christianity is an outlier in this respect?

Another common idea in the context of religion is that faith and reason are fundamentally opposed. But we see from the description of induction in science above that the two may be part of the same process of building knowledge. This leads us to a consideration of the role played by reason in religion. Let's explore three avenues here:

- the use of reason in an attempt to justify religious claims
- the use of reason by believers to maintain their beliefs
- the notion that God/the supernatural may be, in some sense, beyond reason.

Efforts to apply reasoned argumentation in defence of religion are collectively known as *apologetics* – the rational justification of revealed truths. In Europe during the Middle Ages, a school of thought developed known as 'scholasticism', in which arguments concerning Christian belief were proposed and attempts invited to refute the conclusions and put forward counter-arguments. Later on, Christian clerics became 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, and thus the perceived weaknesses of faith as a method for justification could be remedied once and for all.

Among the various applications of reason, many attempts were made to prove the existence of God – two well-known such arguments are presented in simplified form here.

Cosmological argument

- There is a change in the world.
- Every change has a cause.
- For each change there was a preceding change.
- The chain of causes ends in an uncaused first cause.
- The first cause is God.

Ontological argument

- God is the greatest being that can be imagined.
- God exists as an idea in the mind.
- A being that exists in the mind and in reality is greater than a being that exists only in the mind.
- We can imagine a being greater than one that exists only in the mind.
- So God exists.

How convincing do you find these arguments? On what basic concepts are they built? Can you spot any potential flaws or criticisms? Do you think either of these arguments would convince any believers or atheists to change their minds? Does your answer 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 rationalisation, and do these have roles in religious knowledge that are different from those that they have elsewhere?

A further argument also has a long history and crops up in various forms.

Teleological argument

- The world exhibits order, unity, coherency, complexity.
- Such a world could only be created by a designer.
- The designer is God.

This argument was publicised by William Paley in 1802 as support for the view that living organisms must have a designer: hence the 'argument from design'. Paley's version was an argument from analogy in which he imagined that, when out for a walk, he came across a fully functioning watch. The device is so complex and all of its parts so well integrated that it would be absurd to suggest that it came into existence in any other way than by conscious and skilled design. A more recent version of this argument – called *intelligent design*, without the direct reference to God – has been used by creationists, who believe in a literal interpretation of scripture. This supports a bid for teaching of *creation science* in schools alongside well-established evolutionary theory, which posits a mechanism (natural selection) that requires no intelligent external agent. The deist position that God created the universe and then withdrew, playing no further part in its unfolding, can also be reconciled with the teleological argument. Advocates of this view have included such diverse figures as Thomas Jefferson, Neil Armstrong, Dmitri Mendeleev, and Adam Smith.

Cosmological, ontological, teleological – can you allocate meanings to these terms from the following: about purposes, about events, about reasoning from first principles?

We can also appraise the role of reason in the thinking of those who adhere to religious traditions. In Chapter 2.1 **Knowledge and politics**, we met the idea that people tend to maintain their political views. This might be because, in a cost–benefit analysis, the political outcomes of these views are difficult to know in advance, and the investment of time required for examining the alternatives is not sufficiently offset by the difference their vote would make to the overall result. A similar argument can be made that religious beliefs are hard to verify, and even if mistaken will tend to have minimal impact on the believer – thus the religious person has little incentive to examine them rigorously. People realise through a rational argument that they can afford to be irrational about their beliefs: hence 'rational irrationality'. Are you convinced by these rather neat arguments? From your experience, do you think people are likely to undertake consciously such cost–benefit analyses? Is our thinking apparatus tuned to doing the calculation at an unconscious level?

Blaise Pascal is well known for his work in mathematics, but there is also his pragmatic argument in favour of belief in God. This is known as 'Pascal's Wager'. This is most clearly shown by the matrix below, presented in the form of decision theory, in which the possible consequences of belief and disbelief in God are set out. It's clear from this layout that the consequences of belief are, taken together, more favourable than those that would arise from disbelief. The issue here, then, is not so much about the internal logic of the matrix but whether it is feasible for people to choose their beliefs on the basis of the outcomes to which they lead. What is your reaction to this?

Figure 11 Pascal's Wager

	God exists	**God doesn't exist**
Believing in God	Infinite gain	Finite loss
Not believing in God	Infinite loss	Finite gain

Perhaps a more subtle argument is that advanced by William James in a famous lecture called 'The Will to Believe'. James claimed that, under conditions where the evidence required to adopt a belief is not available, it is acceptable to adopt the belief on the basis that the knowledge gained from adopting the belief is beneficial. Contrast this view with the production of knowledge in science, in which the method relies on a skeptical approach and knowledge is considered provisional.

In any case, Pascal's Wager provides at least a stimulus for thinking about how beliefs are arrived at.

Within Christianity, religious ambivalence about reason as a way of knowing 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 relationships between Father, Son, and the Holy Spirit as elements of the Holy Trinity. At the Council of Nicaea (in modern-day Turkey), arguments were heard for and against the notion that Jesus was divine, together with those relating to the status of the Holy Spirit. The agreement reached by the end of the meeting regarding the divinity of God the Son and His relationships to God the Father required such difficult argumentation that it was concluded that God must operate beyond the power of human reasoning. What are the implications here for attaining religious knowledge?

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 whose views diverged from theirs. Perhaps these developments provide an insight into the propensity for religions initially to establish a common community and then refine and 'purify' their own doctrines that exclude non-believers.

Language

> When 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.
>
> (*Analects of Confucius*, XIII, 3)

Alongside reason as a tool for tackling religious knowledge, we need to consider the roles played by language. In at least one respect, the relationship between religion and language is simple.

> La ilaha ila Allah; Muhammadur-rasul Allah. There is no god but Allah; Muhammad is the Messenger of Allah.
>
> (www.islamtomorrow.com/shahadah.asp)
>
> 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; [...]
>
> (www.creeds.net/ancient/nicene.htm)
>
> I take refuge in the Buddha; I take refuge in the Dharma; I take refuge in the Sangha.
>
> (www.lionsroar.com/the-decision-to-become-a-buddhist/)

While entry into a community of religious believers in principle may be an easy matter of uttering statements of belief, such as the Nicene Creed, Shahadah, or Refuge in the Three Jewels, language is more generally important for the transmission and storage of religious knowledge. However, the status of individual languages of a religion is not always the same. Sanskrit, Hebrew, and Arabic occupy exalted positions with respect to the messages of those 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 mere 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 the European Middle Ages, the Latin Bible excluded swathes of the population from the opportunity to read it, so that all power lay with the Roman Catholic clergy in its interpretation. But in one of the most important historical developments in organised religion, Martin Luther and his supporters sought to break the stranglehold of the

Roman Catholic Church by liberating ordinary people to establish a direct relationship with God; not one mediated by the clergy or priesthood. The translation of the Bible into hundreds of different languages has clearly facilitated the spread of Christianity across vast regions of the world and increased the perceived freedom of believers to read the word of God for themselves.

It is often claimed that the power of language cannot describe or encompass religious experience – that the fullest understanding is possible only through participation in religious practices or some other method of direct experience. Such ineffable experiences feature prominently in major Asian religions. For example, the Daoist Chinese text, the Daodejing, tells us:

> Those who know do not talk about it; those who talk about it do not know.
>
> (Daodejing 25)
>
> Look for it and it cannot be seen; listen for it and it cannot be heard; but use it and it will never run dry.
>
> (Daodejing 1.41)

Many Eastern traditions claim that it is possible to see the world without the categories and concepts provided by language – that in contrast to what we said in Chapter 1.1 **Knowledge and the knower**, it is possible to attain a 'view from nowhere'. Do think this is a viable project? If so, how are we going to discuss it? In a way, this assertion of the insufficiency of language parallels the claims examined earlier about the alleged weaknesses of reason to justify religious knowledge.

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. 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 layers of meaning that can be extracted. For example, what should we make of the following?

> 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.
>
> (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 account of parting the seas. But this event undermines much of what we know about the physical world and, if taken literally, 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 might strengthen 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 the 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. This was mentioned earlier as a potential motivation for religion or as a support for the implied imperatives.

Retreating slightly from this position, some claim that the original meaning of 'Red Sea' was 'reed sea', lost in the multiple retelling and many translations of the story. They then rationalise 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.

Believers 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. 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. It seems that deep emotional experience and commitment might need to be taken into account in the attempt to characterise religious knowledge. There may also be counter-examples, such as the deist, for whom God has 'retired', or the Buddhist who renounces emotional states in order to reach nirvana.

In this book, we have emphasised 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.

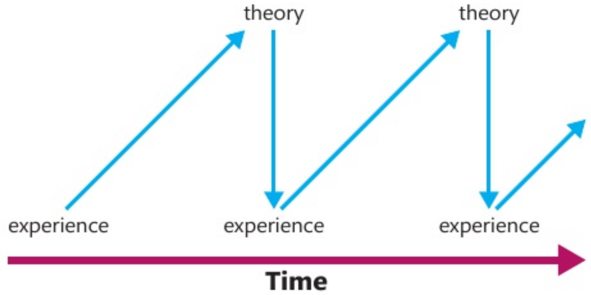
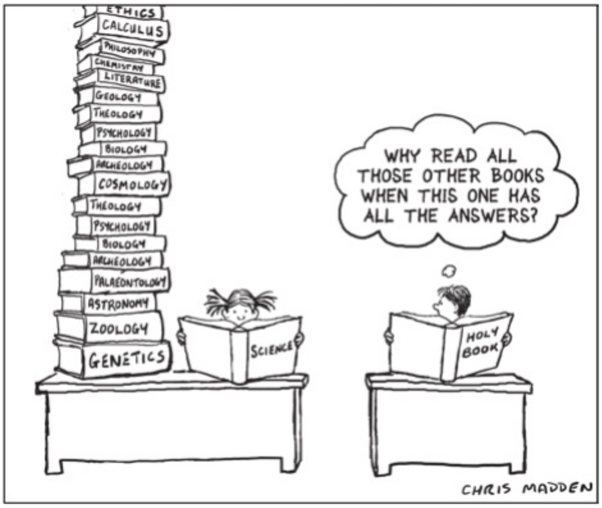


Figure 12 Theories are informed by experiences.



The sciences aspire to limit the input of experience to measurable observation – 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. Ideally, faith or trust 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.

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 such tests for knowledge. Yet, the one thing that we can count on is the existence of the experiences of religious supporters. 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 reason, faith, language, emotion, and perhaps revelation can all contribute to religious experience, and to exclude them would be to undermine the nature of such experiences. We need a 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.

What might be the difficulties in assessing religious experience in a rigorous way? Do you think the cartoon above offers a fair comparison between the methods of science and religion? Do you think that religious knowledge can exhibit steady progress according to the sort of model offered in Figure 12?

So far, we have explored a number of tools and methods for knowledge acquisition that have use in religion and many other fields as well. Is there any route to insight that is particular to religion? In the Abrahamic religions of Judaism, Christianity, and Islam, there is the concept of revelation as direct communication from God. These revelations might be intended for humanity in general; as in, for example, the Qur'an as final revelation from Allah, or as specific to the individual. It is difficult to reach objective conclusions about such events given their nature.

Things to think about

- What are the differences, if any, between claiming, 'I know God exists' and 'I believe God exists'?
- Does God (1) make things good by choosing them or does He (2) choose them because they are good? If (1) then He could choose bad things and just call them good. If (2) then we don't need God to tell us what is good because we are able to work out what is good without Him. Critique this argument. What are the implications for ethics?

Knowledge questions

- Are religious beliefs rational?
- Are faith and reason interdependent?
- Is faith a prerequisite for religious knowledge?
- What difficulties are presented by using human language to discuss religious claims?
- What is the role of analogy and metaphor in the acquisition of religious knowledge?
- How have language developments (such as the shift from Latin to the vernacular) had an impact on access to religious knowledge?
- What role do authority and testimony play in the pursuit of knowledge?
- Can theistic beliefs be considered knowledge because they are produced by a special cognitive faculty or 'divine sense'?

Ethics

Look again at the list of potential problems for religion in the **Scope** section. How many of them are connected in some way with ethical matters? It is perhaps not surprising that religion is often seen as intimately connected with ethics and moral behaviour. Given the history of humanity, during which religion has been a constant feature, it is natural to think of almost all the various religions as guidebooks for negotiating moral dilemmas – concerning decision making, judgements of others, and even of ourselves? The fact that secularism is largely a modern phenomenon disconnected from this history explains why many people, especially in places where religion is very prominent, regard religious participation as a necessary condition for a truly moral life. From the monotheistic perspectives of Christianity, Judaism, and Islam, ethics are tightly bound up with a single supernatural overseer, and may be summarised as the Ten Commandments of Exodus and Deuteronomy in the Bible, or as a similar list of moral stipulations in the Al-Isra chapter of the Qur'an.

But the connection between ethical instruction and a single supernatural overseer is not universal. Buddhists have *sila* (moral discipline) when they follow the recommendation to abstain from harming living creatures, sexual misconduct or intoxicating drugs, and follow the Path toward right speech and actions. These are presented as aspirations rather than laws. The ethical framework of Confucianism has exerted huge influence on societies in East Asia, with its emphasis on education, filial piety, loyalty, and *li* (the correct expression of ritual) in the service of these virtues (*ren* when exhibited by an individual). The first known expression of the Golden Rule is that of Confucius himself – as documented in the compendium of his words and deeds known as the *Analects* – long before the birth of the Abrahamic religions: 'Do not impose on others what you yourself do not desire.'

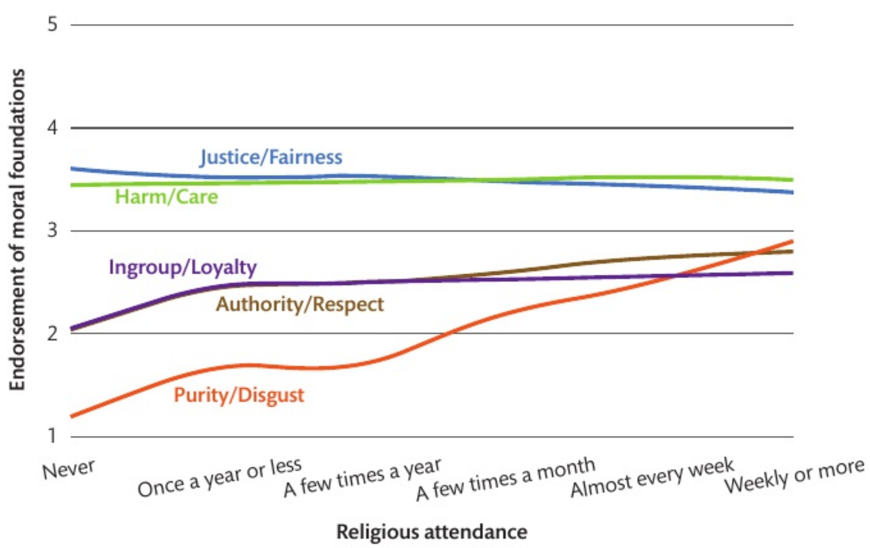
The fact that neither Buddhism nor Confucianism involves appeal to a supernatural being as ethical arbiter shows that these religions offer ethical guidance derived from something closer to a philosophical system than a single figure. While the Abrahamic religions demand allegiance to one, and only one, such figure, the acceptability of a plural approach to religion in parts of Asia might also imply a more inclusive kind of ethics. Buddhism, albeit sometimes in a modified form, has been adopted by many in the West – not so much as a religion but as an attractive philosophy compatible with individualism. As suggested above, the nature of Buddhism perhaps renders this marriage more successful.

Modern psychology has started to give us a lot of insight into the nature of human morality. American social psychologist Jonathan Haidt has identified what he calls 'five foundations of the moral mind' – organised in advance of experience (a 'first draft') but influenced by environment as we grow and mature:

	Harm/Care	Fairness/ Reciprocity	In-group/ Loyalty	Authority/ Respect	Purity/ Sanctity
Emotions	Compassion	Anger Gratitude	Group pride Belongingness	Respect Fear	Disgust
Virtues	Caring Kindness	Justice Honesty Trustworthiness	Loyalty Self-sacrifice	Obedience Deference	Temperance Piety Cleanliness

Haidt has investigated the relationship between the levels of endorsement of each of these moral foundations and Christian religious attendance, with results shown below:

Figure 13 The relationship between the levels of endorsement of moral foundations with Christian religious attendance



- What, if anything, do these results tell us about the effects of religious affiliation on the moral mind? Can you think of at least two reasons to be cautious about drawing conclusions here?
- Have you had any experiences with religion that support the view that religion is indeed responsible for shaping individual morality in the ways suggested by this graph?
- Assuming that there are such effects, do you think they are desirable?

> I am convinced that a vivid consciousness of the primary importance of moral principles for the betterment and ennoblement of life does not need the idea of a lawgiver, especially a lawgiver who works on the basis of reward and punishment.
>
> (Albert Einstein)

If we agree with Einstein that moral virtue does not depend on the kind of lawgiver posited in Christianity, Judaism, and Islam, is affiliation with religion-philosophies like Buddhism or Confucianism the best way of supporting our efforts to live a moral life? Might we instead dispense with religion altogether? Secular ethics, as supported by various humanist organisations, tend to cite compassion, non-violence, altruism, and such like, as virtues to be sought. There is frequent mention of the Golden Rule. Humanists International, for example, claims:

> Humanism stands for the building of a more humane society through an ethics based on human and other natural values in a spirit of reason and free inquiry through human capabilities. Humanism is not theistic, and it does not accept supernatural views of reality.

While the freedom from absolute ethical rules and prohibitions does make a clear contrast with the Abrahamic religions, it is sometimes hard to find significant differences at a basic level between a secular approach and that described in other less theological religions. But secular humanists are often motivated by antipathy to religion rather than indifference. A common criticism is that a personal relationship with God encourages people to become focused on themselves, regarding God as their crutch and insurance against poor decisions and bad luck. By providing a false account of the origins and nature of the universe, religion promotes a distorted perspective of the importance of human life in which the believer is central rather than insignificant. Such a religion stunts people and traps them in a state of intellectual immaturity. In the words of the late Christopher Hitchens:

> We keep on being told that religion, whatever its imperfections, at least instils morality. On every side, there is conclusive evidence that the contrary is the case and that faith causes people to be more mean, more selfish, and perhaps above all, more stupid.

A further attack on the Abrahamic religions concerns the problem of evil. For example, the Indian Ocean tsunami of 2004 was a disaster with natural causes that killed more than 230,000 innocent people – how could an all-knowing, all-powerful, all-good God of the kind described in scripture allow such an event to happen? On the surface, it seems that this God is not all powerful, or not all good, or perhaps just doesn't exist. Theists have struggled to provide an answer to this problem that is convincing to all: perhaps that evil will be swamped with good in the longer term, or that the victims are better off in heaven, or just that we humans are incapable of understanding God's plan. At its base, this is a problem born of monotheism that allows no space for conflict in the supernatural realm.

> Monotheism explains order, but is mystified by evil. Dualism explains evil, but is puzzled by order. There is one logical way of solving the riddle: to argue that there is a single omnipotent God who created the entire universe—and He's evil. But nobody in history has had the stomach for such a belief.
>
> (Yuval Noah Harari)

Whatever our individual orientation towards religion, we ignore the statistics at the start of this chapter at our peril – the vast majority of people on Earth have an active relationship with religion. Given the impact of religion on values and behaviour, it would seem that those with great influence in the world have a responsibility to educate themselves about the religions of the world for the sake of common understanding and international collaboration. But this obligation might extend to most of us, given the increasingly cosmopolitan nature of many of our societies. Our particular views on religion might not be particularly relevant here. But for the believer, there may be additional responsibilities imposed by the religion itself. As an example, Christianity and Islam make demands on followers to seek to spread affiliation through conversion; whereas others, such as Judaism and Hinduism, do not.

Things to think about

- Consider the Ten Commandments in Christianity and Judaism. If you turn atheist, do the commandments still apply? If you were not told these by your parents or religion, would you figure them out for yourself?
- Jonathan Haidt has done research to correlate the importance of his five moral foundations with political affiliation and found roughly universal levels of endorsement for the avoidance of harm and the pursuit of fairness, but much greater approval for in-group loyalty, authority, and purity among conservatives than among liberals. Do these results suggest any interesting links between political and religious affiliation?

Knowledge questions

- Do religious knowledge claims carry any particular obligation or responsibility for the knower?
- Do we have an ethical responsibility to gain knowledge of different religions to help us better understand the world and those around us?
- Does religion provide a way to 'systematise' concepts of right and wrong?
- If religion is intimately connected with ethics, should we expect those with religious knowledge to act more ethically than those without it?
- What role do religious leaders and authority figures play in influencing ethical debates?

Conclusion

In many schools, there will be few parts of the TOK course likely to expose more variety of perspectives than this theme. How is it in yours? Perhaps this chapter has given the militant religious sceptic pause to consider again whether religion truly does deal in knowledge according to the ways in which we have described it in this book. Maybe at least they will recognise that it would be foolhardy to ignore religion when talking about knowledge more broadly in the world. For those with close associations to religion, it will be important to acknowledge a variety of views and be prepared to engage with them, even in the context of strong existential beliefs that others will not necessarily share.

Exhibition thoughts

- In the **Scope** section of this chapter, we organised our treatment of objects around the IA prompt #17: *Why do we seek knowledge?*
- In the **Perspectives** section, the deliberations on the tensions between insiders and outsiders to religious experience might be the spark for an exhibition addressing IA prompt #20: *What is the relationship between personal experience and knowledge?*
- For **Methods and tools**, the focus could be on the limits to knowledge with IA prompt #18: *Are some things unknowable?* Or perhaps on the efforts to establish public verifiability for religious knowledge with prompt #8: *To what extent is certainty attainable?*
- Under **Ethics**, one suggestion is to focus on the role of authority in establishing acceptable moral standards – IA prompt #22: *What role do experts play in influencing our consumption or acquisition of knowledge?*

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2.5 Knowledge and indigenous societies

Introduction

Figure 1 Rice terraces of the Ifugao people, Philippines

Figure 2 An Ifugao woman

Take a moment to consider the ways in which these two photographs might confirm or challenge your initial impressions or expectations for study within the theme of Knowledge and indigenous societies. Record your responses for later.

This theme is concerned with societies that have long associations with particular places and the ways in which those places have shaped the knowledge that we find in those societies. Such societies and the knowledge they produce are often referred to as *indigenous*.

The complexity and diversity of the world demands that we make a concerted effort to pin down exactly what *indigenous* might mean when applied to people and knowledge. Indigenous peoples include the descendants of the first inhabitants of a geographical area – such as those humans who reached Australia around 65,000 years ago, and the Americas much later. For those continents, the original human inhabitants were later overwhelmed by Europeans, who eventually greatly outnumbered many of the original populations, either by migration or deaths through conquest or disease. Groups of people descended from the original populations in these regions are sometimes referred to as *first nations*. But this distinct double-migration pattern in the history of the Americas and Australasia is not so evident in Europe, Africa, and Asia; so perhaps the use of the term needs more attention here. Nevertheless, there are many long-settled peoples on these continents who have had similar experiences to those of the first nations, and have strong claims to be considered indigenous too. Perhaps geography alone is incapable of providing a satisfactory universal answer as to which people can be regarded as indigenous, and hence what we might mean by *indigenous knowledge*. In this chapter, we will take an inclusive approach.

Activity 1 What is indigenous knowledge?

In the spirit of TOK, the questions of where indigenous knowledge ends and some other kind of knowledge begins, and if there is a viable distinction between them at all, are open for discussion. We might start with some alternative adjectives:

Native knowledge	Traditional knowledge	Folk knowledge
Community knowledge	Ethnic knowledge	Craft knowledge
Tacit knowledge	Sustainable knowledge	Experimental knowledge

(Adapted from: Antweiler C. 1998)

At this early stage of the chapter, do you think that any of these alternative terms might be preferable? How do they help you to refine your conceptions of such people and their knowledge?

What might be some of the objections to each of the terms? What objections do you have?

What is the best course of action when there is no linguistic label for something on which everyone can agree?

Given the experiences of many indigenous peoples – including loss of ancestral lands and marginalisation that can lead to loss of language and identity – it is perhaps particularly important that labels are used with great care. Every term in the table above carries a shade of meaning that may support or challenge preconceptions about the kind of knowledge we are dealing with, and the nature of the people who possess it.

In your journey through this theme, you may consider a range of indigenous peoples from around the world and gain an understanding of the general nature of indigenous knowledge through comparisons. Alternatively, you may prefer to focus on one particular indigenous group and acquire a deep insight into its knowledge. Either way, we will need to try to identify some features of indigenous knowledge and address the question of how distinctive such knowledge might be.

Scope

What do we mean by an indigenous society? We can start by thinking of a society as a group of people who share a common territory and live together in an organised way. Often, these people share a common cultural background, where culture is understood to refer broadly to their beliefs and practices. While some societies are very homogeneous, others contain a variety of cultures that interact to varying extents. One feature of indigenous groups is their cultural distinctness, and so it is helpful to think of such groups as societies in their own right.

Nevertheless, *culture* is a slippery word. At first glance, it seems easy to use it to describe how individuals and groups of people think and behave; but often, when challenged, we find that we have to try harder to clarify what we mean. This is because beliefs and practices in a culture bring into play other concepts such as customs, norms, attitudes, laws, significant objects, literature, and other forms of art. There is a danger that *culture* becomes a catch-all term that embraces so many aspects of a people that it becomes powerless to help us with whatever it is that we wish to understand.

In her book, *The Culture Map*, Erin Meyer provides some transparency by identifying a number of dimensions of culture that can be compared across countries. For example, she contrasts 'low context' cultures in which communication tends to be simple, clear, and often abrupt with 'high context' ones where it is nuanced and layered, and understanding requires a deeper familiarity with how people think and behave. She looks at cultures in which problem solving is approached in a linear step-by-step fashion and those where it is tackled in a much more flexible and adaptable manner.

Meyer reminds us of the need to be precise about what we mean when we claim that culture influences what we know. But she is primarily concerned with the cultures that are commonly associated with whole countries from around the world. How then can we engage with the concept of culture in order to throw some light more specifically on the nature of indigenous knowledge? The cultures of different indigenous societies clearly generate different bodies of knowledge, but perhaps at a deeper level we can find similarities across these societies in the nature of the knowledge that they produce. Your task here is to read the following three accounts and look not only at the cultural differences they exhibit, but also for common features of the nature of the knowledge concerned. In this way, perhaps we can reach a provisional judgement about the integrity of the concept of indigenous knowledge when applied across different cultures and provide an answer to the question (IA prompt #21): *What is the relationship between knowledge and culture?* To what extent is knowledge in an indigenous society shaped by its particular culture? Or is knowledge in all indigenous societies similar because those societies possess some common cultural elements that distinguish them collectively from other non-indigenous societies?

Virtual exhibition object 1

The first object in our virtual exhibition is the Polynesian *rebbelib* – a navigation tool.

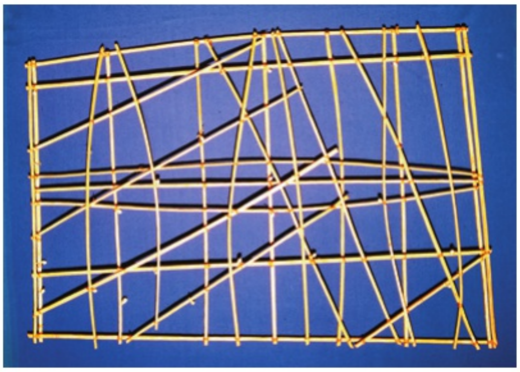


Figure 3 Polynesian *rebbelib*

Across the vastness of the largest ocean on Earth lie thousands of irregularly scattered islands. Many of these tips of submerged mountains of the Pacific were inhabited long before the arrival of European explorers intent on discovery and territorial expansion. But because the colonialists had the finest technological instruments of navigation available at the time, and were keenly aware of the absence of such tools from the indigenous cultures, they mistakenly assumed that the islands must have been originally found and populated as a result of passive drift – a viewpoint held by some Western historians and adventurers until quite recently.

But it is now well understood that Polynesians (the term is used inclusively here to embrace Micronesians and Melanesians, too) used a battery of different methods to construct a sophisticated and accurate knowledge of the Pacific Ocean and of how to navigate it. Outsiders have been forced to accept the reality that Polynesians undertook long-distance purposeful travel in outrigger canoes without the aid of compasses, sextants, or other technological paraphernalia. How did they do 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 200km; the brown tern reaches out as far as 65km, 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)

So Polynesian navigators accumulated knowledge about the particular characteristics of the Pacific Ocean by integrating a range of highly empirical methods – including observation of ocean currents, swells, cloud conditions, behaviour of wildlife, positions of stars, and so on. They were able to switch seamlessly from one source of data to another depending on location and conditions. Navigators committed to memory the knowledge of how to make sense of all this data and applied it at sea. They were able to do this without any theoretical knowledge of meteorology, astronomy, or fluid physics. Apprentices learned it through emulation and direct experience in the boats, but also on land from stick charts constructed of coconut and pandanus root, known as *rebbelib*, set out for learning patterns of swells, currents, favoured routes, and landmarks. Shells and stones represented islands while the sticks themselves indicated the various behaviours of the water.

After several centuries of voyaging, it seems that Polynesians turned away from expansion across the Pacific – a period known as the Long Pause (referenced in the 2016 animated Disney movie *Moana*!) – and only since the 1970s has there been a concerted effort to rehabilitate the original battery of navigation skills and train new generations of navigators; a ship – the Hōkūle'a – was built expressly for this purpose. Given that knowledge of navigational techniques was committed to memory rather than being comprehensively recorded, there was perhaps always a danger of knowledge loss. It may be argued that this feature of indigenous knowledge renders it fragile and vulnerable.

Virtual exhibition object 2

Adinkra symbols are part of the culture of the Asante people of Ghana. Traditionally stamped onto cloth, they can also be found on other cultural artefacts such as gold weights, the stools of chiefs, and as decorative features of buildings. The adinkra stamps are carved out of calabash and dipped into an ink prepared from pigment extracted from the bark and roots of the local Badie tree.

Each symbol refers to beliefs or practices originally expressed in the form of proverbs or aphorisms. Collectively, the symbols make numerous connections between the human, natural, and spiritual worlds. For example, Figure 4 refers to two conjoined crocodiles – Funtunfunefu and Denkyemfunefu – as a representation of the idea that cooperation and unity should take precedence over selfish desire. We might also conclude from it that democracy requires the input of each individual for the common good.

Figure 4 Ghanaian adinkra symbol: Funtunfunefu and Denkyemfunefu

Even in a more literate age, adinkra symbols provide an effective method of retaining and transmitting important social knowledge originally acquired through repeated empirical experience. A selection of other adinkra symbols and their meanings is given in Figure 5.

	**AKOKO NAN**	**Akoko nan tia ba, na ennkum no.** *The hen treads on 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 5 Ghanaian adinkra symbols and their meanings

Virtual exhibition object 3

Figure 6 Buryat shaman with a drum

The Buryat are the largest indigenous group in Siberia, based around the deepest freshwater body in the world – Lake Baikal.

A strong strand in Buryat culture is the role of the shaman, whose job it is to communicate with the gods and the spirit world. The goal is to channel their power so as to maintain harmony and solve personal and social problems, such as marital disputes or lack of success in hunting. Essential to these tasks is his large, flat drum that may incorporate the shaman's ancestral spirit. Through the production of a monotonous rhythm, it can be used to assist him in achieving the altered state of consciousness required to summon spirits or ward them off. Successful interventions by the shaman are central to an understanding of the centrality of spiritual influence in causation of events.

The traditional dwelling of the Buryat is a circular tent known as a yurt, structured and utilised in ways that mirror and reinforce beliefs and practices.

In the absence of books and formal instruction, architecture is the key to comprehending reality. [...] Household wares and utensils are located strictly according to the cardinal directions, and according the place of the entry of the sunrays through the smoke hole—the toono. The smoke hole and sunrays functioned like a clock. At different times of the day the sun rays will pass around different parts of the yurt. The whole circle of the dwelling is "divided" into 12 parts—hours. Every hour was given a name of an animal, and this hour corresponds with approximately 2 hours in European chronology.

[...] The arrangement of the things and objects in the yurt in accordance with the cardinal directions and circular movement of the sun light was very important in the process of children's education. First of all, it formed in the children's minds a clear understanding of the deterministic principle of the world order, where everything has its cause and consequence. Second, it formed the understanding of the unity of time. [...] Buryat-Mongols, introducing the distinct order in the arrangements of the yurt, created a specific logic in children's minds, holistic understanding of the world [...] The division of the yurt into the male and female halves also had broad significance for developing and educating youth as to the polarities active in the world. The west side is male, and is the storage place for men's tools, saddles, bows, and guns. The east side is female, the storage place for the cooking utensils, cradleboards, and other women's objects. The movements of young women in the yurt was limited; for instance, the daughters-in-law had no right in the yurt of her father-in-law to enter the western part. From early childhood a Buryat-Mongol came to realise the difference of the rights of men and women, which allow them to understand the logic of nature, which divided everything alive into males and females.

(Erjen Khamaganova, Chair, Buryat Baikal Center for Indigenous Cultures)

Figure 7 Buryat yurt

Figure 8 Lake Baikal

The Buryat uphold the importance of sacred sites – especially Lake Baikal itself – as repositories of a distinct flora and fauna. Their status reflects the imperative for conservation, supported by the imposition of taboos on behaviour within them, but also links to people through clan membership.

The memorisation of the location of sacred places requires deep attention to the environment and to the distinguishing features of the landscape, along with plant composition, that will ultimately be conducive to a respect towards life-forms in their great diversity. Knowing that one could find protection and rest in the zone of sacred places, a child is imbued with the profound respect toward those places. [...] The presence and active perception of the place as a holistic unity of all living species, spirits and material world helped people to realise the simple truth that we all are connected, that the wellbeing of a site depends on proper conduct of people and vice versa.

(Erjen Khamaganova, Chair, Buryat Baikal Center for Indigenous Cultures)

The extensive classification of the natural world finds further expression in the traditional medical knowledge among Buryat that is based around repeated empirical observation; for example, bears are common in the Buryat region and multiple therapeutic purposes have been found for their blood, fat, brains, bile, and fur.

Activity 2 Does indigenous knowledge exist as a distinct category?

Identify some differences in the content of knowledge produced by the three examples of indigenous societies in this section.

Despite these differences in content, can you identify similarities in the nature of knowledge produced by these three indigenous societies?

To what extent do these similarities in the nature of indigenous knowledge transcend the differences in culture between these societies?

Are the similarities sufficient to distinguish indigenous knowledge from other forms of knowledge? Are they sufficient in order to support a unitary concept of indigenous knowledge?

How are your answers reflected in the following statement from UNESCO?

'Local and indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life. This knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, ritual and spirituality. These unique ways of knowing are important facets of the world's cultural diversity.'

Indigenous knowledge: a characterisation

Here is a summary of suggested characteristics of knowledge associated with indigenous societies.

1. **Local:** it is focused on a particular area and becomes less effective when attempts are made to apply it elsewhere.
2. **Holistic:** there are no clear boundaries between disciplines; all knowledge is interrelated.
3. **Empirical:** it is based on direct observation of the world.
4. **Oral:** it is stored and communicated through speech or demonstration rather than writing.
5. **'Concrete':** it is functional; conclusions are reached without recourse to abstract theoretical explanations.
6. **Flexible:** it is open to change in the light of changes in the world.
7. **Often involves intentional agents:** events are considered to have purposeful spiritual causes rather than being the result of merely physical interactions.

Does this list provide a convincing description of the nature of indigenous knowledge? Some of these features are hotly contested. Which of them seem to you to be most vulnerable to criticism?

The intimate connections between indigenous peoples and their lands (or ocean) leads us to an understanding of the local nature of the knowledge that they produce. The examples in this section are illustrations. Collectively they also highlight the integrated character of indigenous knowledge – in contrast to the disciplinary boundaries that are so familiar to us as we navigate the curriculum at school. As we have seen, connections often extend across human, natural, and spiritual domains. A summary of some of these connections is offered below in Figure 9 – based on the knowledge of the Shona people of Zimbabwe.

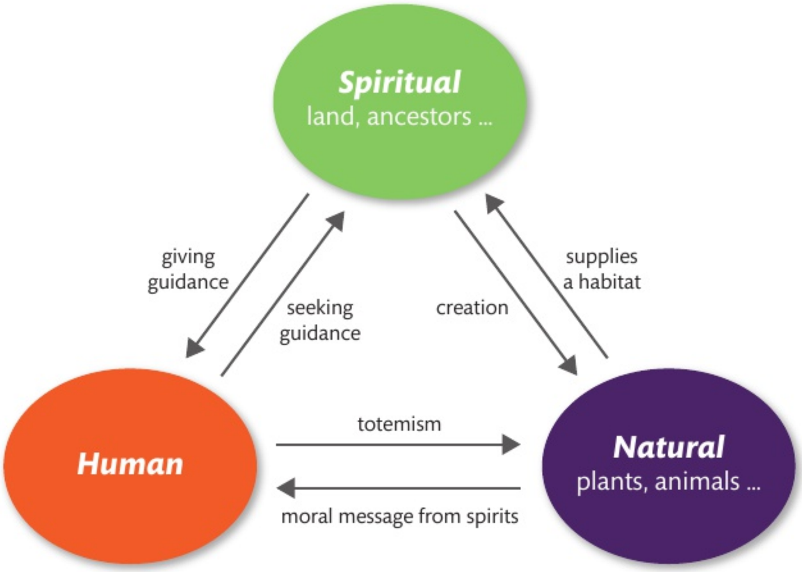


Figure 9 Traditional worldview of the Shona people of Zimbabwe

In Chapter 4.1 **Areas of knowledge** we discuss various possibilities for knowledge to become increasingly fragmented. The drive for this specialisation 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 it all. But specialisation 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 their 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 their 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. Indigenous knowledge tends to place a higher value on the particularities of the local context and is less concerned with the applicability of knowledge beyond the boundaries of the society that produced it. What might Konrad Lorenz have had to say about the lack of compartmentalisation within indigenous knowledge? Are there any insights here related to Ed Wilson's notion of consilience? (See Chapter 4.1 **Areas of knowledge**.)

Activity 3 How to think about indigenous knowledge

In this book, we have been entertaining several ways of thinking about knowledge. Review these ways and consider how helpful each of them might be for thinking about indigenous knowledge.

Way of thinking	Description
Knowledge is about beliefs (*propositional*)	Beliefs supported by evidence
Knowledge is about actions (*procedural*)	Purposeful actions appropriate to circumstances
Knowledge is about representations (*map-like*)	Metaphorical maps of the world

What kinds of evidence are privileged in indigenous knowledge? Would we gain more insight into the nature of indigenous knowledge by focusing on skills, procedures, and actions? Can our list of characteristics of indigenous knowledge be clarified and refined by thinking of indigenous knowledge as a particular kind of map? How might this knowledge map be different from the kind of knowledge map offered by the natural or human sciences? Refer to the list of characteristics on page 158.

Things to think about

- How do you use the term *culture*? How do other people use it? Do you always know what it means? Do you even stop to think about it? What would people say about the culture you belong to? What about where you live? Think about cultures with which you are familiar. Can you speculate about where they lie on the dimensions mentioned above (page 153) from Meyer's book? Have you experienced frustrations when finding yourself in a new location where cultural expectations were unfamiliar to you? How did you attempt to adjust or cope with such a situation? What knowledge was needed?
- Views of human nature have had powerful influences on impressions of various cultures and peoples. For instance, consider whether the tragic and utopian visions of the human condition and the developments in human society might have shaped perspectives on indigenous knowledge. (See page 58 in Chapter 2.1 **Knowledge and politics**.)

Knowledge questions

- Does our culture determine what we know?
- Who owns knowledge?
- What values and assumptions underpin the use of the term *indigenous knowledge*?
- Does the term *indigenous knowledge* necessarily suggest power divisions between a dominant and non-dominant group?
- What role do objects and artifacts play in the construction and sharing of knowledge?
- Does the emphasis on holistic knowledge found in some indigenous societies avoid compartmentalisation of knowledge leading to a limited understanding of reality?
- Why is there sometimes a strong connection between indigenous knowledge and cosmology?

Perspectives

In 2018, a set of 19 skulls were finally returned to Namibia from Germany. These skulls represented only a small part of the grisly story of what has been called the first genocide of the 20th century; when the German colonial occupiers put down a rebellion by the Herero of Namibia, murdering up to 70,000 Herero people in retribution for their killing of about 100 German civilians. The skulls were taken to Berlin to be examined in 'investigations' into racial differences that came to predictable conclusions. This example is just one of numerous similar pseudo-scientific studies conducted by Europeans on other peoples. Anthropology as a modern discipline has done much to enlighten people about false notions concerning different societies and cultures, but it is still important to ensure that the assumptions that we make are free of any traces of historical prejudice.

Somewhat less dramatic, but almost as shameful, have been the various attempts at forcible removal of children from their indigenous background – in some cases a kind of well-intentioned atrocity – involving resettlement of children in white families in Australia (the so-called 'stolen generation') and the creation of residential schools in North America designed to 'drain' the indigenous traits from the inmates and assimilate them into the majority culture. The assumptions of superiority by the captors underlying these acts are not hard to identify. When it was too difficult for political leaders to dismiss elements of society completely, they resorted to talk of the need for 'separate development' of indigenous groups – often in patronising terms that characterised them as 'not ready' for integration. A good example here is the construction of apartheid in South Africa, as articulated by its chief architect, Henrik Verwoerd.

> The [National] Party believes that a decisive policy of apartheid between the white and the non-white race groups and the application of the apartheid principle also regarding the non-white groups is the only foundation on which the character and the future of every race can be protected and safeguarded to develop according to own national character, ability and calling.... In their own areas the non-white race groups will have full opportunity for development in every area, and they will be able to develop their own institutions and social services, through which the powers of progressive non-whites will be used for own nation building.
>
> (Henrik Verwoerd, 1963. *Verwoerd aan die woord Toesprake* 1948–1962 Red A N Pelzer Pretoria: Afrikaanse Pers Boekhandel)

These sorts of historical attitudes challenge us to reflect on our own perspectives and how they may influence perceptions of indigenous societies and the knowledge that these societies produce. It is important to recognise that we cannot dispose of all perspectives even if we wanted to (there is no view from nowhere, as we have seen), but we have an obligation to view others with respect and make a concerted effort to overcome prejudices. As an outsider, one needs to remember how hard it is to appreciate indigenous knowledge, given its close association with particular places that are likely to be unfamiliar. Furthermore, there may be unequal power relationships between the outsider and the indigenous society under consideration, and this dynamic introduces an additional layer of difficulty.

Activity 4 Parallel development or universal trajectory?

Read the following two quotations and summarise what they claim about thinking and knowledge.

'[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…'

(Kwasi Wiredu, Ghana: web.africa.ufl.edu/asq/v1/4/3.htm)

'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.'

(Léopold Senghor, Senegal:dickinsg.intrasun.tcnj.edu/diaspora/part2/pwrpnt/imbo/tsld006.htm)

Generalise the quotations above to embrace indigenous and non-indigenous societies as a whole, and consider the implications of each of them if the quotation is true. What, for better or worse, could it mean if all peoples are on the same path of development in the quality of thinking but some are further along than others? What might be concluded from the notion that some people have a distinctly different cognitive character from others? Do you think Senghor provides a fair description of indigenous knowledge? What might be the consequences of each of these views for a society that is multicultural?

The environmental intimacy of indigenous societies and their knowledge has led to many clashes of competing interests; these conflicts often seem to set indigenous knowledge, with its emphasis on conservation, against industries wielding technological know-how that degrade the land. Examples abound, such as the catastrophic interventions of oil companies on the environment of the people of the Niger delta in southern Nigeria, or the introduction of fracking in the Native American territories of the United States.

Sometimes, indigenous knowledge itself is presented as harmful. There has been controversy about indigenous societies that practise slash-and-burn (*swidden*) techniques that clear forested land for cultivation of crops. As populations grow, land becomes scarcer and can in the end undermine the livelihoods of neighbouring groups. For example, in the Palawan reserve of the Philippines, swidden activity has been restricted by law despite a controversy as to whether local indigenous groups are really responsible for environmental degradation versus the activities of extractive agricultural industries, such as those involved in palm oil and rubber production.

And then there are situations in which both sides claim honourable motives, such as those between 'scientific' conservation groups of outsiders and the long-term stewardship of the environment by those who live there. The latter tend to view interventions by the former as yet another imperial adventure; the former tend to focus on the natural environment while forgetting about those who live there. Examples can be found in the creation of national parks in the United States and the efforts to keep them in a 'state of nature' in which indigenous people were not meant to figure. One consequence has been the creation of new populations of displaced people. Such problems have their roots in the differences between the kinds of knowledge that each group values – contrasts that will be considered in the next section.

Things to think about

- If all humans possess the same potential for thinking and cognitive development, what accounts for the differences between cultures? If on the other hand, cultural differences are the products of a deeper level of cognitive variation, how do we avoid presenting some cultures as 'more advanced' than others? Is it never acceptable to claim that cultures exhibit different levels of development?

Knowledge questions

- To what extent is our perspective determined by our membership of a particular culture?
- Most early literature on indigenous societies was written from a non-indigenous perspective. To what extent does this fact affect its credibility?
- Does a neutral position exist from which to make judgements about competing claims from different groups with different traditions?
- As an 'outsider', can we know and speak about the knowledge held by a different cultural group?
- How might differences in their world-views create challenges for collaboration between environmental scientists and holders of traditional environmental knowledge?

Methods and tools

In this section, we will explore some of the suggested characteristics of knowledge produced in indigenous societies as put forward earlier in the chapter. These comprise **empirical** methods of knowledge production and **oral** methods for storage and transmission. We will also examine how these empirical methods are compatible with the production of so-called **'concrete' knowledge** without the need for deep *abstraction*, and how proximity to the empirical world provides opportunities for *dynamic change*. Finally, we will look at the tendency for such knowledge to invoke the influence of *spiritual agents* in providing satisfactory explanations.

Indigenous knowledge is empirical

The Tzeltal are people of Mayan descent who live in modern-day 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.

This 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'.

▲
Figure 10 The two-barred flasher butterfly

▲
Figure 11 The two-barred flasher butterfly larvae

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 usefulness.

A somewhat similar example comes from Brazil and the Kayapó people. Theirs is a culture that revolves around bees and the products that they provide. Accordingly, they have a complex taxonomy of different types of bee – with vocabulary that describes them (Posey, 1983, p. 63–73):

- **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 per cent correlation between the taxonomy of the Kayapó 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 that model key parts and aspects of the Kayapó universe; these include cardinal directions, the daily cycle of day and night, the village and the field, the Sun and the Moon, and so on.

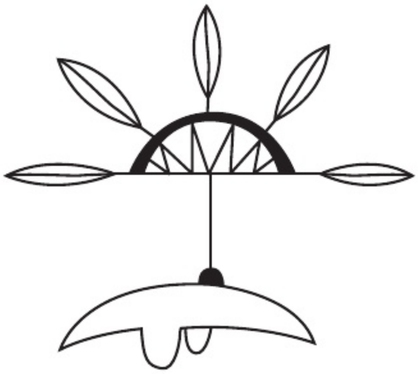


Figure 12 Kayapó ceremonial hat made from beeswax

Me-kutom	Beeswax hat
Kaikwa kratx	Morning sky pole; point where sun rises
Kaikwa not	Evening sky pole; point where sun sets
Pa	North and south cardinal directions
Nipok	Position of Kayapó village
Central stick	The rope by which the Kayapó lowered themselves to earth

These are just two examples of the highly empirical methods used by indigenous groups, rendering detailed and sophisticated classification within their local environment possible.

Indigenous knowledge is oral

What is to be learned from the fact that most of the development of indigenous knowledge 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? In order to answer these questions, consider the following and complete the table below.

Fidelity: how accurately can the knowledge be stored and transmitted?

Access: to whom is the knowledge available?

Acknowledgement: how, if at all, are individuals recognised as producers of knowledge?

Ownership: to whom does the knowledge ultimately belong?

Interrogation: how easily can the knowledge be questioned or challenged?

	Oral	Written
Fidelity		
Access		
Acknowledgement		
Ownership		
Interrogation		

In summary then, which features of the above bring potential advantages for oral and written cultures?

One interesting case study related to these questions is that of the Kallawaya people of Bolivia. As inheritors of the herbalist traditions of the Inca empire, the Kallawaya have succeeded in encoding their specialist knowledge of thousands of medicinal plants gained over several centuries in a language that remains unknown to outsiders – even to certain classes of their own society. How do these arrangements for the storage of knowledge relate to the attributes in the table above?

Legal 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 has in many cases been plundered by outsiders because it is easy to do so when it is not subject to the legal and moral protections available to knowledge in written form.

It may well be that spoken knowledge is easier to interrogate than the written form because those who offer it are immediately available for discussion. Words in a book just sit there – passive – 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 7,000 languages alive in the world today, it is estimated that perhaps half of them will not survive this century. The vast majority of such languages are highly localised and hence the ongoing extinction will have a disproportionate effect on indigenous knowledge. For example, the language of the Tofa people of Siberia (neighbours of the Buryat) is already moribund – meaning that it is no longer being taught to children, and is thus almost certainly doomed as new generations gravitate to Russian. Latest estimates put the number of speakers at fewer than 100. Soon there will be no more active use of Tuvan vocabulary of reindeer types by age, gender, fertility, or rideability, no one to sing Tuvan songs of milking, herding, hunting, or the spirit world. Does this matter?

> As I learned working among the Tuvans, nomadic yak herders of South Siberia, words can also be anchored to a specific place. In Tuvan, in order to say 'go' you must first know the direction of the current in the nearby river and your own trajectory relative to it. Tuvan 'go' verbs therefore index the landscape in a way that cannot survive displacement or translation. Knowledge systems such as the Tofa reindeer taxonomy and Tuvan 'go' verbs get lost, flattened out, and vastly simplified when people switch to speaking another language.
>
> Beyond word meanings, the poetics of song, epic tales, origin myths and everyday stories cannot be translated, or at least not well, without losing expressive power, nuance, and affect.
>
> (Professor K David Harrison, Swarthmore College: www.economist.com/blogs/johnson/2010/11/interview)

Do you agree with Harrison about the value of multiple languages and the need to try to preserve them? Why or why not? Different languages find themselves at different stages in this process of decline. Like Tuvan, the Buryat language was repressed during the years of the Soviet Union, and it was only in 1992 that a ban was lifted on its use. However, once again practicality tends to win out over cultural identity, and young people recognise the value of Russian as a *lingua franca* that Buryat will never be able to emulate.

Prejudice against indigenous knowledge can extend beyond the knowledge itself into the ways in which it is stored, presented, and shared. The medium easily becomes a proxy for the content. Instead of peer-reviewed research papers, indigenous societies present us with a wide variety of forms – from stories to proverbs, rituals, songs, and objects. In the 1950s, American folklorist William Bascom argued that folklore can serve several functions in a culture, including providing instruction and justification for its practices and reinforcing the values and moral behaviour expected of citizens.

Indigenous knowledge is 'concrete', lacking in abstraction

In the 1960s, the French anthropologist Claude Lévi-Strauss (1908–2009) proposed two modes of thought that can be illustrated in the following example – a version of which he himself employed. Our perceptual apparatus allows us to detect odorants, experience them as smells, and even classify these smell experiences into groups. Accordingly, 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. Lévi-Strauss labelled the procedure just described as the *science of the concrete* – engaging the powers of perception and the basic rational process of categorisation.

Analytical chemistry has demonstrated that the former group of odorants are all esters and the latter are aldehydes – hence the knowledge gained through 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. Modern science has emphasised the latter type of thinking – dependent on a much deeper level of abstraction.

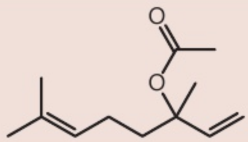
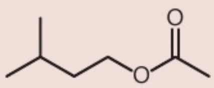
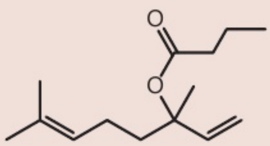
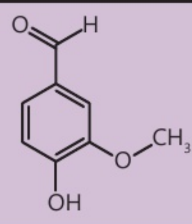
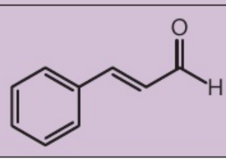
Lavendar	Linalyl acetate	
Banana	Isoamyl acetate	
Peach	Linalyl butyrate	
Vanilla	Vanillin	
Cinnamon	Cinnamaldehyde	

Figure 13 Chemical structures of odorants

Given the fact that the kind of theory-driven science exemplified by analytical chemistry, with all of its laboratories and modern technology, is not evident in indigenous knowledge, would we be justified in claiming that such indigenous knowledge is predominantly 'concrete' in nature? This would imply that perception and observation have key roles to play in the production of indigenous knowledge; we have already described this as highly empirical in nature. It would imply that the recognised links between causes and effects are relatively simple in nature and do not make use of theoretical representations as a way of explaining 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 why.

It is true that sometimes causal connections are left only partially examined. This does not necessarily hinder the usefulness of that knowledge, although it may limit its development. For example, in West Africa, the baobab tree 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 immediately observable traits (appearance of leaves, seeds, etc.) with those 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*. The mechanisms that determine leaf hairiness, seed softness, pulp taste, capsule shape, and so on are unknown, but presumably could be uncovered by controlled investigation resulting in a theoretical frame of explanation. How useful would it be to have a theoretical understanding of the biological processes underlying the ripening of fruit? And to whom?

Figure 14 Fruit of the baobab tree in West Africa

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

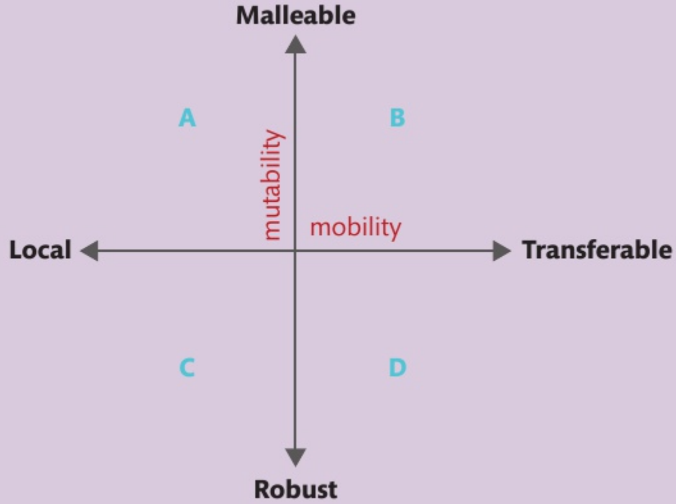
Figure 15 Baobab tree characteristics

Returning for a moment to the smell example, it is interesting to reflect that science is still trying to provide a comprehensive theory that explains the link between chemical structure and subjective smell. It is worth researching the work of biophysicist Luca Turin in proposing a model based on the vibrational frequencies of the bonds in the molecules, but this is not universally accepted. This is a reminder of the provisional nature of scientific knowledge, which is perhaps not so different in some ways to that of indigenous knowledge. However, whatever solution to this problem turns out to be correct, it will almost certainly be based on the well-established conceptual basis of modern chemistry – and that is perhaps where the nature of indigenous knowledge parts company.

Scientific knowledge is flexible within the constraints of well-established theoretical concepts; indigenous knowledge is flexible because it is not thus constrained. It might be the case that this openness to revision of indigenous knowledge is one of the most misunderstood characteristics of indigenous societies.

Activity 5 Indigenous and scientific knowledge – implications of methods

Consider what we have discussed so far with respect to what might be distinctive about the knowledge produced in indigenous societies. As a broad generalisation, where would you locate it on the figure below? How effectively can indigenous knowledge be applied in a different environment from the one in which it was produced? How easily can it be modified over time by changing circumstances? By contrast, where should scientific knowledge go?



Is it possible to distinguish where to put the knowledge from different indigenous societies outlined in this chapter? Can you add a plot for any other society with which you are familiar?

The French sociologist and philosopher, Bruno Latour introduced the following terms to describe knowledge that might fit into two of the quadrants of the diagram above:

- **immutable mobile:** knowledge that is invariant regardless of location
- **mutable immobile:** knowledge that is restricted by location but responsive to changes to it.

In which two quadrants do these knowledge types belong? What are the advantages and weaknesses of the knowledge of each of these two types?

Is there knowledge that might belong in either of the other quadrants? If so, what might that knowledge be like?

Indigenous knowledge accommodates intentional agents

While traditional knowledge in indigenous societies might seem independent from the scientific mechanisms that connect causes and effects, such naturalistic connections are often augmented with others of a more spiritual nature. Indeed, indigenous societies can differentiate between the two types of explanation while considering each of them relevant. Here is the Ghanaian philosopher Kwame Gyekye writing about this distinction.

> 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.
>
> (Gyekye, 1995, pp. 76–80)

While scientific thinking provides a general understanding of causation and has little problem with attributing the contingent circumstances of particular events to chance, the Akan demand an explanation at both the general and the specific levels. We might say that they are looking for a reason as well as a cause, and the pursuit of the reason opens the door to explanations of a spiritual nature.

Things to think about

- We have claimed that indigenous knowledge places limited emphasis on an understanding of mechanisms and is often satisfied with simple cause–effect relationships. But does this claim convincingly distinguish indigenous knowledge from how most people go about their daily lives? Consider situations in your own life where you are content to appreciate what needs to be done in order to bring about certain consequences without understanding why. What about your use of technology, such as your computer or smartphone? What about farmers following the traditions of previous generations?
- In 2020, the Canadian city of Vancouver started to make plans to create a dedicated urban housing development, called Seṅáḵw, for local indigenous groups. This development is supported by the Squamish Nation Council and you can visit www.senakw.com for more information. Is there any conflict within the concept of an urban indigenous community?

Knowledge questions

- How reliable are oral traditions in preserving knowledge in indigenous societies?
- What is the role of oral tradition in enabling knowledge to be handed down through generations?
- In what ways does the loss of indigenous languages signify a loss of knowledge and cultural diversity?
- What role do objects and artifacts play in the construction and sharing of knowledge?
- Does what is seen to constitute 'good evidence' vary from culture to culture?
- What is the role of folklore, rituals, and songs in acquiring and sharing knowledge?
- What methods have indigenous peoples developed to support the recording, preservation, and protection of their traditional knowledge?

Ethics

▲ **Figure 16** Jarawa tribe

▲ **Figure 17** Andaman Islands

Consider the following account.

Andaman Islands tribe threatened by lure of mass tourism

Gethin Chamberlain, *The Guardian*, Saturday, 7 January 2012

'Dance,' the policeman instructed. The girls in front of him, naked from the waist up, obeyed. A tourist's camera panned round to another young woman, also naked and awkwardly holding a bag of grain in front of her. 'Dance for me,' the policeman commanded. The young woman giggled, looked shy and hopped from foot to foot. The camera swung back to the others who clapped, swayed and jumped.

This kind of video is the trophy that tourists dream of when they set off into the jungles of the Andaman Islands 'on safari'. The beauty of the forest functions merely as a backdrop. The goal of the trip is to seek out the Jarawa, a reclusive tribe only recently contacted, which is taking the first tentative steps towards a relationship with the outside world.

The Jarawa tribe is 403-strong. Its members are trusting, innocent and hugely vulnerable to exploitation, living in a jungle reserve on South Andaman. The role of the police is to protect tribespeople from unwelcome and intrusive outsiders. But on this occasion the officer had accepted a £200 bribe to get the girls to perform. 'I gave you food,' he reminded them at the start of the video.

Every day hundreds of tourist cars line up on the Andaman Trunk Road, which winds through the reserve. Signs at the entrance warn them of the rules; no pictures, no contact, nothing to disturb the tribe members. Most are already struggling to come to grips with the diseases of the outside world which have beset them since they started to make forays out of the jungle 14 years ago. But, on the day the *Observer* visited, when the gates opened the cameras immediately started clicking. Tourists threw bananas and biscuits to the tribespeople at the roadside, as they would to animals in a safari park.

Denis Giles, the campaigning editor of the islands; *Andaman Chronicle* newspaper, says there have been cases where Jarawa women have given birth to children fathered by outsiders. The babies are not accepted by the tribe and are killed, he says.

'They are humans and they are a race which is looking at us and they are at a crossroads and we are not sure what is on their minds,' says Ajai Saxena, secretary of the Andaman Adim Janjati Vikas Samiti, the island administration's tribal welfare office. Anthropologists think the Jarawa are descendants of some of the first humans to move out of Africa. Theirs is a simple life. Men hunt pigs and turtles with bows and arrows; women gather fruit and honey. They have no gods and when people die they are left under a tree until only the skeleton remains. Then the tribe tie the bones to their bodies to bring luck during the hunt.

Those responsible for the tribe's welfare think the only solution is to keep them apart from outsiders for as long as possible. 'Forced coexistence would be total genocide for them,' says Dr Anstice Justin, head of the Anthropological Survey of India in Port Blair.

(www.theguardian.com/world/2012/jan/07/andaman-islands-tribe-tourism-threat)

Which of the following reactions seems to you most perceptive in understanding the situation and shaping opinion as to how we might respond? What knowledge should be taken into account when making a judgement about this scenario? How should this knowledge be collected? What would be an ethical approach to learning about the Jarawa?

COMMENT A: It is truly disgraceful. People who think of themselves as the rulers and the modern – throwing *bananas and biscuits to the tribespeople at the roadside, as they would to animals in a safari park* and sleeping with them, the same night!

COMMENT B: Using words like 'innocent' is patronising. If pregnancies have been a result of abuse, that is awful; however, what is reported is infanticide by the tribe. It is offensive to report the actions of people within the tribe as only as a result of outside influence as if they had absolutely no agency over their actions. It is this kind of 'othering' of the tribespeople, depicting their way of life as authentic whilst denying their autonomy that does nothing to challenge this attitude.

COMMENT C: The words of the Jarawa are completely omitted, and their ideas and motivations represented by outsiders, who sound as though they themselves have never spoken to representatives of the group, making unfounded suppositions about the eventual outcomes of this colonialist, bullying, disrespectful behaviour.

COMMENT D: Only knowledgeable anthropologists familiar with the culture of the tribe should be allowed to interact with them, and not permit the police to play tourist guides to curious visitors. The authorities are being totally irresponsible in this sad case – perhaps due to the common false presumption that indigenous people are inferior to the rest of the population.

COMMENT E: If people spent less time pontificating on the morality of indigenous cultures they really know very little about, other than information supplied by anthropologists from their own cultural perspectives, and more time campaigning actively about the decline of morality in their own culture, the world would be a much better place. I know next to nothing about indigenous people other than the experiences I have had about trying to learn more about my own, but we should not assume that indigenous people are not capable of dealing with their own problems.

While a major aim of this chapter has been the effort to establish a basis on which we can recognise a common nature for indigenous knowledge, it would be a mistake to overlook the differences that can be found between customs and practices in different indigenous societies.

The temptation may arise to adopt a stance that is called *moral relativism*; that because we have no (cultural) view from nowhere this means that we have no basis for evaluating the claims that emerge from any society. However, further investigation of cultural customs may reveal that they consist of behaviours that mask underlying common agreements about values.

Even if we are unconvinced by the existence of an implicit agreement across cultures, it might be possible to reach a resolution of ethical matters by referring to the internal standards of the culture. For example, prohibitions concerning female genital mutilation can be found in Islamic teaching despite its widespread practice in many countries with substantial Islamic communities. Alternatively, a standard might be acquired from a respected external authority such as the medical profession, and the obligations imposed on practitioners concerning the avoidance of harm.

As we have seen, many indigenous peoples have experienced subjugation of their languages, knowledge, and property. This long history continues to cast a shadow over intercultural affairs in debates over what some would describe as the embracing of multiculturalism, and others as cultural appropriation. Given the typical relationships between indigenous and non-indigenous, it is easy for the latter to overlook what the former might find offensive. What can seem innocent acquires a different dynamic when there is a distinct unequal power relationship between the cultures involved.

For example, consider the headdress worn by model Karlie Kloss at the Victoria's Secret fashion show in 2012. What was presented by the designers and company as a creative costume appeared as inappropriate to Native Americans as an artifact which represented a status that needs to be earned, and for which no permission was solicited. Perhaps the difference between appreciation and appropriation lies with such criteria. Does the use of the artifact in a novel context create mutual benefit? Does it rather sustain unhelpful stereotypes? And have both parties been involved?

Such tensions can run particularly high when the 'object' at stake is a human being. In 2015 Rachel Dolezal was president of the branch of the National Association for the Advancement of Colored People (NAACP) based in Spokane, Washington State, USA, when her claims to be of mixed race, to have an African American father, and to have been the victim of racially motivated discrimination were undermined by the revelation that she had no black genetic heritage at all. After her resignation, Dolezal admitted that she was 'born white' but continued to insist that she self-identified as black and changed her name accordingly to Nkechi Diallo. Is it acceptable to identify as belonging to an ethnic category without any corresponding ancestry? What might be some of the arguments on either side?

Figure 18 Nkechi Diallo/ Rachel Dolezal

Most of the world's primary health needs are serviced by traditional medicine based on products of herbal origin. For example, with more than 200 million cases of malaria reported worldwide per year, the importance of the anti-malarial 'artemisinin' from the plant *Artemisia annua* is difficult to overestimate. Most of the world's fishing and agricultural activity is based on methods that arise from continually refined traditional practices, rather than the direct application of what we would call scientific findings. Various techniques for fishing with nets have their origins thousands of years ago. It is for reasons like these 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. In this highly practical area, it is essential that indigenous knowledge is studied and appreciated for what it is and what it has achieved. Failure to take seriously the efficacy of indigenous knowledge in the fields of medicine and food production has often led to negative unintended consequences.

The communities who live around Lake Turkana in northern Kenya are pastoralists. They have accumulated the comprehensive knowledge that is needed to support this lifestyle in an unforgiving environment and they have never extended this knowledge to what is required for supporting their community through 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.'
>
> (www.redorbit.com/news/science/456246/kenyas_turkana_learns_from_failed_fish_project/)

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.'
>
> (www.redorbit.com/news/science/456246/kenyas_turkana_learns_from_failed_fish_project/)

This is a simple example that illustrates how a lack of consultation inevitably leads to disregard for knowledge that should have guided the intervention in the first place.

The Canadian anthropologist, Wade Davis, has used the established 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 recognise the value of an appreciation of the diversity of knowledge and the range of possible perspectives from which understanding can be achieved.

Perhaps a special place among indigenous peoples belongs to the Inuit. If one of the characteristics of indigenous knowledge is mastery of the locality, then the ability of the Inuit to live in such an inhospitable near-polar environment must count as a particularly noteworthy achievement. Living largely above the tree line in Canada, Alaska, Greenland, and Siberia, Inuit people are unable to cultivate plants and thus they must rely on a diet dominated by large animals acquired by hunting.

The harshness of the environment confers a 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 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
Avatimik Kamattiarniq	Stewardship of environment, holistic approach
Qanuqtuurunnarniq	Problem solving, creative improvisation
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 the concepts in this table with the suggested characteristics of indigenous knowledge as a whole (see page 158). Although the question of the degree to which these features are shared by most indigenous knowledge systems is still open, there does seem to be some strong congruence with the Inuit example.

In the globalising world of the 21st century, and 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 of 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.

Things to think about

- Research the case of Elizabeth Warren, who sought to be nominated as presidential candidate for the Democratic Party in the US presidential election of 2020, and her self-initiated investigation of her indigenous origins. Do you consider this case to illustrate the concept of cultural appropriation?
- Revisit your reflections on the photographs at the start of this chapter. How would you modify them after studying this theme?

Knowledge questions

- Does the diversity of moral practices that we see in indigenous societies around the world support the case for moral relativism?
- To what extent does deliberate disinformation by education and governments threaten indigenous knowledge?
- Is cultural appropriation an example of a violation of collective intellectual property rights?
- Is there is a difference between moral values and cultural customs?
- Is there any knowledge that a person or a society has a responsibility to acquire, or not to acquire?
- Can the practices of one individual or culture be judged with any validity by applying the moral values of another generation or another culture?

Conclusion

As we reach the end of this chapter, it is worth reprising the exercise 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 – in some cases consisting of a Western 'scientific' education resting on indigenous foundations. Often, these layers complement each other; but it is often easier to separate them in the mind in order to avoid conflict or contradiction. In an increasingly interconnected world, it may become necessary to make more strenuous efforts to reconcile knowledge produced from both traditions.

In recent years there has been a gathering consensus in non-indigenous societies that indigenous knowledge has been carelessly cast aside as part of a misguided understanding of what constitutes 'development', and that we must recognise its true value. This theme is an attempt to contribute to this movement.

Exhibition thoughts

- In the **Scope** section, we organised our discussions around the IA prompt #21 *What is the relationship between knowledge and culture?*
- In **Perspectives**, we focused on IA prompt #12 *Is bias inevitable in the production of knowledge?*
- In **Methods and tools**, our discussion was organised around IA prompt #6 *How does the way that we organise or classify knowledge affect what we know?*
- In **Ethics**, we concentrated on IA prompt #14 *Does some knowledge belong only to particular communities of knowers?* or IA prompt #29 *Who owns knowledge?*

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3 Assessment – Exhibition

Introduction

> Experience without theory is blind, but theory without experience is mere intellectual play.
>
> (Immanuel Kant)

Much of the value of our engagement with the Theory of Knowledge course lies in an interplay between concepts and ideas on the one hand, and our everyday lived experiences on the other. The exhibition task is a great opportunity for you to explore and demonstrate the connections between what we call the 'TOK world' and the 'real world' around us. In a nutshell, the exhibition is about how TOK manifests in the world. It has been designed with the learner profile and IB mission in mind – as an attempt to foster a recognition of the range of TOK enquiry as it extends throughout and beyond academic study, and to show how TOK has practical importance.

The need to put together an exhibition is a powerful reason for keeping a **TOK journal** in which ideas and the nature of objects can be recorded as they emerge. Don't forget to include items that relate to your life beyond, as well as within, your academic study; an exhibit can benefit from a personal touch with one or more of your objects relating to your particular experiences.

The components of your exhibition

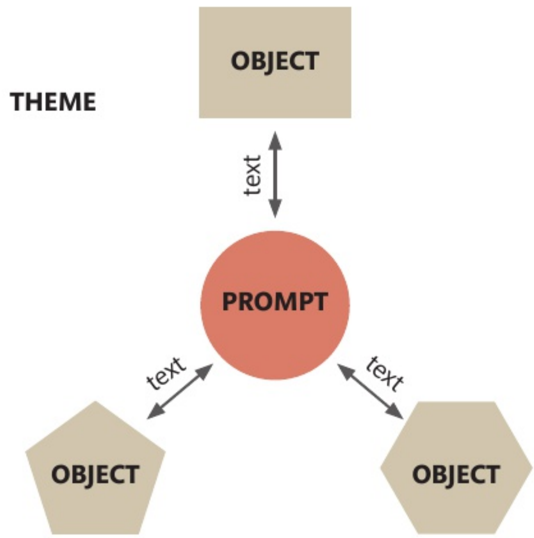


Figure 1 The components of your exhibition

As you contemplate the exhibition task, it is important to be aware of a number of components that need to be integrated. Your exhibition should have its roots in one of the *themes* that you have studied. This is a strong recommendation.

Much more strictly, your exhibition must be a response to one of the 35 internal assessment *prompts* found in the subject guide and replicated in this chapter on pages 182–183. The IA prompts are all knowledge questions. It is essential that your exhibition consistently addresses the prompt that you have chosen.

You need to select three *objects* that illustrate something significant about the prompt that you have chosen. These objects can take a wide variety of forms, but they should be specific items or photographs of items as far as possible – not generic images of whole classes of object, or objects created specifically for the exhibition itself.

You need to explain in writing the TOK connection between each of the objects and the prompt, and provide a justification for their inclusion. Again, you need to ensure that each of the objects offers a different insight into the prompt. The limit for your three pieces of text altogether is 950 words.

The construction of your exhibition

You might start with the selection of a theme that you found particularly interesting and find an object that says something within it. You might then look for a suitable prompt that can link to that interesting object. Alternatively, you might begin from a prompt that engages you within a theme and identify some possible answers to the prompt that can then be connected to objects that illustrate those answers. Then again, you might have an object that fascinates you. You would then link it to one of the prompts, and expand the exhibition into two other objects.

There are different ways into the exhibition so you might want to play with them to see what you think works best for you. Some approaches are shown below:

	1	**2**	**3**	**4**	**5**
Theme first	Select theme	Identify object	Search for suitable prompt	Write text	Add other objects and texts
Prompt first	Select prompt	Select theme	Find possible answers to prompt	Identify objects	Write texts
Object first	Select object	Link to prompt	Write text	Add other objects and texts	

An essential point is that your teacher is there as a support with the construction of your exhibition. But they can assist only in response to whatever you bring to the conversation, and there are limits to what is permitted. Talk to your teacher at an early stage, and then later on take advantage of your one allowed consultation once you have a well-advanced draft.

Stick rigidly to *one prompt* for your whole exhibition. Check that the points your objects make are *precise and about knowledge*. And make sure that your objects exhibit diversity in the points they trigger about the prompt.

Consider the advantages of choosing a theme that has been covered in class, and try to use your selected theme as a way of making your exhibition coherent. Remember that some leeway will be tolerated for the treatment of a prompt that transcends themes or draws on areas of knowledge, but do not make this an aim of your work.

Make sure that your explanation sets each object within its own context so that everyone understands what your objects are, what they do, and what they mean. Then make a clear link from each object to the selected prompt, and explain for each object what it has to say about the prompt and how it offers an explicit and precise perspective on it. Keep to the 950-word limit for all three texts together – aim for 300 words per object. Include references to support factual claims that you make about each object.

The assessment instrument is shown on page 184. Read it carefully and keep it in mind during the process of constructing your exhibition. In particular, aim to exemplify the characteristics described under the heading 'Excellent'. Remember that your teacher will assess your work using what is called *global impression* marking; this means that they are looking for the description in the instrument that provides the best overall fit for the quality of your exhibition.

As with all other internally assessed tasks in the diploma programme, a sample of student work will be sent to examiners as a check against the standards applied by your teacher to the work of all TOK students in your year group.

The IA prompts

You must select one prompt from the list below on which to base your exhibition.

1. What counts as knowledge?
2. Are some types of knowledge more useful than others?
3. What features of knowledge have an impact on its reliability?
4. On what grounds might we doubt a claim?
5. What counts as good evidence for a claim?
6. How does the way that we organise or classify knowledge affect what we know?
7. What are the implications of having, or not having, knowledge?
8. To what extent is certainty attainable?
9. Are some types of knowledge less open to interpretation than others?
10. What challenges are raised by the dissemination and/or communication of knowledge?
11. Can new knowledge change established values or beliefs?
12. Is bias inevitable in the production of knowledge?

13. How can we know that current knowledge is an improvement on past knowledge?
14. Does some knowledge belong only to particular communities of knowers?
15. What constraints are there on the pursuit of knowledge?
16. Should some knowledge not be sought on ethical grounds?
17. Why do we seek knowledge?
18. Are some things unknowable?
19. What counts as a good justification for a claim?
20. What is the relationship between personal experience and knowledge?
21. What is the relationship between knowledge and culture?
22. What role do experts play in influencing our consumption or acquisition of knowledge?
23. How important are material tools in the production or acquisition of knowledge?
24. How might the context in which knowledge is presented influence whether it is accepted or rejected?
25. How can we distinguish between knowledge, belief and opinion?
26. Does our knowledge depend on our interactions with other knowers?
27. Does all knowledge impose ethical obligations on those who know it?
28. To what extent is objectivity possible in the production or acquisition of knowledge?
29. Who owns knowledge?
30. What role does imagination play in producing knowledge about the world?
31. How can we judge when evidence is adequate?
32. What makes a good explanation?
33. How is current knowledge shaped by its historical development?
34. In what ways do our values affect our acquisition of knowledge?
35. In what ways do values affect the production of knowledge?

The chosen IA prompt must be used exactly as given; it must not be altered in any way.

The exhibition assessment instrument

Your teacher will use the assessment instrument below to mark your exhibition.

Does the exhibition successfully show how TOK manifests in the world around us?					
Excellent 9–10	**Good 7–8**	**Satisfactory 5–6**	**Basic 3–4**	**Rudimentary 1–2**	**0**
The exhibition clearly identifies three objects and their specific real-world contexts. Links between each of the three objects and the selected IA prompt are clearly made and well explained. There is a strong justification of the particular contribution that each individual object makes to the exhibition. All, or nearly all, of the points are well supported by appropriate evidence and explicit references to the selected IA prompt.	The exhibition identifies three objects and their real-world contexts. Links between each of the three objects and the selected IA prompt are explained, although this explanation may lack precision and clarity in parts. There is a justification of the contribution that each individual object makes to the exhibition. Many of the points are supported by appropriate evidence and references to the selected IA prompt.	The exhibition identifies three objects, although the real-world contexts of these objects may be vaguely or imprecisely stated. There is some explanation of the links between the three objects and the selected IA prompt. There is some justification for the inclusion of each object in the exhibition. Some of the points are supported by evidence and references to the selected IA prompt.	The exhibition identifies three objects, although the real-world contexts of the objects may be implied rather than explicitly stated. Basic links between the objects and the selected IA prompt are made, but the explanation of these links is unconvincing and/or unfocused. There is a superficial justification for the inclusion of each object in the exhibition. Reasons for the inclusion of the objects are offered, but these are not supported by appropriate evidence and/or lack relevance to the selected IA prompt. There may be significant repetition across the justifications of the different objects.	The exhibition presents three objects, but the real-world contexts of these objects are not stated, or the images presented may be highly generic images of types of object rather than being specific real-world objects. Links between the objects and the selected IA prompt are made, but these are minimal, tenuous, or it is not clear what the student is trying to convey. There is very little justification offered for the inclusion of each object in the exhibition. The commentary on the objects is highly descriptive or consists only of unsupported assertions.	The response does not reach the standard described by the other levels or does not use one of the IA prompts provided.
Possible characteristics					
Convincing Lucid Precise	Focused Relevant Coherent	Adequate Competent Acceptable	Simplistic Limited Underdeveloped	Ineffective Descriptive Incoherent	

Some exhibition exemplars

The following pages offer suggested examples of how exhibitions could be constructed in each of the themes of the TOK course. They are here to give you some guidance as well as to give you an opportunity to apply the assessment instrument in order to evaluate their quality. In general, they are intended to illustrate the top bands of the instrument, but they may have their flaws, which you are invited to identify in the light of the advice and assessment instrument provided above.

Example A: Knowledge and the knower

IA Prompt #14: Does some knowledge belong only to particular communities of knowers?

The student has used a personal touch.

Object 1: Bottle of Irn-Bru®

My first object is a bottle of Irn-Bru from my native country of Scotland. This carbonated soft drink was first created as 'Iron Brew' by the company AG Barr in 1901 as an alternative refreshment to beer for steel workers constructing the central railway station in Glasgow. Changes in food labelling law in the 1940s prompted a change in name to 'Irn-Bru', as the production process did not involve anything that could satisfy the definition of brewing. The drink has maintained an iconic presence in Scottish culture ever since, while production has remained in the hands of the Barr family. Although required to list ingredients, the company has kept the exact recipe a closely guarded secret – it is known only to the chairperson and one other individual, and also written down and kept in a bank vault somewhere in Scotland. Although there is now a range of products that include reduced sugar and extra ingredients, such as ginger, the picture displayed here is of a bottle of the original drink recently relaunched.

The knowledge required to produce Irn-Bru is not available to the public, and the trademarked name means that this knowledge can be considered legally to belong to the AG Barr company. This is an example of knowledge restricted to certain people for commercial reasons, in order to prevent others from using it to their financial advantage. There are many other examples of brand-named and trademarked products that belong by law to individuals or companies – along with the knowledge needed to produce them. Such knowledge belongs to a particular community only because of its secret nature protected by law, and, in the absence of these safeguards, there would be no fundamental reason why it could not belong to others too.

Reference:
www.agbarr.co.uk/our-brands/irn-bru/

Object 2: Grigori Perelman

My second object is Grigori Perelman – a Russian mathematician mentioned in my Mathematics HL class who is famous for providing a proof for one of the seven 'millennium problems' identified by the Clay Foundation in 2000 as the most important open questions in mathematics. The foundation attached a prize of $1m for a successful proof for each problem. The problem that Perelman disposed of was in the field of topology concerning the nature of surfaces – called the *Poincaré Conjecture*.

In the first years of the 20th century, the French mathematician and physicist Henri Poincaré first raised the conjecture, which remained unsolved until the work of Perelman was published and accepted by the mathematics community in 2006. With this acceptance came the awards: first the Fields Medal, the most prestigious prize in mathematics, and then the million-dollar prize sponsored by the Clay Foundation. Perelman immediately made headlines by rejecting both prizes – allegedly on the grounds that he did not value prizes but rather the mathematics itself.

Perelman's response to these awards suggests that he believes that mathematical knowledge belongs to a community rather than, in this case, being attributed to him personally. But what community? The number of people who understand his proof is very small when compared to the population as a whole, so perhaps we could claim that the proof of the Poincaré Conjecture belongs only to them. On the other hand, this community could include a wider range of people if more of them were to specialise in mathematics. However, the simple knowledge that the conjecture is true (rather than the proof of it) is something that could be considered to belong to humanity as a whole, as long as the mathematics community is trusted to maintain the standards required for mathematical proof. This case is concerned with knowledge that may belong to a particular community due to the unavoidable exclusion of others, as opposed to the deliberate decision to exclude them.

Reference:
www.claymath.org/millennium-problems/poincar%C3%A9-conjecture

Object 3: Antiva® medicine

My third and final object is a packet of the anti-viral drug Antiva, produced in Bangladesh and active against chronic hepatitis B infection. Like all anti-retrovirals, Antiva works by inhibiting the enzyme reverse transcriptase, which the virus needs in order to make copies of itself and hence proliferate. In Bangladesh, Antiva is manufactured by the company Square Pharmaceuticals. Bangladesh currently qualifies as one of the least developed countries (LDCs) in the world.

In 2015, the World Trade Organization (WTO) extended a waiver for patents and other intellectual property rights in relation to the 48 least developed countries in the world. This waiver will extend to 2033, when it will be discussed again. The waiver allows poor countries easier access to drugs and the opportunity to manufacture and distribute them at much lower prices than those that would otherwise apply. One concern is that economic development in Bangladesh is such that by 2024 it may no longer count as an LDC, and hence no longer qualify for this WTO arrangement.

Here is a situation where knowledge would ordinarily belong to the manufacturer in a similar way, as is the case with AG Barr and Irn-Bru. However, in this case knowledge has been deliberately shared with others on humanitarian grounds. Unlike the case with the Poincaré Conjecture, this knowledge is not limited by a general inability to understand it. One might claim that the knowledge does not really fully belong to the community of LDCs as the waiver is of limited duration. However, when knowledge is known it cannot usually be 'forgotten' again. Hence, if the waiver were cancelled, one could argue that it would be the permission to use the knowledge that would be withdrawn rather than the knowledge itself. It should also be mentioned that the importance of extending the community to which the knowledge belongs, in this case is dependent on the existence of the resources needed to exploit it.

The student has linked the objects but this is not strictly required by the assessment instrument. However, it does emphasise that that the objects make different points about the prompt – which is required.

Reference:
www.un.org/ldcportal/wto-drugs-patent-waiver-for-ldcs-extended-until-2033/

Word count = 940

Example B: Knowledge and technology

IA Prompt #33: How is current knowledge shaped by its historical development?

Object 1: Typewriter

My first object is a typewriter owned by my father. Although various forms of the typewriter have been invented since the 16th century, the versions that we most clearly recognise today were produced in the 1870s by Christopher Sholes and co-workers. Sholes eventually settled on an arrangement of keys that we still use in the design of keyboards today – this is known as the QWERTY layout, after the sequence of keys found at the top-left portion of the array. There are varying accounts of why Sholes arrived at the overall arrangement of letter keys. These include the effort to locate keys such that common combinations of letters are located far apart in order to prevent jamming of the typewriter arms that swing and deliver the letter impressions to the paper; but there are anomalies here as some keys for common combinations of letters such as 'e' and 'r' are found next to each other. A contrasting claim states that the arrangement was made deliberately difficult for typists in order to slow them down and minimise errors, but touch typing was not a common skill at that time, so this explanation also seems unconvincing.

Whatever the origins of the key layout, it became standard when Sholes's invention became mass-produced by the company Remington and Sons; 150 years later, the

QWERTY keyboard is still the default today. Typists obviously need to learn to use it, so we can see that current technology in the form of computer keyboards, and the procedural knowledge needed in order to use them, has been shaped by the historical development of earlier technology. Furthermore, this arrangement has become 'locked in' to our knowledge as any major restructuring of the keyboard layout would result in inefficiency, with significant difficulties in adjustment resulting in reduced typing speeds.

Reference:
www.forbes.com/sites/quora/2019/01/10/why-was-the-qwerty-keyboard-layout-invented/#64409f4957ae

Object 2: Mesosomes

Many biology textbooks refer to the appearance of structures within prokaryotic cells, such as bacteria, that are known as *mesosomes*. These mesosomes are my second object. In older texts, these structures are assigned rather speculative roles in cellular respiration or cell division. This is the case in one of the textbooks I am using for my studies. However, more recent research has demonstrated to the satisfaction of most biologists that mesosomes are artifacts; that is, they are features of cells caused by the processes used in order to prepare the specimens for observation using the electron microscope, rather than real structures in the cells. These processes include the application of heavy metals and freezing in order to fracture the cells and membranes in ways that make viewing easier.

It might have been more striking if the student had used a page from their biology textbook as the object, rather than the mesosomes themselves.

We commonly think of technology as the product of science, and this is clearly the case with the invention of the electron microscope. However, technology is also needed in order to advance science, as is the case here. This object reminds us that we must also be aware of the possibility that the application of technology itself may influence what we observe and what we think we have discovered. Such concerns are particularly important in science, where so many objects and events are observable only with the aid of scientific equipment. Furthermore, misinterpretations of observations may persist long after the observations have been explained more accurately – as appears to be the case here with instructional texts in biology sometimes still accrediting mesosomes with the cellular functions mentioned above.

Reference:
www.sciencedirect.com/topics/medicine-and-dentistry/mesosome

Object 3: Orrery

The last object in my exhibition is an orrery. An orrery is a mechanical representation of the solar system driven by a clockwork mechanism. The first orrery was created by the clockmakers George Graham and Thomas Tompion in about 1710, who presented it to Charles Boyle, the Earl of Orrery – hence the name. The mechanisms that drove the movements in orreries were ingenious and needed to be complex in order to replicate the simultaneous observed movements of a substantial set of astronomical bodies, including planets and the Earth's moon.

Perhaps more interestingly for TOK, the use of clockwork in these models seemed to chime with some more philosophical views – popular at the time – about the nature and functioning of the universe. In particular, some scientists (such as Isaac Newton) adopted an interpretation in which God set up the universe and then 'retired' to leave the laws of physics (such as Newton's law of universal gravitation) to run their course. This is analogous to a clockwork mechanism, which is cranked up and then left to unwind without further intervention. This philosophical view is known as *deism*, and was attractive not least because it suggested that, at least in principle, the behaviour of the universe is entirely predictable.

This object illustrates how technological inventions can extend their influence well beyond the job that they are originally intended to perform. Another example would be the modern tendency to regard the mind as if it were a collection of software. Unlike the case of the mesosome, where it is false empirical claims that persist in our knowledge about something specific, the notion of a clockwork universe is an example of a powerful metaphor that burrows into thinking and can shape knowledge in a wider field – often below the threshold of conscious thought.

It is best not to introduce another example – use the available word count to develop the effectiveness of the selected object.

Reference:
www.universetoday.com/44671/what-is-an-orrery/

Word count = 852

Example C: knowledge and politics

IA Prompt #11: Can new knowledge change established values or beliefs?

Object 1: Portrait of Aung San Suu Kyi

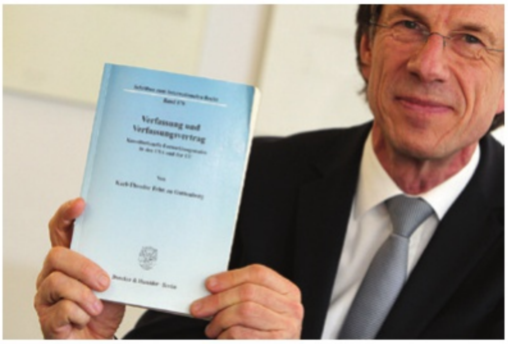
The first object in my exhibition is a portrait of Aung San Suu Kyi, who was placed under house arrest for most of the two decades from 1990 to 2010 in Myanmar. During this time, she was a focus of opposition to the military government after the annulment of elections which her party had won. Her refusal to leave Myanmar during these years, despite having permission to do so on condition of not returning, coupled with her determined resistance against the regime, won her many plaudits and awards. These included the Nobel peace prize in 1991 and an honorary doctorate from her *alma mater* – Oxford University – in 2012. In 2015, when her party achieved a landslide victory, she was made state counsellor (the equivalent of prime minister) but her international reputation subsequently suffered because of her perceived indifference to the plight of the Muslim minority Rohingya people, who were oppressed in Myanmar and displaced into neighbouring Bangladesh. In 2017, St Hugh's College in Oxford decided to remove her portrait from public display, although the honorary doctorate was not revoked, in contrast to many other awards that were being withdrawn from her at this time.

Here, the portrait is more effective as an object than the person because it creates a tighter focus.

This object illustrates how new knowledge can change beliefs about a prominent person active in the field of politics. In this case, the new knowledge about Suu Kyi was inconsistent with what was previously assumed to be the case, and her more recent apparent inaction in the face of injustice was generally deemed more significant than her earlier resilience in captivity. It is worth noting that the change in beliefs about Suu Kyi's character has probably not been accompanied by any change in values among those who have observed her; rather it is her perceived failure to live up to those enduring values, such as those that underlie the expression of human rights by the United Nations, that has led to the change in beliefs.

Reference:
www.theguardian.com/world/2017/sep/29/oxford-college-removes-painting-of-aung-san-suu-kyi-from-display

Object 2: Dissertation of Karl-Theodor zu Guttenberg



My second object is the PhD dissertation of Karl-Theodor zu Guttenberg, who served as German defence minister from 2009 to 2011. During this period, queries were raised as to the authenticity of his submission in support of his doctorate. The University of Bayreuth eventually identified 23 violations of copyright in the work, and ruled that this was a case of intentional deception as evidenced by numerous modifications of original texts in an attempt to prevent discovery of their origins. Zu Guttenberg simplified the task of the university to revoke the award of the doctorate by making a request for the withdrawal himself. Subsequently he tendered his resignation as government minister. Although this was initially not accepted by Angela Merkel as German chancellor, further enquiries into the work prompted zu Guttenberg to offer his resignation again and this time it was accepted.

Cases like these invite further scrutiny of past behaviour on the part of the individuals involved, and zu Guttenberg was not spared in this respect. While plagiarism has long been considered academic malpractice, the tools available for research and for detection of the traces of unreferenced work have vastly expanded in recent years with the advent of digital searching and online publication. This has sparked a more general debate as to the ownership of ideas and whether established expectations for attribution of the work of others are sustainable in a highly interconnected world. The question here is about how the high value that we assign to originality and respect for the work of others should be protected. Nevertheless, beliefs about the integrity of zu Guttenberg as an academic were certainly brought into question by this series of events.

Reference:
www.spiegel.de/international/germany/the-guttenberg-plagiarism-scandal-german-society-is-applying-a-double-standard-a-748090.html

Object 3: Bill Clinton's announcement concerning Monica Lewinsky

Finally, my third object is the announcement made by former US President Bill Clinton concerning his relationship with White House intern Monica Lewinsky.

A still from the video of this event is acceptable as an object.

Clinton became embroiled in a scandal in 1998 while US president when accused of conducting this affair. In the briefing Clinton first denied having sexual relations with Lewinsky, but eventually had to concede that the truth was otherwise. The result was that Clinton became only the second US president in history to be impeached by the senate – for perjury and obstruction of justice.

Clinton's approval ratings reached their highest point of his eight-year incumbency at 73 per cent immediately after impeachment proceedings were concluded and he was acquitted of the charges, despite the fact that he had not told the truth to the US public. According to Gallup polling, his final rating after stepping down was 65 per cent – higher than any other US president since the early 1950s – and, in a further poll in 2007, Clinton came fourth in the list of the greatest US presidents in history.

In this case, the allegations levelled against a prominent politician seemed to have little effect on some of the beliefs of observers. I have presented in this exhibition three cases where new knowledge comes into contact with established beliefs. There is an opportunity to examine how the nature of this knowledge might produce differing effects on beliefs – ranging from a realisation of indifference to injustice, to a lack of respect for the protocols of knowledge ownership, to the private behaviour of a public figure. There is a further chance to reflect on how the reactions to new knowledge about prominent individuals might be influenced by their particular characters, or be shaped by variations between cultures as a result of differences in values.

The temptation is strong to make explicit comparisons between the points made by each object, but consider how the words might be effectively used to develop the point of each example, while leaving the examiner to appreciate the differences.

Reference:
www.bbc.com/news/world-us-canada-50813276

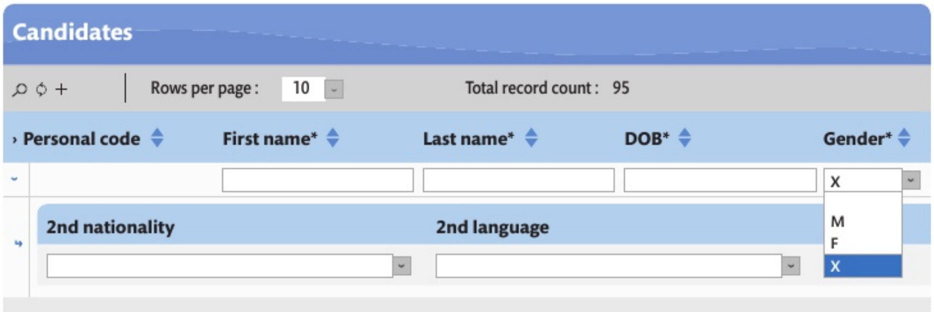
Word count = 894

Example D: Knowledge and language

IA Prompt #6: How does the way that we organise or classify knowledge affect what we know?

Object 1: IBIS registrations – gender options

My first object is a screenshot from the IBIS examination registration website. A recent amendment to this page now permits candidate registration under three gender options: M for male, F for female, and now X as well. This change raises important issues about classification. We human beings tend to like classifications, as they are a way to organise what we know. This particular example questions some of our most basic traditional assumptions about gender. Although classification in



some areas of knowledge is less directly connected to the human experience, we are still comforted in some way by being able to 'organise' our knowledge. Think of the classification of Pluto as a dwarf planet, for instance. Elsewhere, artistic movements are a great way to make sense of art history and, while they are sometimes determined in hindsight, they often come about when a group of artists decides to classify themselves (surrealism, Dadaism, and so on). That kind of classification also helps us to have an identity.

By catering for all gender identities, the IB registration options highlight the performative function of language. I have heard of people who have undergone surgical procedures in order to fit in with traditional established gender options, but the widespread recognition of gender X and the power to choose pronouns to reflect perceptions of identity may render the need for such people to alter their biology unnecessary or incidental. More generally, I have heard of people in therapy who are comforted to hear that they are autistic or have ADHD, because the diagnosis helps them to put a label on their own experiences.

Reference:
www.themandarin.com.au/83991-what-is-gender-x/

Object 2: Capybara

My second object is the capybara, the largest rodent in the world. Native to South America, capybaras can reach a length of 1.2 metres and a weight of more than 45 kilograms. Their diet is herbivorous and they spend much of their time in the semi-aquatic environment of marshes and swamps. They are strong swimmers, have partially webbed feet, and protect themselves from predators by hiding underwater.

In Venezuela, capybara meat is considered a delicacy. When 17th-century Spanish missionaries arrived in this area, they set about enforcing the dietary restrictions of their religion among the converted – including the prohibition on meat consumption during Lent. But they also realised the importance of the capybara in providing required nutrition to local indigenous groups, and so they appealed to the Vatican to allow their converts to continue to eat the animals. The descriptions provided by the missionaries of the appearance and habits of capybaras were insufficient for clear communication so the Vatican authorities, having never seen capybaras themselves, ruled that the capybara was a kind of fish. It is a matter of debate whether, had they known of the true nature of the animal, they would have made the same decision given that there is explicit prohibition in the Bible of rodent consumption.

While the way in which the Vatican authorities classified the capybara can be considered to be a reflection of their knowledge, for the missionaries and the indigenous people of Venezuela the categorisation of the animal was an indication of pragmatic realities. It is unlikely that thinking of the capybara as a fish made any difference to those directly involved in consuming them. Indeed, there are reports that capybara meat tastes like a combination of pork and sardines, with the fishy notes presumably a consequence of their lifestyle as described above.

Reference:
www.cogwriter.com/news/religious-news/did-a-pope-conclude-a-rodent-was-a-fish-for-lent/

Object 3: Swastika in Ghana

The third object in my exhibition is a symbol displayed on a commercial building in Ghana close to my school. This is a swastika. Variations on this symbol are quite common in Africa and in diverse locations across the world. They are sometimes found on weights used by the Akan people of Ghana and Côte d'Ivoire in order to measure gold dust, which is present in copious amounts in these countries. In this context, the symbol references gold as a currency and, by extension, the concepts of power and wealth. Also, the swastika can be described as a stylisation of the adinkra symbol of two conjoined crocodiles representing the values of democracy and cooperation, and futility of greed.

Use of an object from the local environment can enhance authenticity and stimulate discussion in the audience for the exhibition. Some sort of audience is a requirement, whether class sharing or major school event.

Symbols act as a convenient way of representing concepts important for social knowledge – adinkra symbols are ideographs that function well in a pre-literate culture. The meanings of such symbols are easily communicated and understood, but they are more strictly tied to the culture in which they originated than is the case with full written language, which means that there is a greater need to acquire knowledge of the context. The swastika has a long and varied history across many cultures around the world, but the many meanings that it transmits have been overshadowed by its usage by the national socialists in Nazi Germany in the 1930s and 1940s, and hence with the crimes and atrocities that they committed. Such an overpowering connection of a symbol to a particular set of circumstances can interfere with the message it was originally intended to convey, and hence disturb the organisation of knowledge in a different cultural context.

Reference:
africa.si.edu/collections/view/objects/asitem/Objects@632/26/displayDate-asc?t:state:flow=8b789e5f-e870-41da-ba2d-2d7a629fa493

Word count = 839

Example E: Knowledge and religion

IA Prompt #8: To what extent is certainty attainable?

Object 1: Grandmother's Bible

The first object in my exhibition is my grandmother's Bible. Sunday visits to church were common during my early childhood, and by the time I was 15 there were lessons from the minister leading up to confirmation. Throughout all of this, I was more confused than convinced. The stakes seemed high. I needed to know. I confided my doubts to my grandmother who led me to her Bible and placed her hands on the book, a very large book, and said, 'See. These words are a light unto my path. It says so right here.' I didn't see. How was her certainty possible? I read the book over the summer. I still was not certain. 'But grandmother,' I said, 'bad things happen.' She just looked at me.

Questions arose: what must it feel like to be certain? How and why does this condition elude others? How does one dimension of certainty, say, in religion, attach to a disposition to believe claims from elsewhere? What other high-stakes claims are impossible to believe except through an act of uncritical belief? Is there an afterlife? Am I a good person? Who/what created the universe? Is there a meaning to life? Why does it matter? What would count as evidence? Maybe it's all around me and I don't see it. That's what my grandmother said.

The student has demonstrated a strong personal input, but needs to develop further the link between scripture, religion, and psychological certainty.

This object and the circumstances described above concern the pursuit or attainment of psychological certainty in which one is completely sure of something. An important feature of this kind of certainty is that it can be held even if the person who is certain is actually wrong.

Reference:
centerforinquiry.org/blog/religious_certainty_is_a_dangerous_weapon/

Object 2: Gödel's ontological proof of God

Ax. 1. $(P(\varphi) \wedge \Box \forall x(\varphi(x) \Rightarrow \psi(x))) \Rightarrow P(\psi)$
Ax. 2. $P(\neg\varphi) \Leftrightarrow \neg P(\varphi)$
Th. 1. $P(\varphi) \Rightarrow \Diamond \exists x\, \varphi(x)$
Df. 1. $G(x) \Leftrightarrow \forall\varphi(P(\varphi) \Rightarrow \varphi(x))$
Ax. 3. $P(G)$
Th. 2. $\Diamond \exists x\, G(x)$
Df. 2. $\varphi \text{ ess } x \Leftrightarrow \varphi(x) \wedge \forall\psi(\psi(x) \Rightarrow \Box \forall y(\varphi(y) \Rightarrow \varphi(y)))$
Ax. 4. $P(\varphi) \Rightarrow \Box P(\varphi)$
Th. 3. $G(x) \Rightarrow G \text{ ess } x$
Df. 3. $E(x) \Leftrightarrow \forall\varphi(\varphi(\text{ess } x \Rightarrow \Box \exists x\, \varphi(y))$
Ax. 5. $P(E)$
Th. 4. $\Box \exists x\, G(x)$

My second object is an ontological proof for the existence of God offered by the Austrian mathematician, Kurt Gödel. An ontological proof is one in which the conclusion is reached from starting premises arrived at by rational thought rather than empirical observation. These premises may be thought of as axioms in a similar fashion to those found in mathematics. Gödel claimed that his proof was motivated by his desire to construct a watertight argument rather than support any personal religious conviction that he may have harboured. The details of Gödel's argument are too complex and difficult to discuss in detail here, but it involved what is known as *modal logic*, the distinction between necessary and contingent truths, and the concepts of properties and essences. As with ontological arguments in general, criticisms of Gödel's argument understandably focus on the legitimacy of the axioms he used. If the starting points of an argument can be called into question, then the truth of the conclusions can be too.

This object is concerned with epistemic certainty – the attempt to arrive at knowledge that is demonstrably true whatever the feelings or allegiance may be to it of individuals. There have been numerous attempts to achieve this kind of certainty, often inspired by the apparent power of logical thought as applied in other fields of knowledge. The philosopher Bertrand Russell commented that our uneasiness with such arguments when applied to religion is often undermined by our difficulty in identifying exactly what is wrong with them. The implied question is whether logic is an appropriate vehicle for trying to support or reject claims in the field of religion.

Reference:
plato.stanford.edu/entries/ontological-arguments/

Object 3: Isotope-ratio mass spectrometer

The final object in this exhibition is an isotope-ratio mass spectrometer (IRMS). This device is used to determine the ratio of different isotopes in a sample. If the heavier isotope is radioactive, and the rate of its decay into the lighter isotope is known, then an estimate of the age of the sample can be made. For example, uranium-238 decays into lead-206 with a half-life of 4.47 billion years, meaning that half of the uranium will have converted into lead over that period. The age of a sample of zircon mineral, for example, which we know contains no lead at formation, can be estimated in this way. An isotope like uranium-238 with such a long half-life is useful for dating very old samples, such as those formed shortly after the formation of the Earth and solar system. It is true that the older the sample the greater the opportunity for error, as the proportion of remaining uranium diminishes and approaches zero. However, modern methods reduce this error to a maximum of around 1 per cent in terms of time.

Radiometric dating provides a scientific basis on which claims about the age of the Earth can be evaluated. As with all scientific work, there has to be not only an acceptance of error but an attempt to quantify it. Science does not seek epistemic or psychological certainty as described above, but rather an approximation to certainty on the basis of available empirical evidence. By quantifying uncertainty, science can arrive with confidence at conclusions that rule out other claims that are well beyond credibility. This includes claims made by some religious adherents (inferred from scripture) that the Earth is only a few thousand years old. We all need to adjust to a world in which a degree of uncertainty is tolerated.

Reference:
www.tulane.edu/~sanelson/eens212/radiometric_dating.htm

Word count = 838

Example F: Knowledge and indigenous societies

IA Prompt #29: Who owns knowledge?

Object 1: Hoodia plant

Hoodia gordonii is a type of flowering cactus that grows in Southern Africa. It has been used widely by the San and other people in the region as a natural appetite suppressant. In keeping with cultural practices, the San shared the knowledge of the effects of the plant when consumed with outsiders, including an anthropologist in the 1930s who noted its use. This reference came to light in the 1960s and the South African Council for Scientific and Industrial Research (CSIR) commenced research into what might be the active ingredient – eventually isolating a molecule known as P57. The commercial potential for an anti-obesity product was quickly appreciated, but the San people were not initially recognised as the original holders of the knowledge about the plant, with the CSIR claiming that it was impossible to identify who first became aware of its effects. Eventually an agreement was reached that provided the San with 6 per cent royalties on any sales of anti-obesity products containing the active ingredient. However, heavy marketing by pharmaceutical companies has led to a level of demand such that the plant is now listed as an endangered species. Moreover, some producers have now been accused of selling *Hoodia* products that do not contain any *Hoodia* extract at all.

This object illustrates what can happen when the concept of knowledge ownership and the means of legally establishing it (such as intellectual property law) are familiar to one group and not the other. Furthermore, the sharing of knowledge with outsiders in this case has led to the depletion of a natural resource for an indigenous society. While the San were eventually recognised for their role in supplying the knowledge, questions arise as to the degree to which the CSIR can lay claim to knowledge as a result of their success in isolating the active ingredient – something beyond the capacities (or desires?) of the San themselves.

Reference:
www.wipo.int/ipadvantage/en/details.jsp?id=2594

Object 2: Indonesian batik

My second object is a batik shirt design from Indonesia. The batik technique involves the selective application of wax to cloth, such that subsequent dyeing will be restricted to the areas without the wax. The wax can then be removed with hot water and more wax applied in a different pattern, followed by the application of a different coloured dye, and so on as required. The technique allows for much creativity in the production of new patterns, but there are thousands of designs with traditional meanings that have long histories and are deeply embedded in local culture. The use of these designs has in the past been agreed between the batik-producing community as a whole. However, batik is popular beyond Indonesia and production occurs elsewhere, leading to concerns in the batik artist community as to the appropriation of the knowledge of the designs for profit, and without the corresponding knowledge of their meanings.

In recent years, an Indonesian government-sponsored patent programme has been set up that assigns ownership to particular families or groups, and requires all other producers to acquire permission for those particular designs to be used. Both the assigning of ownership of a design and the use of it by others is accompanied by the payment of a fee. This has been an intensive process because of the many designs in existence and the demand for their use. This object is linked to the problems that can arise when ownership of knowledge carries a financial obligation. Some designers struggle to pay the fee needed to guarantee their status as owners, and small-scale producers face similar financial hurdles. Overall, the pattern of ownership and use of batik has been recast by a well-intended intervention.

Reference:
web.law.duke.edu/cspd/itkpaper/

Object 3: DNA swab kit

My third object is a DNA swab kit. Kits like this collect data on genetic profiling and are particularly concerned with markers for ancestry. Projects like the Genographic Project – an initiative in human genetics sponsored by the National Geographic Society – use them to track human migration patterns. Cheek swabs can be provided by individual citizens and analysed in order to contribute to the overall database. Eventually, maps can be created which show the movement of the human species over vast amounts of time.

However, different countries operate on the basis of different laws concerning the ownership and use of genetic data. At one point, the National Congress of American Indians called for a halt to the project until procedures are clarified on an international basis. Some indigenous people refused to participate, concerned about possible undermining of traditional beliefs about their origins. There were worries about indigenous people being treated as curiosities, objects of study, rather than as equal partners; possible discoveries that the science might assert that the ancestors of the indigenous are not original inhabitants. There was unease that traditional land rights might be challenged, and that policies aimed at compensation for earlier injustices might be weakened. At the same time, other indigenous people saw the project as an opportunity to reaffirm their status. Some were reassured by the nature of the project as non-profit and affiliated with the support of various conservation initiatives.

The word count here is 115 short of the permitted maximum. How could these extra words be used to improve the exhibition?

Reference:
web.law.duke.edu/cspd/itkpaper/

Word count = 819

4.1 Areas of knowledge

4.1 Areas of knowledge

Introduction

At this point in our book we switch from looking at **themes** to looking at **areas of knowledge**. What are the differences between these two domains of the TOK course?

Themes provide a broad focus – their inclusion in the TOK course encourages us to think deeply about the influences they exert, how they shape our knowledge and how we might deploy our own knowledge in order to respond to them.

Areas of knowledge are concerned with knowledge in the academic field, including most of the subjects you study in the IB diploma. As such, we study areas of knowledge in order to reflect on the nature of academic disciplines to enrich our understanding of why they are organised the way they are, and to put ourselves in the shoes of the people who make their living from producing knowledge in them.

Very roughly, we might say that the emphasis in the themes is on making sense of the knowledge that we acquire from our everyday environment, whereas exploring the areas of knowledge is concerned with the ways in which knowledge is produced.

That said, we should not make a rigid distinction between themes and areas; they complement each other and interconnect in many ways. You should be looking for opportunities to make these links. The integration of the two domains is enhanced by the common use of the knowledge framework across them.

Knowledge framework	
Scope	Perspectives
Methods and tools	Ethics

Scope

Let's start our journey with a comparison of the subject groups in the IB diploma and the five areas of knowledge to be addressed in TOK.

Figure 1 Areas of knowledge in the diploma programme

Areas of knowledge

Students are required to study the following **five** areas of knowledge:

- History
- Human sciences
- Natural sciences
- Mathematics
- Arts

The way that subjects are arranged in the IB diploma suggests that they can be classified according to a consistent scheme, based on similarities and differences. Most of the subjects you study are well-established academic disciplines. For example, economics, psychology, and anthropology are in Group 3; biology, chemistry, and physics are in Group 4; music, visual arts, film, dance, and theatre are in Group 6. In these clusters of disciplines we can detect the three TOK areas of knowledge – namely human sciences, natural sciences, and the arts, respectively. We will need to identify what it is about each of these three clusters of subjects that supports this classification:

- Group 3: anthropology, economics, psychology → human sciences
- Group 4: biology, chemistry, physics → natural sciences
- Group 6: dance, film, music, theatre, visual arts → the arts.

Mathematics is a fourth TOK area of knowledge, leading some to ask why the discipline of mathematics gets a group in the diploma to itself. Now consider why is it that history belongs in diploma Group 3, but has a special status in TOK on its own? This is a question that will need to be answered; what is your provisional response? Then there is geography – also from Group 3 – where should it be placed in the TOK scheme? To which TOK area of knowledge can your language A course best contribute?

One clear feature of the areas of knowledge scheme is that some areas include a number of disciplines while others contain just one. So we have to ask not just why history and mathematics seem privileged, but also what it is that provides the 'glue' that binds each of the areas of knowledge together.

As we go through this chapter, we will examine the role of each of the following in characterising and distinguishing the five TOK areas of knowledge:

- subject matter
- methodology
- community practices.

The knowledge framework will help in exploring these questions as the following chapters unfold.

You will be alert to the existence of other subject courses available in the diploma, at least one of which you are almost certain to be studying. You are probably following a Group 2 course, for example. Or you might be taking computer science, digital society, design technology, global politics, world religions, and so on. Study of these courses can be invaluable in addressing some of the TOK themes.

Activity 1

Having considered all of the above, on what basis would you explain the following? Could these statements be contested?

1. Chemistry and biology belong together in the same area of knowledge.
2. Physics and economics belong in separate areas of knowledge.
3. Literary studies and dance belong together in the same area of knowledge.

4. History and mathematics should be considered areas of knowledge on their own.
5. Geography is both a human science and a natural science.
6. Algebra and geometry are not separate areas of knowledge.

Knowledge as a map

The map metaphor for knowledge introduced in Chapter 1.1 **Knowledge and the knower** is useful for thinking about how to classify disciplines.

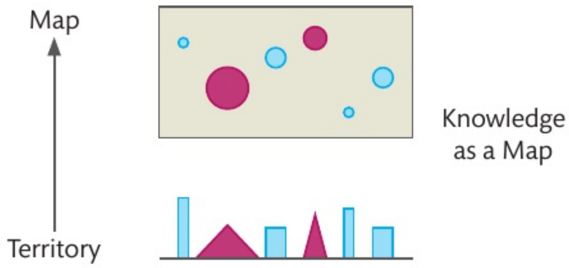


Figure 2 Knowledge as a map: world/territory → knowledge/map

This metaphor provides a powerful tool for thinking about the nature of disciplines and areas of knowledge, and their interrelationships (see more diagrams in Chapter 1.1 **Knowledge and the knower**).

Activity 2 Maps and territories

If knowledge in each area of knowledge is a 'map', what is the 'territory' to which each map refers? An answer is provided here for the natural sciences – what about the others?

Map/Area of knowledge	World/Territory
Natural Sciences	*The physical/material world/universe*
History	
Human Sciences	
Arts	
Mathematics	

Is it easier to identify territories for some areas rather than others? If so, does this tell us anything important about the areas of knowledge, or something about using the idea of a map as a metaphor for knowledge? It is important to be able to appraise the methods and tools that we employ. Do areas of knowledge ever have overlapping territories? If so, does this mean that some parts of areas of knowledge are redundant? Or might this overlap yield advantages in knowledge and understanding?

Knowledge is dynamic and under constant review in the areas of knowledge. In terms of the map metaphor, a general goal would be to strive to improve the quality of the map (i.e. produce ever better knowledge). 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 our portfolio of knowledge maps is evolving. Let's look at two perspectives on this process.

Specialisation

> 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.
>
> (Konrad Lorenz)

A few hundred years ago, it was possible for an educated individual (sometimes referred to as a 'Renaissance man', and indeed almost invariably a man) to keep abreast of developments across all the disciplines, but the expansion of knowledge has made this an impossible ambition. The Austrian ethologist Konrad Lorenz put his finger on a key feature of knowledge in the modern world. As knowledge expands, scholars must specialise in order to remain at the cutting edge of progress 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 with the fragmentation of knowledge and the possible consequent failure to grasp the connections between different disciplines (or even within one discipline).

One interesting example is medical science. Fifty years ago, most doctors were general practitioners. Today nearly every physician is a specialist of some kind, but patient care does not seem to be greatly improved. In fact, doctors from different branches of medicine find it difficult to coordinate with other doctors when treating the same patient. To what extent do you think the tendency expressed by Lorenz is real? Is it inevitable? Do the benefits of specialisation outweigh the drawbacks?

Integration

Despite the 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 on some basis. Such a prospect seems a long way off when even physicists alone cannot so far produce a unified theory for gravity, electromagnetism, and the two forces associated with the atomic nucleus. This ambitious goal is known as *consilience* – the facts and theories of sciences, humanities, and arts – all the areas of knowledge in the IB matrix can be brought together in coherence. Such a vision for the **integration of knowledge** has been set out by the American entomologist EO Wilson in his book titled, *Consilience*. Rather than providing maps of distinct territories, in this scenario the disciplines would merge into one massive interlocking, self-reinforcing 'theory of everything'.

Do you think consilience is a realistic prospect? 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 and theories? 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, showing that 'nature is organised by simple universal laws of physics to which all other laws and principles can eventually be reduced'. 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.

Collaboration

How can we negotiate a path between fragmentation of knowledge into many sub-disciplines and the dominance of a few over others? The growing collaboration across subjects in the academic field is reflected in the IB curriculum. In the diploma, there are now a number of interdisciplinary courses available, such as Environmental Systems and Societies (bridging Groups 3 and 4), and Literature and Performance (Groups 1 and 6), in which the subject matter and methodologies of two disciplines are embraced 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 substantive difference from your other subject courses? Furthermore, debate about the prospects for interdisciplinarity might take place during your Group 4 project – particularly during the planning phase.

"I'M ON THE VERGE OF A MAJOR BREAKTHROUGH, BUT I'M ALSO AT THAT POINT WHERE CHEMISTRY LEAVES OFF AND PHYSICS BEGINS, SO I'LL HAVE TO DROP THE WHOLE THING."

Activity 3 Group 4 project

In your Group 4 project, are you being asked to work within your individual science subjects and then bring your conclusions to the multi-disciplinary table, or 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?

A review of past efforts suggests that the founding of an interdisciplinary subject is not easy. Initially, authorities may have to come from more established subjects and authors may find it difficult to get articles published in traditional journals. Specialist communities often feel strong loyalty to their own disciplines and are wary of the approaches made by outsiders, worrying about 'mission creep' in which methods and findings established by their own communities become reinterpreted.

Knowledge questions

- How effective is the map metaphor in making sense of disciplines and areas of knowledge?
- What might be the advantages and drawbacks of specialisation of knowledge?
- Is the unification of all academic knowledge a realistic or desirable goal?
- Is the subject matter to which areas of knowledge are directed the best way of distinguishing between them?

Perspectives

In 1959, the British novelist and physicist, CP Snow, delivered a lecture called 'The Two Cultures' where he drew attention to a gulf, as he saw it, between those who were familiar with the sciences and those comfortable in the humanities subjects. Perhaps you recognise this dichotomy today. Is there a preference for, or prejudice against, one or the other in your school, or among groups of students? Are mathematics and sciences considered hard subjects; literature and the humanities as interesting but soft?

Snow considered the tension between these two cultures as a major hindrance to solving global problems, such as poverty and inequality – instances of what in TOK we sometimes call 'knowledge at work in the world'. Following on from the map metaphor, this culture metaphor might help us to examine the relationships between all disciplines; not just the sciences and humanities. The general idea has been expressed thus:

> 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 behaviour, 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, pp. 215–227)

So we are now armed with two metaphors that may guide our exploration of academic knowledge as we proceed through the chapters that follow:

- Knowledge is a kind of **map** or representation of the world.
- Each discipline or area of knowledge functions like a **culture**.

Knowledge questions

- To what extent is it helpful to think of disciplines as cultures?
- Do concepts determine what is accepted as subject matter in each area of knowledge?
- Do all areas of knowledge exhibit continuous growth in knowledge?

Methods and tools

It is a common view that the main defining differences between academic disciplines are the subject matters that they seek to address. In our map metaphor, it is the territory that counts. But what if we consider specific types of method to express the distinctions among the disciplines. And perhaps we could take the line of thinking further – perhaps those discipline-specific methods, through their tight fit with the subject matter for which they were designed, actually could 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.

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

Activity 4

Consider the following research questions from extended essays.

1. How did the British quest to make the 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?

For each of the essay research questions above, sketch out what method would be required to answer the question.

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, the sciences. 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, and possibly augmented by some first-hand data collection through questionnaire or interview. Question 3 requires close textual analysis and examination of narrative technique.

You may be familiar with these procedures. More formally, they might include the following:

- **inductive method** – collection of data and searching for patterns or general conclusions
- **hypothetico-deductive method** – testing empirically 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.

The effectiveness of methods such as these will form part of the discussion in the following chapters. But 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, caused by properties of the air. As an outcome of his work in promoting the alternative germ theory of disease, Koch developed a set of four postulates which described a clear method for establishing the connection between a microorganism and disease.

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 eventually emerged from the use of these postulates was that pathogens often reside 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 microbes 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 that field of knowledge.

It is only in recent times that molecular biology has developed the tools (new method) to circumvent the culturing challenge – now we can extract genetic information from microbes instead of trying to multiply them and observe them optically.

Knowledge questions

- To what extent do areas of knowledge have exclusive methods for producing knowledge?
- Are the methodologies of areas of knowledge perfectly aligned with their subject matter, or do they shape or constrain the knowledge that can be produced from them?

Ethics

Across the areas of knowledge, there are methods that shouldn't be applied and perhaps even questions that shouldn't be asked on ethical grounds. Some of these will emerge in the following chapters. For example, the IB has developed policies that must be followed with respect to animal experimentation in biology, and investigations in psychology and anthropology.

But there are other aspects of research and scholarly practice that also deserve attention from an ethical perspective. Just as cultures establish specific acceptable codes of behaviour, the behaviour of academic practitioners might be similarly constrained. For example, scientists are supposed to maintain a sceptical attitude to knowledge and a disinterested stance with regard to research. These norms might not apply to all other areas of knowledge.

In order for a community of scholars to work efficiently – to be an actual community – some norms concerning the treatment of knowledge and practices within the community must be present. While these norms might not in every case be upheld or even known, practitioners become familiar with them as part of their informal induction into the knowledge community. Awareness of expectations and limits of institutional behaviour of this kind sits alongside the necessary procedural knowledge of the actual methods by which each discipline tackles its subject matter.

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

Knowledge questions

- To what extent is knowledge in an area of knowledge a shared enterprise?
- If shared knowledge is important, how does this impact ethical aspects or its acquisition?
- How can we know when an available method in a discipline or area of knowledge should not be employed?
- How important is it to have established and agreed codes of behaviour among practitioners in a discipline or area of knowledge?

Conclusion

Henry Miller noted: 'In expanding the field of knowledge we but increase the horizon of ignorance.'

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 it.

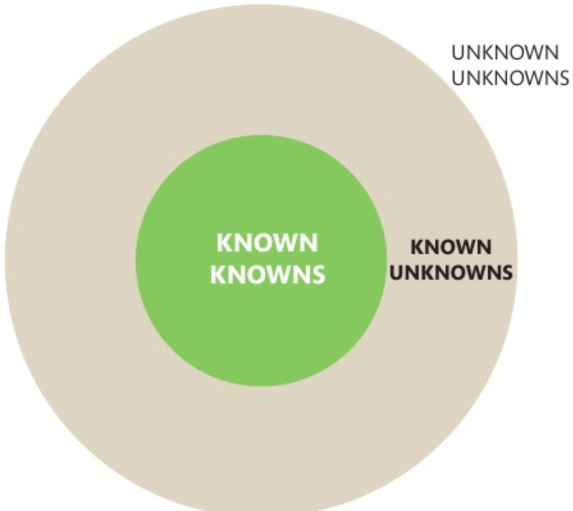


Figure 3 Types of unknown

Activity 5

Applying this distinction to Miller's quotation and Figure 3, identify some *known unknowns* in various disciplines and areas of knowledge. Why are they unknown? What is it that makes them known unknowns, as opposed to what Rumsfeld called *unknown unknowns* – what we don't know that we don't know? Apart from the knowledge already produced, each area of knowledge (and each discipline that it embraces) provides means by which some unknowns can be treated as known unknowns.

CP Snow believed strongly in the power of education for change. Indeed, the 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 (he even said at one point that he could have called his lecture 'The Rich and the Poor'). You might reflect on how academic knowledge can have a place in CAS activities and how you can bring *your* scholarly experience to bear in this important 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 public knowledge! In order to tackle poverty in the world, which disciplines would you enlist for the challenge?

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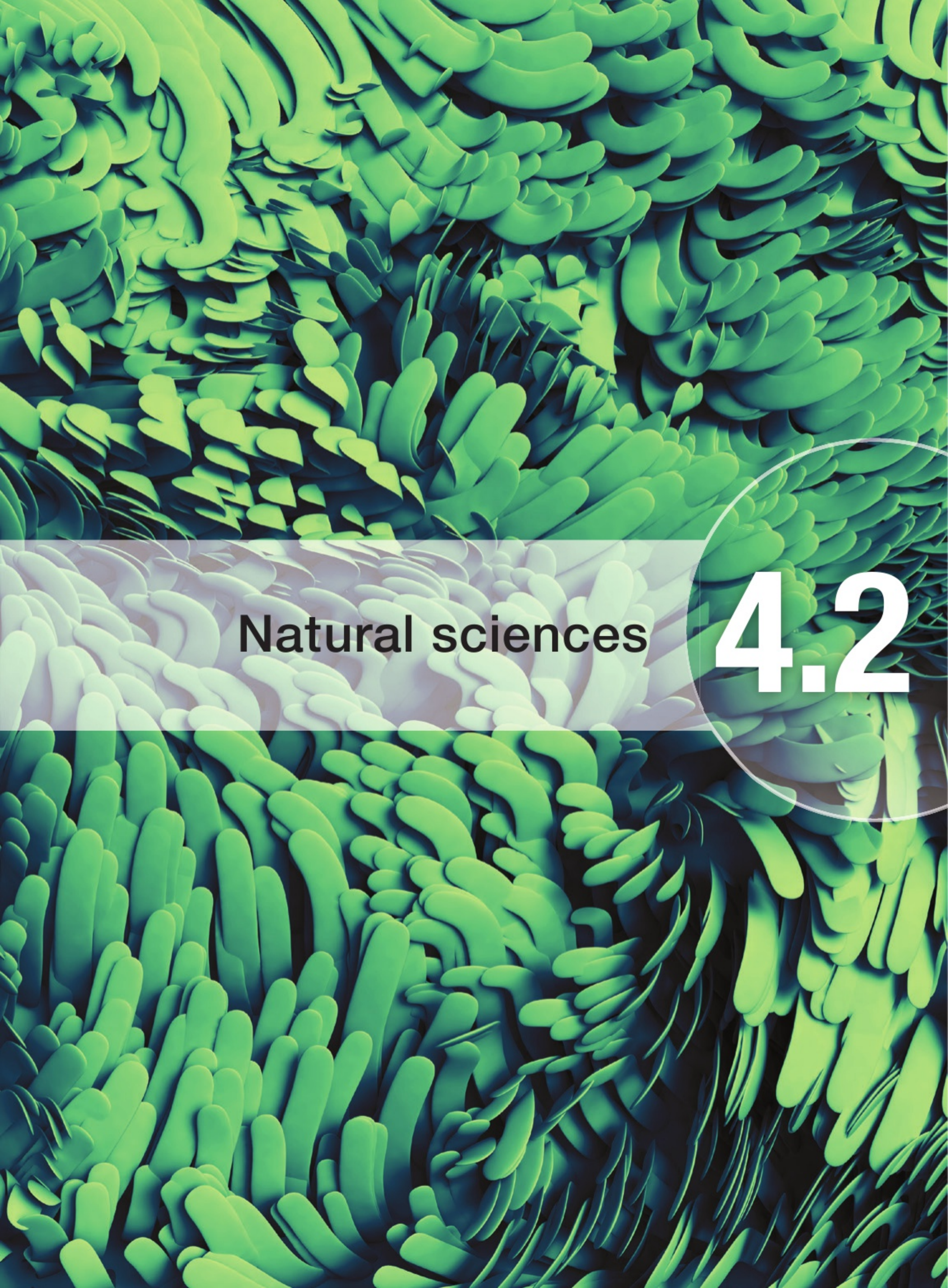


4.2 Natural sciences

Introduction

For many people the natural sciences are the perfect model of knowledge production. Indeed, not long ago, one of the TOK essay titles was: *Is science a superior way of knowing?* Scientific results, people say, are precise, reliable, independent of human desires, and capable of being definitively proved or disproved. Yet, scientists themselves might say that the use of the word 'proof' in connection with science is hasty. Scientific knowledge is forever provisional, they tell us, and the real-world scientist is always looking worriedly at the horizon waiting for the sweeping new discovery that refutes their results.

While the claims made on science's behalf might be overblown, there is something in the notion that science is immensely successful. Look around you at the technology (and more) that is the offshoot from scientific endeavour. Surely science must be getting some things right if its knowledge underpins the functioning of marvellous gadgets such as phones, computers, 3-D printers, and the like. As TOK students, your job is to try to understand the secret of the success of science. Does science have a special method of lifting the lid on the mysteries of the universe? What do the natural sciences have in common with other areas of knowledge? Why do other disciplines not measure up to the natural sciences in terms of their power of explanation and prediction? Compare economics and physics. Physics predicted the Higgs boson and 40 years later found it. Economics largely failed to predict the 2008 financial crash just weeks before.

In this chapter we take a TOK view of science and try to understand exactly what makes it work as an area of knowledge. Maybe it will turn out that science is just as vulnerable, as prone to error, as reliant on unsubstantiated assumptions as other areas of knowledge; or maybe there is indeed something special about its methods that make it the perfect model of knowledge.

Scope

This section deals with three questions.

1. What are the natural sciences about?
2. What are the natural sciences trying to do?
3. What distinguishes the natural sciences from other areas of knowledge, such as the human sciences?

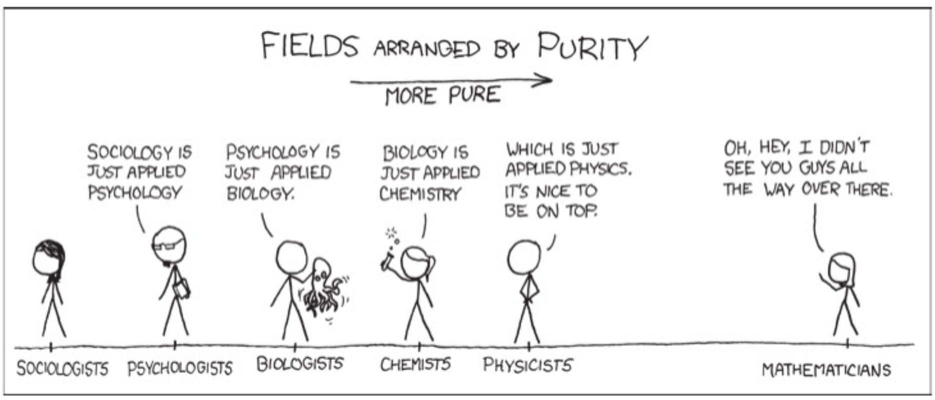
Before we go further try to answer the question: what do the words *natural science* mean to you?

Activity 1

Throughout this book we invoke the map metaphor to help us think about knowledge of all kinds, so one way of understanding science is by identifying its subject matter – the territory of the map. How would you fill in the following table of maps and territories? What do you think of this analogy? Does it work?

Map	Territory
Physics	The world of matter and energy
Chemistry	
Biology	
Astronomy	
	The materials of the Earth's crust and the processes which formed and changed them
Materials science	
Biochemistry	
	The study of the whole universe and the largest and smallest objects of which it is composed

There are some thinkers who believe that all the sciences are reducible to physics. They are called *reductionists*. They argue that the objects that chemistry, biology, and the other sciences study are composed, like everything else in the world, of particles of matter and fields of energy. If we could have complete knowledge of physics we would have complete knowledge of the other sciences. Every result in chemistry and biology is just a special case of a result in physics. However, in contrast, there is a growing movement today in favour of the idea that each of the sciences (human sciences included) adds something special to the mix. People who make this argument are called *anti-reductionists*. For many, biology is a special case and is *autonomous* from physics and chemistry; indeed, the biological sciences are often referred to as the *special sciences*. The anti-reductionists do not deny that the objects of biology are physical, there are no ghostly forces like an *elan vital* or *life force* that make things living. But they argue that results in biology cannot be simply reduced to results in physics: that biological explanation adds something extra. At the level of physics there is no difference between a living organism or a dead one. It is fair to say that this debate is not resolved. Ask your biology teacher which side they are on!



Info box

Scientific reductionism comes in a many different forms, but a central idea is that the natural sciences are fundamentally unified. They each describe the same physical universe, though perhaps at different scales. They each employ their own special set of concepts and vocabulary in which they state results, generalisations, and laws. But deep down there is the belief that results in biology and chemistry can be stated in terms of physics. This view is allied to a scientific realism. Since the natural sciences are describing the same reality, their different descriptions should translate readily into each other.

Scientific anti-reductionism takes the view that each of the natural sciences contributes uniquely to our understanding of the world. Anti-reductionists can still be realists in the sense that they regard the objects of the different sciences as real and physically existing in the world. It is just that they do not think that physics captures all the high-level organisational features of, say, a complex organism or human psychology. Physical stuff may be the only thing in the universe but there are types of higher level organisation of this stuff that is not captured by the concepts or vocabulary of physics.

Are the sciences reducible to physics?

What are the natural sciences aiming to do?

Another way to understand the natural sciences is to look at what they are trying to *do*. There are a number of possibilities.

The natural sciences aim to:

- make predictions
- find universal laws
- provide explanations for phenomena.

You will not be surprised that there are no easy solutions here – this is Theory of Knowledge after all! Each of these suggestions has pros and cons which need careful consideration. What they have in common is that they deal with phenomena; that is, they are concerned with things that happen in the world – either predicting them, finding regularities, or explaining them. Let us take each suggestion in turn.

Making predictions

Making predictions is a useful thing to be able to do. It helps us in our daily lives to know about phenomena such as tides, weather, earthquakes, and the position of the stars and planets (for navigation). If we can predict the world then, to some extent, we can control it. We can organise our lives around what the world is like; for example, if we can predict the weather, we make our plans accordingly. Human beings have been able to correctly predict certain events since ancient times. Predictions of eclipses of the Sun and Moon and the state of the tides have been made accurately for thousands of years. People have been making predictions about the local weather for at least as long (perhaps with less success; but with greater success than with earthquakes). Certainly being able to predict something is a type of knowledge, but is it the same as having scientific knowledge? Do we not have to know the cause of a phenomenon to be able to say that we know how it works?

The ancient Egyptians and Hippocrates, the father of medicine, counselled taking the bark of a willow tree to cure headaches. Nowadays we take aspirin, which contains the same active ingredient – salicylic acid. It is only in recent times that we understood how salicylic acid blocks the production of prostaglandins, which transmit pain signals. Yet Hippocrates and the ancient Egyptians were on to something. They realised that by intervening in the right way they could cure headaches in a reliable way. So just like being able to predict on the basis of regularities in the natural world, being able to predict the effects of an intervention should still, surely, count as a type of knowledge. The question is whether this is what is meant by scientific knowledge? Indeed, there are sciences that are not really concerned with making predictions. Geology does not seem to produce a lot of predictions. Seismology studies earthquakes but an important finding of this field is that earthquakes are difficult to predict! Cosmology, the study of the whole universe, does not make many predictions either, unlike its close cousin astronomy. Prediction on its own does not seem to be necessary or sufficient for knowledge to be scientific.

Finding universal laws

Laws in science are not the same as, say, traffic laws. Look up 'law' in a science textbook. You will find many entries: laws of gravity, electromagnetism and thermodynamics, conservation of energy, symmetry laws, and parity laws. Probably the book mentions regularities of some sort; for example, causal regularities such as 'if X happens, Y must happen and if X does not happen, Y does not happen'. But what about biology? Biologists tend not to talk about laws across the whole of their subject. They tend to talk more about the mechanisms within an organism that perform certain functions, such as the respiratory system in mammals, or the flagellar system that allows bacteria to move around. There are exceptions of course, such as the 'laws' of population genetics, but these are rare. Not many biologists would sign up to the idea that their subject was about finding universal laws. You might therefore wonder whether there is a difference between the *physical* sciences and the other natural sciences.

Explaining phenomena

The final possibility – to provide explanations for phenomena – seems, on the face of it, to be less contentious. The physicist, chemist, geologist, cosmologist, and biologist are at least united on this question. But there are two problems here. The first is that finding explanations of phenomena does not seem to pick out just the natural sciences. Surely the human sciences do this as well. If we define phenomena broadly as *events*, then history too might fit this description. The second problem is that the idea of explanation itself needs clarification. What exactly is an explanation? This is a deep TOK *knowledge question* but it is worth tackling – it has cropped up in essay titles since the earliest years. If science is ultimately about providing explanations then the truth of reductionism – see the info box on page 213 – seems less likely. It does not seem plausible that a good explanation in biology can be reduced to an explanation in physics. Biology is about the remarkable capacity of living systems to maintain themselves, organise themselves, and repair themselves as open systems (able to exchange energy with their surroundings) in a state far from equilibrium. Physics just tells us that such systems are likely to be disrupted in the long run. It says little about the myriad ways life finds to defend itself from disruption. So, it seems possible that physics and biology are interested in explaining different things. Think about what you understand by 'explanation' before you read the info box below.

Info box

Explanation is a contested concept – this means that people disagree about what it means. Thinkers in the mid-20th century tended to put explanation on a par with prediction. We could explain something if we could show that it behaved according to universal laws of nature and that we could make predictions about its future state. More recently, explanation has been linked with understanding. A successful explanation of something leads to an increased understanding of it. One way of fleshing this out is by saying that increased understanding guides further investigation of a phenomenon. Alternatively, we could think of understanding in terms of being able to answer 'what if' questions. A student understands Newton's laws of motion if they can answer questions like 'what happens to the ball whirling round on the string if the string is cut?'. Teachers tend to use 'what if' type questions to check understanding in class. One feature of explanation thought of in these terms is that what makes a successful explanation depends on the audience. An explanation of an electric bell for a six-year-old will be different from that for a teenager who has studied electric circuit theory. The explanations in this book make basic assumptions about the level of knowledge and reasoning capabilities of the average TOK student. Some authors, such as Alison Gopnik, think that a successful explanation is accompanied by an emotional response in the audience. A puzzle produces a 'that's strange?' feeling: questioning and uncertain. An explanation relieves the tension with an 'aha!' moment: clarity, reduction in tension, and an increase in understanding. The dependence on human understanding is thought by some to be a problem with this view of explanation. But ultimately, knowledge is a human artefact made for human use.

Purpose of the natural sciences – why do science?

Returning to the map metaphor, recall that every map is made with a particular purpose or set of purposes in mind. Geographical maps give information about the terrain that allow one to navigate from A to B. Nautical maps give information about depths, shoals, and other hazards to shipping, and lighthouses and buoys that allow mariners to navigate on the sea. Star maps make it possible for astronomers to identify objects in the night sky. Persisting with the metaphor: for what overall purpose is the map that is the natural sciences designed? What are the natural sciences for? This is not the same as what they *do*. What they *are for* is a more general question. Take a moment to think about your answer to this question.

- The natural sciences satisfy our curiosity about what there is in the world and how it works.
- The 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 answer *applied science*. The difference is related to motivation. Pure science is motivated by our desire to know more about the universe in which we live, whether or not such knowledge is useful. Applied science aims to be useful and solve practical problems. Can you think of examples of pure science that have produced useful applications? Here are some examples to get you started:

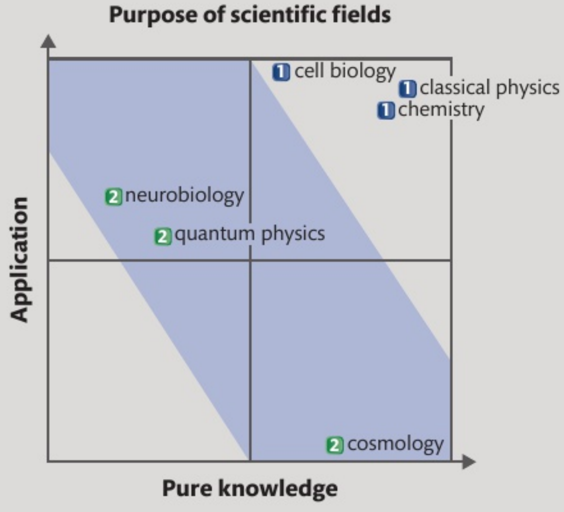
Pure science	Applied science
Optical qualities of materials in magnetic fields	LCD display screens
Mapping the Human Genome	Screening for genetic diseases
Investigating the structure of carbon molecules	Carbon fibre materials for use in aircraft

Although some science is undertaken to solve a specific problem – think of cancer research – the practical value of pure science is not obvious at the beginning of an investigation. So even if applications were the main reason for doing science, there are still good reasons for doing pure science. Can you name a current scientific project that has no obvious application?

Nevertheless, much inquiry in the natural sciences belongs to the first category. It is motivated by a set of 'open questions'; big questions as yet unanswered. One way to understand a subject in any area of knowledge is to find out the big unanswered questions towards which research is progressing. It might be worthwhile asking your science teachers what the big open questions are in their particular field.

Things to think about

- Copy the diagram below which shows the purpose of various scientific fields. Place the following fields in the natural sciences on your diagram: astronomy, genetics, geology, X-ray crystallography, medicine, nuclear physics, string theory, volcanology.



- How do you interpret the different regions on the diagram? (1 = top right, 2 = middle shaded band, 3 = bottom left)
- If you were a government minister responsible for funding research in the natural sciences, how would you decide which projects to fund? List the criteria you would use.

- Describe the three most important open questions in the natural science subject you are studying in the IB diploma programme. What makes these questions important?
- Think of a satisfying explanation you have come across in one of your science subjects. What makes it a good explanation? Are these the same features that make a good explanation in other areas of knowledge, such as the human sciences, maths, or history?
- Collect the definitions of science that appear in the first chapter of science textbooks and the definition at the front of the Subject Guide for group 4 subjects in the IB. How similar are they? If they are different what are the main differences?
- Do you accept that an artist could be explaining the world in their painting? Perhaps their vision of what the world will be like is a prediction. Do the concepts of explanation and prediction begin to lose their meaning in this case?

Knowledge questions

- Why might some people regard science as the supreme form of all knowledge?
- Should the natural sciences be regarded as a body of knowledge, a system of knowledge, or a method?
- Could there be scientific problems that are currently unknown because the technology needed to reveal them doesn't exist yet?
- Is human knowledge confined to what the natural sciences discover, or are there other important inquiries that are not covered by the natural sciences?
- What knowledge, if any, is likely to always remain beyond the capabilities of science to investigate or verify?
- Is prediction the primary purpose of scientific knowledge?
- How might developments in scientific knowledge trigger political controversies or controversies in other areas of knowledge?

Perspectives

One might think that science is a totally objective area of knowledge with no room for multiple perspectives. However, not only are there differences of viewpoints when it comes to interpreting scientific results but there also are differences regarding what science is doing and whether the objects hypothesised by science actually exist.

Interpreting scientific results

An example of the first sort of difference is the importance given to genes in evolutionary and developmental biology. Some biologists, such as Richard Dawkins in his 1976 book *The Selfish Gene*, place the gene at the centre of our understanding of living organisms. According to Dawkins, the organism is simply a vehicle for its DNA – a way of allowing it to replicate itself. The genome, the entire set of genes, is something like a giant blueprint that determines the form and structure of the organism. More recent work suggests that the picture is more complicated. Genes interact with the environment in complex ways. There are epigenetic factors; that is, factors that operate on the genome itself – such as those that switch genes on and off. Some contemporary biologists speak about gene regulatory networks (GRNs), vast complex systems involving genes and environmental factors that work dynamically together to produce and sustain the organism. The disagreement – this open question – is not so much about the details of the science, although there is still much that is unknown that could settle the question one way or another; it is more to do with different ways of interpreting biology on a large scale. The issue comes down to a basic understanding of how to think of an organism. Should it be thought of as a thing, a bit like a machine, manufactured according to instructions that we call genes? Or should it be thought of as a process extended over time, in which genes and many other factors play a dynamic role? These different points of view deserve to be called perspectives. They are not differences about facts – they are differences about what *metaphors* are best used to understand the facts, what methods should be used in further investigation, and ultimately what sort of thing it is that biologists study.

Take the group 4 subject you study in the IB diploma programme. Can you identify another issue in this subject on which scientists disagree because they hold different perspectives? Is it possible to resolve questions of perspective? Are there scientific ways of resolving the differences in perspective that you have identified?

What is science doing? Scientific realism and anti-realism

A second type of difference of perspective concerns the view that non-scientists have of what, in a general sense, scientists are actually doing. It is natural to think that the objects scientists talk about actually exist and many scientists hold adamantly that they do. Let's do a thought experiment here starting with familiar objects and drilling down. It is difficult to doubt the existence of things on a human scale: other mammals, trees, plants, rocks, and so on. Probably, you are happy about thinking that our own Sun is real and, if so, then it is not such a stretch to accept the reality of the other 100 billion that make up our galaxy. Forces are more problematic since they cannot be observed directly – we can only observe their effect on other things. Still, you might grant that they exist since they have the power to cause things to happen. But what about much smaller things? Bacteria cannot be observed directly with the human eye but nonetheless can be photographed using powerful electron microscopes; we can observe their effect on agar jelly or when, for example, they allow us to digest food – or make us ill! But how do you feel about things like protons and electrons, or the fundamental constituents of matter – quarks and gluons – that are, even in principle, unobservable. Or the Higgs boson whose presence can only be detected through the shrapnel of high-energy collisions in powerful accelerators? Are you happy that they exist in the same way as you are happy that trees and horses exist? And what about abstract things like laws of nature? Do they also exist out there in the universe? All we have to go on is observations of behaviour of things – we cannot ever observe laws of nature directly.

Indeed, there are some thinkers who argue that scientists go too far in assuming that the objects of science exist in the same way as things in the everyday world. They say that these objects are *inferred* from the data of experiments and that this inference is problematic. If scientists are careful and precise in drawing conclusions, as they should be, then they cannot conclude that things like quarks and elementary particles actually exist. Such things are only models that help scientists gain understanding and perhaps allow predictions to be made. This perspective on the objects of science is called

Info box

Inference is a word that shows how the conclusion of a scientific investigation depends on the data. Unlike mathematics, where the conclusion can be *deduced* from the starting point, the link in science is not a question of logical deduction. In mathematics the conclusion follows deductively from the axioms – this means that given the axioms *the conclusion must follow*. In the natural sciences, the experimental data support the conclusion but it is not the case that it *must* follow. There is a gap between the experimental data and the conclusion. Unlike in a mathematical proof, the conclusion could be wrong. The conclusion is *inferred* not deduced.

anti-realism because it doubts the reality of many of the things that other scientists take for granted. A particular type of anti-realism is *logical empiricism*, which takes only the results of experiments as being real. Everything else that scientists talk about (forces and particles and the rest) is just a convenient way of talking about models.

Of course, there are people who are far more trusting of science to deliver knowledge about real things in the world. They are called, unsurprisingly, *realists*. Realists understand the problem they have with inferring the existence of subatomic particles and so on from the data, but they think they have a strong argument in their favour. To understand this debate imagine the following dialogue between Roger the realist and Alice the anti-realist:

Info box

Realist

A **realist** is someone who thinks that the objects that get mentioned in scientific textbooks really exist in the world. A realist thinks that the Moon, black holes, protons, quarks, and gluons all exist even if it is not possible to observe them, even in principle. An anti-realist thinks that these ideas are useful and are instrumental in our understanding of the world but that they do not all necessarily exist. They are models of the world.

Alice: So, you see Roger, you break your own careful scientific principles when you say that things like quarks exist. All you can say is that they are a useful model for the experimental data. You could say that 'quark' is just a short way of talking about a rather complicated model.
Roger: OK Alice. But suppose you are right, the things that we realists talk about are just models and do not describe how the world really is. But tell me this. How come these models explain what is going on – how come they can often accurately predict the results of experiments, how come they can predict new phenomena? It would seem to be a miracle that some random model that is not true can get these things right. The reason that the model gets the predictions right, Alice, is that it is true! Quarks and electrons and other particles really do exist.
Alice: I get it that the 'no miracles' argument is a powerful one. But models can get predictions right even if they are not true. Look at the Chinese astronomers who thought that a solar eclipse was caused by a dragon eating the sun. They thought they had a perfect understanding of the phenomenon and they were able to predict it accurately. The history of science is littered with examples of successful false models.
Roger: But Alice, I think you are cherry-picking examples to suit your cause. There are plenty of examples where the models do turn out to bear a relationship with things in the world. Moreover, we use things like electrons to make other things happen in our experiments. For example, we can spray them in a cathode ray tube. And as Ian Hacking points out: 'if you can spray them, then they must be real.'

We shall leave the argument between Roger and Alice at this stage where there are convincing arguments on both sides. What we learn from it is that there are different perspectives on the reality of the world that science shows us. Just because something explains our observations does not mean definitively that it exists. On the other hand, if these things do not exist, we will need another explanation for the success of science rather than that it discovers what there really is in the world.

The social perspective on science

In the 20th century a new perspective emerged on the natural sciences – what we shall call the *social perspective*. It started with the work of Thomas Kuhn and continued in the 1970s and 1980s with the 'Edinburgh School' and the 'strong programme of the sociology of science'. We shall examine Kuhn's ideas first and then show how the strong programme developed from them.

Figure 1 Thomas Kuhn (1922–1996)

Thomas Kuhn (1922–1996) was an American historian of science interested in how scientific knowledge developed over time. He argued in his book *The Structure of Scientific Revolutions* (1962) that progress in the natural sciences was not smooth, but jagged – that science changed through a series of revolutions. Kuhn likened scientific revolutions to political ones and suggested that science, being a social activity, was subject to many of the same forces as human politics.

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 much like what we call a knowledge framework in TOK. It is the whole system of concepts, language, assumptions, methods, values, and interests that define scientific research. It can be thought of as the entire system of scientific knowledge expressed through scientific theory along with the underlying foundations: concepts, language, convention, assumptions, and so on. A paradigm was established through a set of typical examples of scientific practice that served as a set of templates for scientific activity.

In Kuhn's research in the history of science he noticed that paradigms rarely existed without being challenged. New observations or unexpected phenomena sometimes contradicted the predictions of theory or defied current styles of explanation. Despite the potential of awkward results or unexpected findings to disrupt the smooth operation of science, Kuhn noted that the scientific community was reluctant to let go of the paradigm – the way of thinking that informed their whole outlook towards doing science. Threatened with a challenge, they would try to patch up their current understanding rather than let go of it. For example, they could try to explain the awkward results as being somehow atypical or a special case.

However, there is a limit to the number of special cases defying the orthodox worldview before the scientific community would be forced to let go of their old picture of the world. The paradigm that had operated hitherto would be abandoned. Kuhn described this point as the start of *revolutionary (abnormal) science*. The old paradigm was broken and at this point there was nothing to replace it.

During this period Kuhn believed that rival theories, explanations, and template cases emerge; each, perhaps, with its own system of concepts and methods. To be successful these new theories must explain the new observations, but they must also explain all previous observations handled by the old paradigm. The parallel in political revolutions is the period when there is no stable government and many rival groups making 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 might 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 the circle is complete; a new period of normal science begins.

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…

Kuhn's theory suggests that progress in the natural sciences is cyclic and that the circle of revolutions never stops. The whole cycle is called a *paradigm shift*. Below is an example of this process at work in the case of continental drift.

Timeline of a paradigm shift: continental drift

Continental drift (the idea that the continents were once together and are moving apart) could be thought of as the result of a paradigm shift in geophysics. Here is an abbreviated timeline. Use resources in your school library or the internet to fill in the details.

1830 Lyell's *Principles of Geology* summarises the orthodox view. The features of the Earth, such as the masses of the continents, are fixed.

1903 Alfred Wegener first becomes interested in the congruence of the coastlines of South America and Africa. It looks as though the west coast of Africa fits nicely into the east coast of South America.

1910 Bailey Willis: 'The ocean basins are stable features of the Earth's surface.' They do not move.

1911 Wegener 'decides' that continental drift is a reality based on overwhelming geological, geophysical, palaeontological, palaeobiological, evidence.

1915 First edition of Wegener's book outlining his ideas.

1928 First conference on continental drift rejects the idea.

1950 First extensive map of ocean floors published.

1960 Harry Hess model of sea-floor spreading. A mechanism is discovered for driving continental drift.

1963 Vine-Matthews's work on magnetism of mid-ocean ridges. Shows wonderful symmetry of magnetic fields across the ridge.

1966 Eltanin-19 profile of the magnetism of the Pacific Antarctic ridge (Hiertzler, et al.). Again shows precise symmetric pattern of magnetic fields across ridge.

1966 Confirmation of magnetic reversals in deep sea cores (Opdyke). This shows that the Earth's magnetic field changes over geological timescales. These changes get 'frozen' into magma flowing out of the mid-ocean ridges. These ridges drive sea-floor spreading, which is pushing the continents apart.

Discovery of continental drift as a paradigm shift

When	Theory	Methods	Concepts
Before: 19th century	Geological features are stable and do not move.	Classical geology.	Sedimentary, metamorphic, and igneous rock. Metamorphism occurs at the bottom level of the crust.
During: 1911 – 1960s	Stabilism/ displacement hypothesis.	Comparisons of fossils and geological layers on each side of Atlantic.	Continents founded on plates.
After: 1966	Continental drift (refined form of displacement hypothesis).	Magnetometry, magnetic cores.	Sea-floor spreading, plates moving apart, mid-ocean ridges with associated volcanic activity, Earth magnetic field reversals 'frozen' into lava provides evidence of movement.

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:

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.

Despite this list of characteristics, nature does not tell us which theory to go for and the choice is a result of social interaction among the relevant group of scientists.

What makes Kuhn's perspective truly radical is buried somewhat in his understanding of a paradigm shift. When the paradigm changes (shifts) what changes is the whole way in which science is done. This means the theories make sense of scientific observations, the way experiments are done, what questions are deemed interesting and, perhaps most important of all, the concepts that are thought to be useful in describing how the world is. But if the framework of concepts changes in a paradigm shift it means that there is no way that we can compare the science before the change to the science after the change. (To make a comparison you need at least one concept to remain the same – to use as a measurement.) Kuhn called this *incommensurability*. It seems to imply that you cannot say whether the new science is an improvement on the old. All you can say is that it is different. In these terms then, it does not make sense to talk about progress in science, if progress means getting better and building on what came before. This is indeed a radical position to take.

Kuhn's perspective took science to be essentially a social activity. It involved shared understandings of how to conduct experiments or other investigations, what theories to invoke to interpret the results, what concepts to use, and what values should apply. The *Strong Programme in the Sociology of Science* took this a stage further by suggesting that if we want to know about how scientific knowledge is made, we should look carefully at the social processes underlying scientific activity. This perspective takes the view that words like 'truth' and 'objectivity' are defined relative to certain social arrangements. For example, in the 18th century, scientific truth might be generated by the men (and it was only men) who were members of the Royal Society, a British scientific body. But this would mean that truth is now something that depends on human social groups or institutions. This perspective is called *social relativism*. While it has received much criticism there are many who support it, among whom are feminist thinkers criticising science for being the knowledge that is produced by a particular privileged group of men.

Things to think about

- To what extent is it legitimate to talk of paradigm shifts in other areas of knowledge? Can you identify paradigm shifts in history or the arts?
- What is your position regarding the things that science says exists, such as electrons and quarks. Are they really there or are they just an elaborate model designed to explain the results of experiments.
- **Challenge** The questions that can be asked at a given moment in a scientific field depend on the concepts that are currently available. This means that new developments might make old questions irrelevant or meaningless because they throw out the concepts needed to state these questions. As a field progresses do you think that the number of unanswered questions increases, decreases, stays the same, or does not show any steady pattern?
- It took nearly 60 years for Wegener's ideas regarding continental drift to become accepted theory, despite much of the evidence supporting the drift hypothesis over the stabilist hypothesis (the continents being static) being available at the start. What does this tell us about the way scientific communities respond to new evidence that challenges orthodox theory?

Knowledge questions

- How can it be that scientific knowledge changes over time?
- What role do paradigm shifts play in the progression of scientific knowledge?
- How does the social context of scientific work affect the methods and findings of science?
- In what ways have influential individuals contributed to the development of the natural sciences as an area of knowledge?
- Does the precision of the language used in the natural sciences successfully eliminate all ambiguity?
- Does the list of disciplines included in, or excluded from, the natural sciences change from one era to another, or from one culture or tradition to another?
- Does competition between scientists help or hinder the production of knowledge?

Methods and tools

We have spoken in general terms about science from a number of perspectives. Now it is time to try to piece together a story about how science actually goes about producing knowledge. In this section the methods and tools of science will be analysed to try to find out whether there really is something special about scientific knowledge that distinguishes it fundamentally from other types of knowledge.

The success of science is often credited to the method that it uses. This method is thought to be so important that it merits a special title: *The* Scientific Method. Before we go further reflect on these questions:

- Is there just one scientific method?
- What it is about this method that guarantees the reliability of scientific knowledge?

Activity 2

Draw a flowchart that describes the scientific method and includes boxes for: hypothesis, analysis of experimental results, observation, design experiment, modify hypothesis, carry out experiment, question, form conclusion. How does your flowchart compare with those in the group 4 textbooks?

Rather than just one scientific method, there are many tools used to produce knowledge in the sciences. We shall deal with four of them:

- hypothetico-deductive method
- models
- mechanisms
- classification.

Hypothetico-deductive method

The first tool is something like the sort of experiments you do in your group 4 subject. A simple version will be presented here, but you might need to refine it somewhat when you apply it to more complicated cases.

Recall that the mantra for this book is that knowledge is a map that is produced to do something useful.

This is true as much in the natural sciences as in any other area of knowledge. At a basic level, scientific inquiry starts with a question. So, while it is often claimed that all science rests on observation, it does not occur in a vacuum. All scientific activity takes place within the context of a question. This question is often posed in the form of a *hypothesis*, which is a first guess at how a particular part of the world works. Often in science an *experiment* is devised to test whether the hypothesis is true. *Results* are collected and analysed carefully. Results are just data – numbers – and they need to be interpreted. The background theory to the hypothesis enables scientists to make sense of the results. The interpretation and analysis leads to a conclusion. The conclusion suggests a new hypothesis leading to a new cycle of testing.

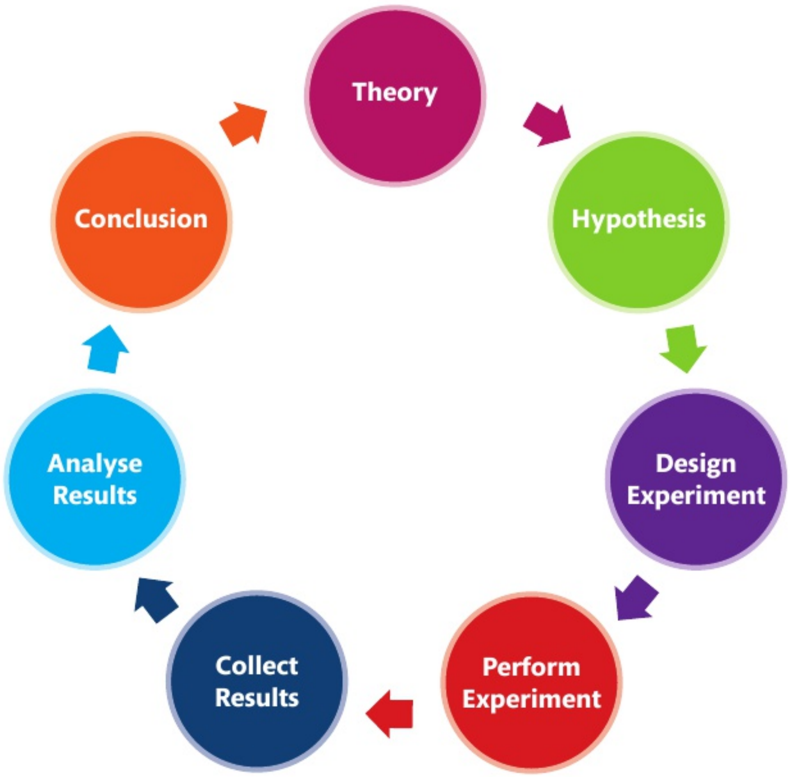


Figure 2 Model of a scientific method

The model in Figure 2 contains two feedback loops. The first is that on completion of the cycle, the hypothesis can be modified after the analysis of experimental results. The second is through peer review and replication. An experiment done by one group of people is repeated by another group elsewhere. The second group try to *replicate* the results of the first. If they cannot do so, the validity of the results is called into question. Further investigation is then needed to understand why the two groups obtained different results. Such feedback mechanisms make the natural sciences *self-correcting*.

This model might represent the sort of thing that goes on in your science lab session, but what about your theory classes? Where do they fit in? We saw that we needed theory to make sense of the results. Scientific results are often said to be *theory laden*. This means that we cannot just read off the way the world is from the results that we get from experiments; we must interpret the results as being related to the theory we are testing and need to use special theoretical vocabulary (and concepts) to do so. Imagine that we are doing an experiment to measure the acceleration due to gravity (g) by dropping a stone from the top of the science building and timing its descent. The experimental results are just numbers: the time taken for the stone to hit the ground

Info box

Peer review is the process that scientific work goes through in order to be taken seriously by the community. Other scientists review the results in the form of a scientific paper. These others are usually experts in the field. If they accept the work then it is published in a scientific journal.

There is often a second review stage once the paper is published. Other researchers try to replicate the results of the experiment to confirm it. In the natural sciences if a result cannot be replicated, it is considered to be doubtful. Other (non-scientific) areas of knowledge share the first stage of peer review but not the second.

over a number of trials. Using the concept of acceleration, we do some mathematics. We know that distance travelled is $\frac{1}{2}gt^2$ where g is the acceleration due to gravity and t is the time in seconds. Given that we know the height of the science building then we know the distance travelled. Rearranging the formula, we get that $g = \frac{2(\text{height of building})}{t^2}$. This can be calculated for each trial and the average taken to find g. But our method only makes sense if the background theory is true. If gravity is not something that produces a uniform acceleration in falling bodies then our experimental method will not work. Put it another way: we can only measure someone's weight if we have the concept of a force (because weight is a force). The concept of a force comes from theory (in this case Newtonian mechanics). Without this theory there is no concept of weight. It is not just out there in the world.

Theory also supplies the hypothesis in the first place. The aim of the experiment above is to find *the* acceleration due to gravity. In other words, every time we drop a stone from the top of the science block we expect the answer to the calculation for g to be the same. If the results vary wildly, we will need to revise our theory. If they vary a little, we can assume experimental error is responsible. The hypothesis that is tested by the experiment is *deduced* from the theory. Hence, we call this method the *hypothetico-deductive method*: it relies on a hypothesis that is deduced from the theory.

One conclusion we might draw from the circular flow diagram is that the results of the natural sciences are always provisional. They are always open to modification in the future. Go back to 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 us to the Moon after all.

Things to think about

- Write down a hypothesis you have tested during a lab class in your group 4 subject. Explain the different stages of the lab that correspond to the method above.
- Did you follow the method strictly?
- Are there possibilities for error in the method? Where are they?
- What is it about the method that makes it reliable?
- Reflect on what you could have done to improve your experiment to make it more reliable.
- 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?

Models in the natural sciences

Models certainly play a central role in the natural sciences, as well as being important in many other areas of knowledge. Let us start again with knowledge as a map. We discussed how a map is a simplified representation of the territory in 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 represents, it can be used to solve practical problems.

A model is like a map except for an important difference. Usually when we talk about a map, we assume that there is some territory out there that is being mapped, since maps are representations of things that exist. Scientific models, however, are strange in that they might not map anything. Consider the model in Figure 3 that you probably met in Year 9 chemistry. It represents the sodium atom. The large red dots are electrons. This model is used to show how elements acquire their chemical properties; how they react with other elements. The key is whether the electron shells are full or not. As you probably know, from this information you can build up the Periodic Table. It is a really useful model.

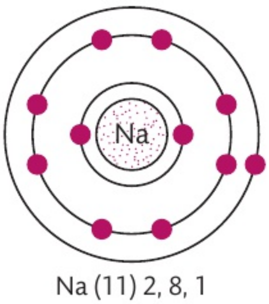


Figure 3 A model of the sodium atom

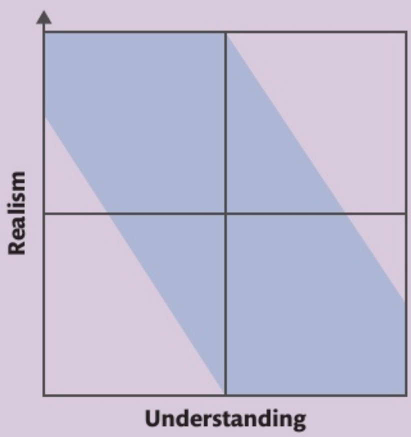
The problem is, the model is utterly false! If you do IB chemistry you realise that it is not true that electrons circle a central nucleus, like planets in the solar system. Electrons are smeared-out probability waves and their exact position cannot be known; they certainly don't orbit the nucleus. How can a completely false model explain the chemical properties of the elements? In fact, how can a completely false model tell us anything about the world at all? As we saw from the section on perspectives, a scientific *realist* like Roger has to do a lot of work to explain how false models can help us in our quest for scientific knowledge. One answer he could give is to claim that, while the model is false, it still corresponds *in some way* with reality for it to give us information about the world. We talk more about the special issues that crop up with models in Chapter 4.3 **Human sciences**.

Activity 3

Models in the natural sciences

1. Use the QR code to go to the website and watch the computer simulation of two galaxies colliding.
2. Why do you think astronomers have to use computer simulations when investigating phenomena such as the collision of two galaxies?
3. Is there a difference between a simulation and a model?
4. What are the strengths and weaknesses of simulations like this?
5. 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?
6. Place each of your models on the realism–understanding diagram below.

Function of scientific models



7. Does it matter that simplifying assumptions makes a model inaccurate?
8. What other functions might a model have apart from accuracy or predictive power?
9. Can an inaccurate model still give us knowledge?

Knowledge questions

- How can we know what to measure (what factors are relevant) before we know the solution to the problem?
- How do we know which model is appropriate?
- How do we know what assumptions to make in constructing the model?
- If different models give different solutions to the problem, how can we decide which one is best?
- How do we know how we should we manipulate the model to get an answer?
- How should we interpret the model answer back in the real world? (Often this means interpreting a number.)

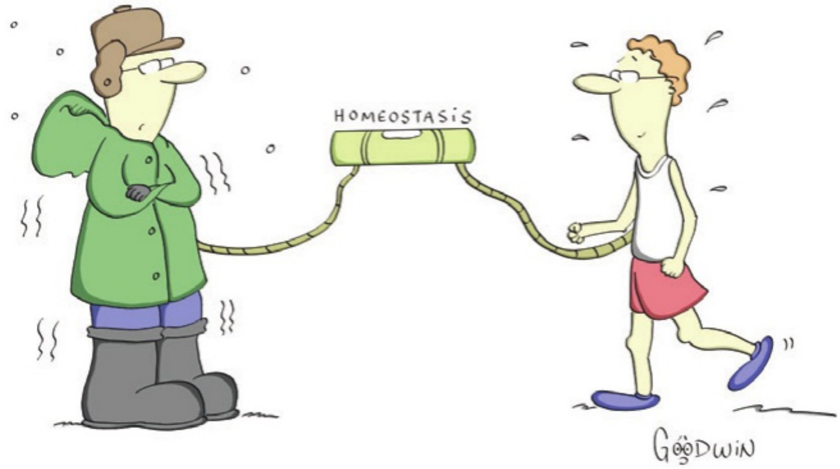
Mechanisms

The quest for mechanisms is something that has been associated with science since the early 17th century – the century of clocks, orreries, and other mechanical devices. These became the metaphors through which scientists like Newton, Galileo, and Hooke understood the universe. There has been something of a renaissance in mechanistic thinking in philosophy of science in recent times.

Figure 4 Joseph Wright of Derby's fine depiction of a philosopher lecturing on the orrery (1765) shows the mechanical nature of the heavens mirrored in the mechanical genius of the human race. Orreries were common by the mid-18th century when this was painted.

We have observed that, unlike in physics and chemistry, laws of nature do not play a central role in biological reasoning. Instead, the biologist tries to understand something going on in an organism by looking for a mechanism that accounts for this phenomenon. A mechanism is a set of component parts that interact with each other to produce the phenomenon observed. For example, what mechanism is responsible for a mammal being able to maintain its body temperature at a constant level?

There are a number of components: cellular metabolism, circulatory adaptation, sweat glands, hair muscles, shivering, and so on, that interact to maintain the temperature. These components work together to produce a mechanism that helps regulate temperature.



Some take the extreme view that a phenomenon is understood only when the mechanism for it is identified. This seems too strong. Certain aspects of human psychology, such as working memory, are understood through a lot of empirical studies backed up by theoretical models. Using these resources, accurate predictions can be made for things like reaction time experiments. However, the neural mechanisms responsible for working memory have not been identified. Does this mean that we do not have an adequate explanation of how memory functions?

Nonetheless, finding a mechanism is part of the explanation in many cases. Mechanisms are what can be added to *correlation* to infer *causation*. We do not understand how the carburettor of an engine works unless we can describe the mechanism by which it mixes fuel with air to be injected into the combustion chamber. It does seem fair to say that the question of continental drift was only settled when a mechanism was discovered that could shift the continents, and that the ancient Chinese did not really understand eclipses because they did not identify the correct mechanism for them.

Classifying and taxonomy

Classification systems are used extensively in nearly all of the natural sciences. Since they are concerned with 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 to us that were previously unnoticed.

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 are grouped together according to important common features. You might want to think about what features a taxonomy (system of classification) must have if it is to add to our knowledge – surely not every system will be equally useful.

Info box

Correlation and causation

Popular newspapers often scare the public with headlines such as 'Drinking coffee will give 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 **correlation** is not the same as **causation** and conclusions like this one should be approached with caution.

In an investigation, the first stage might be to note regularities in the world. For example, pea plants near the window are taller than those on the other side of the room. The second stage might be to find a mechanism that links one variable to the other. Photosynthesis is a mechanism in the leaf of the plant that takes light, carbon dioxide, and water to produce the output of glucose and oxygen. Some scientists argue that only when the second stage is successfully completed can claims about causation be made with confidence. Hence, an investigation that completes both stages can be said to have demonstrated causation while one that completes only the first stage has demonstrated correlation.

In biology an important level of classification is the species. Carl von Linné, also known as Linnaeus, defined species by morphology; that is, similarities in organisms' physical form. However, there are other ways of deciding questions of species membership including developmental and genetic factors. What a species is, is still a deep open question in biology.

Nevertheless, the hope is that the classification system will have explanatory power. This means that statements such as the following can be made: 'This thing does X because it is a Y.' 'This organism does not lay eggs because it is a mammal.' (Is this true?)

Carl von Linné (1707–1778): Classification as knowledge?

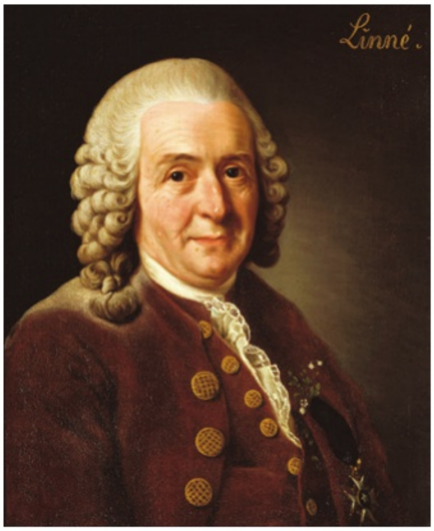


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Figure 5 Carl von Linné, painted by Alexander Roslin, 1775. This oil painting is in the portrait collection at Gripsholm Castle.

▲

Figure 6 The perennial lupin (*Lupinus perennis*)

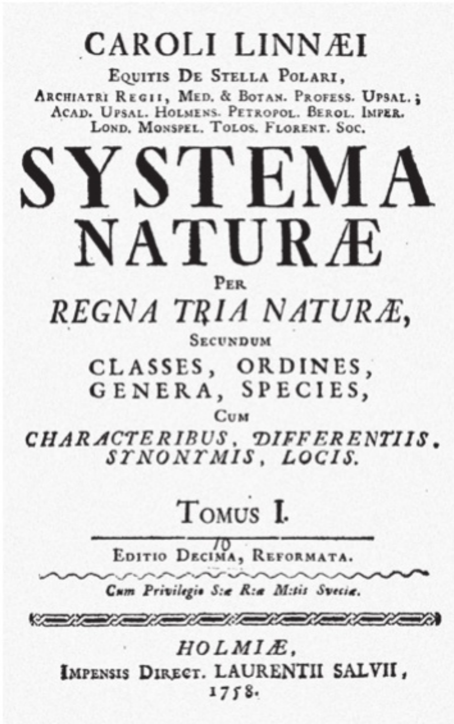
Carl von Linné was a Swedish botanist who introduced the system of binomial (two-part) names for plants in his *Species Plantarum* of 1753. The idea is that the name of each plant has two parts: a genus followed by a species name. For example, the wild perennial lupin pictured in Figure 6 has the name *Lupinus perennis*. This system of naming is designed to aid the *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 such as English there were many different names for the same species, sometimes depending on local custom or tradition. The rigorous standardisation of names made it possible for local botanical knowledge to 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. A genus of plant species also belongs to a tribe and a family. These in turn belong to an order, which belongs to a kingdom. Our lupin species above 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 what plants belong to a particular species. The second is what 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?

Linné tried to solve a more basic problem in his work: how do we define a plant? Although this might sound straightforward, biologists tell us that the sheer variety of lifeforms sharing some characteristics with plants makes such a definition problematic. This is a typical taxonomic problem in biology.



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 Sveciæ.

HOLMIÆ,
IMPENSIS DIRECT. LAURENTII SALVII,
1758.

Figure 7 The front page of Linné's *Systema Natura* of 1758

Figure 8 Drawings of shapes of leaves from Linné's *Hortus Cliffortianus* of 1737

Sir Karl Popper and *falsificationism*

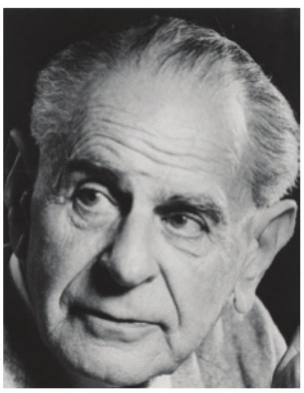


Figure 9 Sir Karl Popper

Sir Karl Popper (1902–1994) 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.

Popper's *Logic of Scientific Discovery* (German 1934, English 1954) was hailed by the scientist Sir Peter Medawar as 'one of the most important documents of the 20th century'. In it, he suggests an answer to the problem of induction – that there will always be a leap of faith required to go from a set of individual observations to a generalisation like 'all swans are white'. He argued that the existence of this gap means that establishing generalisations cannot be the aim of scientific inquiry. He argued that such universal generalisations can be shown to be false by finding a single *counterexample*, such as a black swan. Therefore, Popper said that the energies of science should be devoted to disproving universal statements rather than proving them. For Popper, science consisted of statements that haven't yet been disproved. This idea, known as *falsificationism*, has influenced how working scientists approach their investigations. The scientist should aim to disprove his pet theory rather than prove it. If he is unsuccessful in this task, the theory is in good health; at least for the time being.

Popper was impressed by the fact that Einstein's theory of relativity was put to a severe test in the 1919 solar eclipse when it made the novel prediction 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 was 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 less reliable) as a result.

Info box

Theory

The word **theory** comes from the Greek word for 'theatre', meaning a space from which you view the world. It is usually taken to mean a system of interdependent, well-established, scientific results using a particular set of concepts and couched in specialised language. Scientific knowledge is theoretical in this sense. The theory of molecular chemistry tells us that water is H_2O for example; it is a well-established, reliable piece of knowledge about the nature of a substance commonly occurring on our planet. While highly unlikely, this chapter tells us that scientific knowledge such as the composition of water is not immune from being revised at some point in the future.

Unfortunately, there is another use of the word. *Theory* is sometimes taken to mean something for which there is little or no evidence. 'That idea is purely theoretical – 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 substantially verified body of knowledge. Unfortunately, some of its detractors latch on to the word *theory* and claim 'but it's only a theory'.

Things to think about

- Pseudoscience is described as alleged knowledge that may look like science but does not use the methods of science. Examples are astrology, telepathy, tarot card reading, and other forms of fortune-telling and homeopathic medicine. Find out what you can about the theory behind astrology or homeopathic medicine. What evidence is there to support the claims made in each? Why could these be described as pseudoscience rather than genuine knowledge?

Assumptions underlying the tools of science – laws of nature

One view that has been prevalent in science since its modern beginnings in the early 17th century is that nature has laws and it is the job of science to discover them. This view fits naturally with the hypothetico-deductive method. Here the role of the law of nature was the source of a testable hypothesis forming the basis for an experiment. There is a further assumption that is 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. Both Newton and Einstein were impressed by the apparent simplicity of the laws of nature when expressed in mathematical form.

For laws of nature to play a role in scientific explanation they must be constant from one day to the next. With roots in ancient Greek ideas, laws of nature are supposed to be deep and immutable features of the universe underlying its rapidly changing surface. Explanation can have no unity if its underlying principles change continually. That there are laws of nature that do not change over time and are expressible in mathematical language, are assumptions that underwrite many predictions in science and are a central part of much explanation.

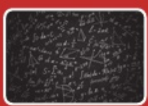
Similarly, it is assumed that there is nothing special about the Earth's position in the universe – it is a small planet orbiting a fairly ordinary yellow star in, as Douglas Adams might have put it, 'a rather unfashionable part' of a typical galaxy. This assumption is necessary for us to be able to extrapolate the conclusions we reach about nature as we see it from our local perspective on Earth to the universe as a whole.

It is difficult to see how there can be any evidence for either the assumption of the existence of laws of nature or their continuity and universality. They are the starting point for doing science rather than its conclusion – any analysis of evidence presupposes them. Think back to the experiment determining the acceleration due to gravity by dropping a stone from the roof of the science building. The experiment assumes that there *is* an acceleration due to gravity and it does not change every time the stone is dropped. This experiment also takes the universality of Newton's law of gravitational attraction seriously. It does not just apply to stars and galaxies, but also to stones and the Earth. Without these assumptions, the experiment would not make sense.

Talk to a scientist (perhaps your science teachers) and they may tell you that they believe there are laws of nature. But scratch a little below the surface and some tricky problems begin to emerge. The first problem is, as we have mentioned before, laws of nature seem more suited to the methods of physics and chemistry, whereas in biology they do not play a central role. But even in physics and chemistry the idea of universal laws without exceptions begins to look a little thin. Newton's law that two bodies attract each other with a force proportional to the product of their masses and inversely proportional to the distance between them only works if everything else is kept constant; if gravity is the only force that is relevant. As soon as we take other forces into account, say electromagnetism, it is no longer true. Physics works well when dealing with a particular aspect of the world in isolation, but it works less well when having to combine different aspects.

The following example might help to illustrate this idea. Water boils at 100 degrees celsius at sea level. If we take the pan of water to the top of Mount Everest the boiling point is 71 degrees celsius. Let us call the relationship between air pressure and the boiling point of water a 'law'. Also, if we take an ordinary pan of water at sea level and add around 120 g of salt, we raise the boiling point to 101 degrees celsius. Again there is a well-established relationship between the salinity of the water and the boiling point which is law-like. Now, what happens when we add salt and go to the top of Everest? The answer is we don't really know. Why can't we assume that we can just combine the laws: that it reduces by 29 degrees and raises by 1 degree – so that it boils at 72 degrees? Well, the problem is that the factors might not be independent. They might combine in interesting and unexpected ways. We would need a new law for combining salt and air pressure. Far from being universal these laws only apply to particular special situations: they are called *ceteris paribus* laws, meaning 'everything else being equal'. They only work if *all other factors remain constant*. When they are combined it is not clear what will happen. But the problem here is that in the world outside the laboratory all other factors do not remain constant. The universe does not conveniently set up *ceteris paribus* conditions for us. Factors have a nasty habit of changing at the same time.

A deeper problem is that if we accept, for the sake of the argument, that laws of nature exist, it is not entirely clear what sort of existence they have. Are laws of nature created at the same time as the rest of the universe? Do they exist unchanged for all time? Do they exist even if there is nothing else in the universe? Why are they there? The idea of laws of nature seems to lose some of its strong scientific character when faced with these questions. More plausible is that laws of nature are just practical rules made by human beings to make the universe easier to understand. Many scientists would, nonetheless, be unhappy with this conclusion and cling on to laws of nature despite the problems. This in itself is interesting – the possibility that the belief in the laws of nature might act as an important psychological prop to the individuals involved in scientific work, rather than being something that comes out as the result of their endeavours.



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

Figure 10 Assumptions made about laws of nature that are needed to support experiment in the physical sciences

Things to think about

- What is the point of trying to replicate scientific results?
- If two groups of students were engaged in similar scientific experiments but in different schools in different countries, why might the second group fail to replicate the results of the first?
- **Challenge** Was Popper right that a universal generalisation is refuted by a single counterexample? Investigate the Duhem-Quine Thesis in your school library or on the internet.
- **Challenge** Is it true that the more positive results there are supporting a hypothesis the more likely the hypothesis is to be true? Investigate Hempel's raven paradox in your school library or on the internet.
- Classification exercise. Collect together 20 objects at random. Create five categories into which the objects have to be sorted. All objects should belong to a category at the end of the exercise. You are not allowed to label a category 'miscellaneous'. What problems did you encounter in your classification? Does your classification system explain anything?

Knowledge questions

- Is there a single 'scientific method'?
- What is the role of imagination and intuition in the creation of hypotheses in the natural sciences?
- What kinds of explanations do natural scientists offer?
- Why are many of the laws in the natural sciences stated using the language of mathematics?
- What is the role of inductive and deductive reasoning in scientific inquiry, prediction, and explanation?
- Does scientific language have a primarily descriptive, explanatory, or interpretative function?
- Do the natural sciences rely on any assumptions that are themselves unprovable by science?

Ethics

What are the responsibilities of those producing scientific knowledge? In what ways are they answerable for their actions as scientists? There are five main clusters:

- responsibility for the types of question investigated
- responsibility for the methods of investigation
- responsibility for the use that is made of the knowledge produced
- responsibility for the quality of knowledge that is produced
- responsibility for taking the contributions of others seriously in producing scientific knowledge.

Responsibility can be understood as putting yourself in a position where you are answerable to someone for your actions. If you are responsible in some way, then you can be held accountable for the relevant actions: this means that your conduct can be evaluated; you can be praised or blamed for it. Carrying a responsibility means that you think carefully about your actions. It might mean that you decide against certain actions and in favour of others. Interesting questions in ethics concern the conditions under which you carry responsibility for a given action.

Responsibility for questions asked

Asking a question counts as an action. There are consequences to asking questions. This is clear in public life or in a situation such as a scientific investigation where it could lead to further actions. Assuming responsibility regarding asking questions might involve thinking about the sort of questions that should or should not be asked, and trying to understand a principled reason for distinguishing between them. Can you think of a question that should not be asked? What are your reasons for thinking that it is ethically wrong to ask this question?

National Institute for Race Biology

Sweden became the first country in the world to establish a National Institute for Race Biology in 1922. All the major political parties had supported the creation of such an organisation, and Herman Lundborg was soon appointed as head. The institute collected huge amounts of statistics and photographs which it used to calculate the racial composition of around 100,000 Swedes. When the first round of analysis was completed in 1926 it provided the basis for Lunborg's textbook 'Swedish racial studies', created for secondary schools. However, over time the popularity of this prominent figure in Swedish race biology diminished. Lunborg's visions of Nordic supremacy along with his growing anti-Semitism became increasingly indefensible as events unfolded in Germany. Gunnar Dahlberg became the Institute's new head in 1936. Lundborg died in 1943. As the years progressed the institute moved towards the emerging field of genetics and away from racial profiling. It merged into Uppsala University in the 1950s and eventually became what is now the university's genetics centre.

Why might asking questions about racial biology be unethical?

What responsibilities do we have regarding knowledge gathered under past programmes such as this one?

Responsibility for methods used

Activity 4

Responsibility for the methods of investigation is probably the first thing you thought about when considering the ethical dimensions of the natural sciences. IB students must abide by the ethical code of practice. There is a document called 'Guidelines for the use of animals in IB world schools' that regulates the use of animals, including other people, in all aspects of the IB programmes. Use the QR code to read through this document.

What reasons are there for the recommendation that the use of animals in experiments should be severely limited? Are there situations in science or medicine when it is justified to use animals in experiments? Are there situations where it is ethically required to use animals in experiments? On what grounds can you decide whether the use of animals in experiments is prohibited, allowed, or required?

Responsibility for how knowledge is used

The knowledge produced by the natural sciences is often applied to solving problems in the world. What might start off as pure knowledge is used to produce technology that, hopefully, makes our lives easier. What responsibility do scientists bear for the use to which their knowledge is put? You might want to think about this question before you read on.

One of the problems scientists face in taking on this responsibility is that they cannot really predict what use will be made of their work. It can take years or even decades before pure scientific knowledge is put to practical use outside the laboratory. It can be notoriously difficult to imagine possible applications of an idea on the basis of its pure form. Did Thomas H Maiman, the inventor of the laser, in his lab in Malibu California in 1960, imagine for one moment that his invention would be used for playing music (in a CD player), welding metal, surveying, communications technology, in surgery, measuring speed, identifying fingerprints, in art, marking military targets, missile navigation systems, destroying satellites, and military weaponry? Could he be held responsible for these applications? Surely 'ought' implies 'can'? What if Maiman could not influence the development of these applications even if he could imagine that, one day, they would happen?

Clearly in some situations the applications are a little easier to predict. Scientists working in military research establishments have a good idea about the use to which their work will be put. Then they must examine the ethical implications of their decisions carefully. This is not easy. It is a sad fact of the modern world that the greatest proportion of science spending is associated with military projects. Young scientists choosing not to go down this route are making a huge sacrifice. Other scientists might face the choice of whether to work for big pharmaceutical companies (another large employment sector for scientists). Here the use of the science is surely for noble ends. The problem, of course, is that not everyone has access to these medical products. Moreover, since pharmaceutical companies are in the business of making profits, they often do not spend money on research for rare diseases. Here there may either be only a small number of patients, or diseases may affect people who cannot pay for the medicine. Scientists, like others, must weigh up these difficult ethical questions carefully.

Responsibility for the quality of knowledge produced

The fourth cluster of responsibilities concerns the knowledge produced by science. Scientists, like other producers of knowledge, have a responsibility for its accuracy and reliability. Unlike other producers of knowledge though, there might be much at stake if they get things wrong. The case of thalidomide shows what happens if shortcuts are taken with the self-correcting checks and balances of clinical trials. Thalidomide was a mild drug produced in the 1950s to treat people with a sleeping disorder and was sold over the counter without prescription in certain European countries. It was marked safe to take during pregnancy even though there had been no animal tests to check this. As a result of mothers using the drug, there were more than 10,000 cases of babies being born with missing or deformed limbs. The Science Museum, London, describes thalidomide as one of the darkest episodes in pharmaceutical research history.

Can you think of other cases where science has gone wrong, either through financial or political pressures to shorten or bypass safety procedures? Where does the responsibility lie in cases like this?

Responsibility for taking seriously the contributions of others

Finally scientists, like other knowers, bear a responsibility for taking the knowledge of others seriously and attributing their contributions accordingly. In this connection there are striking cases where a co-worker was removed from the historical record because she was a woman. Until recently, astronomy books attributed the discovery of pulsars in 1967 to Anthony Hewish, despite the fact that it was his research assistant

Jocelyn Bell who trawled through miles of radio telescope traces to discover curious regular signals coming from a distant part of the sky. Some biology books still attribute the discovery of the structure of DNA to James Watson and Francis Crick. They do not mention the work in X-ray crystallography done by Rosalind Franklin that provided the experimental data from which Watson and Crick derived their model. This example is sometimes taken to mean that Watson and Crick themselves did not acknowledge the contribution made by Franklin or that they stole her data, which seems not to be the case. The culprits in this case are the textbook writers who establish exemplars for the next generation of scientists. Use the QR code for more information on this.

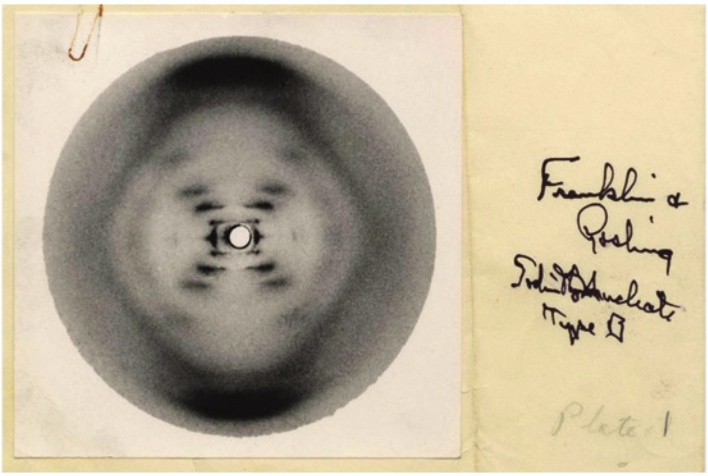


Figure 11 Rosalind Franklin's X-ray diffraction pattern 'image 51' gave Watson and Crick the idea for the double-helix structure of DNA.

Figure 12 shows the astronomer Henry Pickering at Harvard Observatory with the group of women who helped him catalogue thousands of stars according to their spectral type. One woman, Annie Jump Cannon, is credited with inventing the system of spectral classification of stars that is still used today. Sadly, there is little mention of the contribution of these women in many astronomy textbooks.

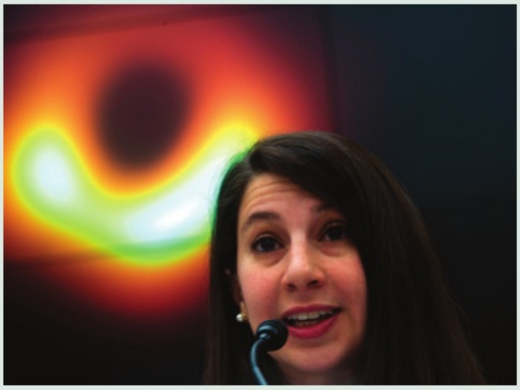
Figure 12 Henry Pickering and the women who first catalogued stars according to their spectral type

Activity 5

Read the article below about more recent achievements of women in science. Katie Bouman received hate-mail after the publicity around her part in the production of the first ever telescopic picture of a black hole. You might want to reflect on the obstacles women face in becoming successful scientists. Some of these obstacles might apply in other areas, such as the human sciences.

Women in science

Katie Bouman: the 29-year-old whose work led to the first black hole photo



Katie Bouman is a post-doctoral fellow at MIT whose algorithm led to an image of a supermassive black hole.

This week, the world laid eyes on an image that previously it was thought was unseeable.

The first visualisation of a black hole looks set to revolutionise our understanding of one of the great mysteries of the universe. And the woman whose crucial algorithm helped make it possible is just 29 years old. Dr Katie Bouman was a PhD student in computer science and artificial intelligence at the Massachusetts Institute of Technology (MIT) when, three years ago, she led the creation of an algorithm that would eventually lead to an image of a supermassive black hole at the heart of the Messier 87 galaxy, some 55 m light years from Earth, being captured for the first time.

Bouman was among a team of 200 researchers who contributed to the breakthrough, but on Wednesday, a picture of her triumphantly beaming as the image of the black hole materialised on her computer screen went viral, with many determined that Bouman's indispensable role was not written out of history – as is so often the case with women scientists.

The data used to piece together the image was captured by the Event Horizon telescope (EHT), a network of eight radio telescopes spanning locations from Antarctica to Spain and Chile. Bouman's role, when she joined the team working on the project six years ago as a 23-year-old junior researcher, was to help build an algorithm which could construct the masses of astronomical data collected by the telescope into a single coherent image.

Though her background was in computer science and electrical engineering, not astrophysics, Bouman and her team worked for three years building the imaging code. Once the algorithm had been built, Bouman worked with dozens of EHT researchers for a further two years developing and testing how the imaging of the black hole could be designed. But it wasn't until June last year [2018], when all the telescope data finally arrived, that Bouman and a small team of fellow researchers sat down in a small room at Harvard and put their algorithm properly to the test.

With just the press of a button, a fuzzy orange ring appeared on Bouman's computer screen, the world's first image of a supermassive black hole, and astronomical history was made. In a post on social media, Bouman emphasised the collaborative efforts that had made the imaging of the black hole possible.

'No one algorithm or person made this image, it required the amazing talent of a team of scientists from around the globe and years of hard work to develop the instrument, data processing, imaging methods, and analysis techniques that were necessary to pull off this seemingly impossible feat,' said Bouman. While their discovery was made in June, it was only presented to the world by all 200 researchers on Wednesday.

Bouman, who is currently a post-doctoral fellow at MIT, is due to take up a post as an assistant professor at the California Institute of Technology, but intends to keep working with EHT.

Speaking in a 2016 TED talk, Bouman said: 'I'd like to encourage all of you to go out and help push the boundaries of science, even if it may at first seem as mysterious to you as a black hole.'

(Hannah Ellis-Petersen, The Guardian 11 April 2019. www.theguardian.com/science/2019/apr/11/katie-bouman-black-hole-photo; accessed 16 November 2019)

Things to think about

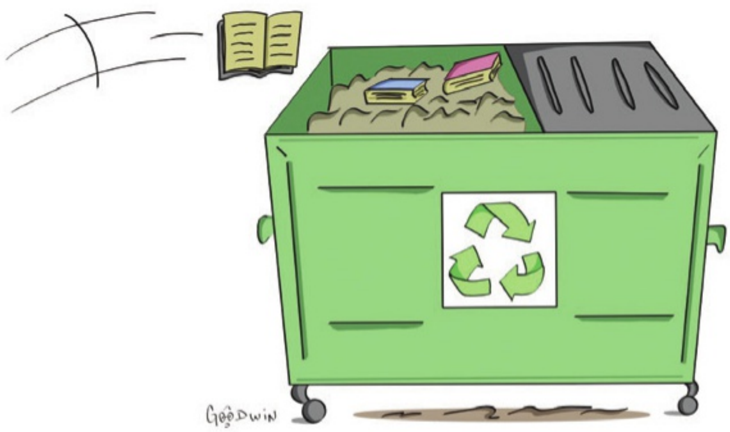
- Write a question that you feel would be unethical to ask in the context of a scientific investigation. Is it the question itself, the nature of the investigation, or the consequences of the conclusions that make it unethical?
- Is the production of pure knowledge ever an adequate justification for an investigation that involves harm?
- What is your position on the use of animals in testing medicines for treating disease? Is your position different regarding their use in the testing of beauty products?
- Do we all bear a responsibility for the quality of the knowledge we produce, whether or not we share it with someone else?
- In your opinion, why did Katie Bouman receive hate mail after the photograph of her with the picture of the black hole went viral? What does this tell us about the nature of the general public regarding scientific work?
- Is it right that all high school students should take at least one science subject? If so, why? If not, why not?
- Is it ethically acceptable to use animals in the following situations: (a) science classes for primary school children, (b) science classes for upper secondary students, (c) biology classes for university students, (d) classes for doctors and surgeons? Explain your reasoning.

Knowledge questions

- Is science, or should it be, value-free?
- Should scientific research be subject to ethical constraints or is the pursuit of all scientific knowledge intrinsically worthwhile?
- Do we tend to exaggerate the objectivity of scientific facts and the subjectivity of moral values?
- In what ways have developments in science challenged long-held ethical values?
- Can moral disagreements be resolved with reference to empirical evidence?
- Do human rights exist in the same way that the laws of gravity exist?
- Do scientists or the societies in which scientists operate exert a greater influence on what is ethically acceptable in this area of knowledge?

Conclusion

In the introduction we talked about the natural sciences sometimes being taken as the template for all knowledge. We suggested that it has a rigorous method common to all its branches that rendered its results inviolable. Yet take a look at the history of science and you see a different picture. The author of this chapter has a science textbook belonging to his grandfather dating from the beginning of the 20th century. Little of the theory claimed as certain truth in its pages still survives. Even the parts that we could accept as not entirely wrong need to be modified considerably. It is a surely a reckless individual who is prepared to suggest that our current science is any different. Will not our grandchildren look back, in turn, on our science textbooks and be amazed at how we got things so wrong?



Most science of the past
has ended up on the scrap heap.

Science does not have a golden method that puts it beyond the reach of other disciplines in terms of its exemplary knowledge making. Rather, it is a diverse set of disciplines with no common method guaranteed to produce truth. Instead of a single scientific method, we find a rag-bag of tools and methods: hypothetico-deductive method, modelling, classification, and the search for mechanisms. Together these serve a pragmatic purpose in making a knowledge that, if not exactly unchallenged in perpetuity, will hold good for a few years until the next useful idea comes along.

Looking at science from a distance as if we were aliens viewing earthly scientific activity with a disinterested curiosity, there are a variety of perspectives that we could take. Science could be thought of as the search for the laws of nature, or the search for the mechanisms responsible for the phenomena observed, or as the latest paradigm in the constantly changing history of knowledge to be overthrown in the next Kuhnian revolution.

Such a pragmatic plurality of tools, methods, and perspectives, and such a tendency to get things wrong is not a weakness but a strength. It is not being inviolable or the producer of eternal truths but being open to criticism and correction that makes science the shining example of knowledge that it is.

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4.3 Human sciences

Introduction

Figure 1 shows a picture of the French economist Esther Duflo, one of the winners of the Nobel Memorial Prize in Economics in 2019 for her work on an experimental approach to alleviating global poverty. At school her passion was history and during her second year at the École Normale Supérieure in Paris she went to Moscow in order to research her thesis on the use of large industrial sites for propaganda purposes. There she worked as an assistant to the economist Jeffrey Sachs and became convinced that 'economics had potential as a lever of action in the world' and that she could satisfy her intellectual curiosity at the same time as doing something that made a real difference. After her degrees at the École Normale Supérieure and the Paris School of Economics she completed a PhD at MIT for a project focusing on a *natural experiment* involving an Indonesian school expansion programme in the 1970s. Much of her work centres on the use of *randomised control trials* in designing experiments in economics. After receiving the prize, she stated simply, 'Our goal is to make sure that the fight against poverty is based on scientific evidence.'

Figure 1 Human science at its best: Esther Duflo won the Nobel Prize for Economics in 2019 for her work on global poverty.

An MIT web page about a book on her work with Abhijit Vinayak Banerjee, *Poor Economics,* states:

> Through a careful analysis of a very rich body of evidence, including the hundreds of randomized control trials that Banerjee and Duflo's lab has pioneered, they show why the poor, despite having the same desires and abilities as anyone else, end up with entirely different lives. Through their work, Banerjee and Duflo look at some of the most surprising facets of poverty: why the poor need to borrow in order to save, why they miss out on free life-saving immunizations but pay for drugs that they do not need, why they start many businesses but do not grow any of them, and many other puzzling facts about living with less than 99 cents per day. *Poor Economics* argues that so much of anti-poverty policy has failed over the years because of an inadequate understanding of poverty.
>
> (https://economics.mit.edu/faculty/eduflo/pooreconomics)

Duflo's story is not only one of a woman overcoming the odds to excel in an area dominated by men; it illustrates how fields like economics have a role to play in improving the lives of the millions of people caught in the poverty trap. It also underlines the crucial role knowledge in the human sciences can play as a prerequisite for action to change the world for the better. From a TOK standpoint, Duflo's work raises questions to do with whether experimentation is part of economics, and whether economics and the other disciplines that make up the human sciences are concerned with *scientific* evidence? What is your initial response to these questions?

This chapter will explore what is distinctive about disciplines like economics – that is, those that perhaps have pretensions to be a natural science but might have to settle for something short of scientific rigour because their subject matter is difficult, awkward, wilful, and not always predictable: the human being.

Scope

Disciplines in the human sciences

The disciplines that make up the area of knowledge called the human sciences were staked out, beginning in the 18th century, with economics leading the way followed shortly by sociology, psychology, anthropology, and political science. Some are seen as well established – economics, perhaps – demanding a respect for their use of mathematical modelling and empirical data gathering.

There are now newer human sciences appearing, reflecting a growing awareness of complexity of human life and sociality. For instance, we find gender studies, cultural studies, Asian studies, post-colonial studies, and so on wanting the same respect. 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 look 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 those questions it is good to remember that the human sciences (or the social sciences as they are often called outside the IB) are diverse. What is it that unites them? While they differ in the details of their subject matter, they are all focused on some aspect of the human being alone or set against the background of society. Moreover, it is their interest in the human being that ties these varied disciplines together; not as an example of a biological organism or of a physical or biochemical phenomenon, but as a human being with beliefs and desires, dreams and feelings, and plans and ideas about how life should be lived.

What are aims of the human sciences? Here are the aims of the IB psychology course from the Subject Guide (emphasis added).

The aims of the psychology course at SL and at HL are to:

1. develop an understanding of the biological, cognitive and sociocultural factors affecting mental processes and behaviour
2. apply an understanding of the biological, cognitive and sociocultural factors affecting mental processes and behaviour to at least one applied area of study
3. understand diverse methods of inquiry
4. understand the importance of ethical practice in psychological research in general and observe ethical practice in their own inquiries
5. ensure that ethical practices are upheld in all psychological inquiry and discussion
6. develop an awareness of how psychological research can be **applied to address real-world problems and promote positive change**.

In psychology at least, there is an emphasis on diverse methods of inquiry; on the mixture of biological, cognitive, and social factors contributing to mental phenomena and behaviour, and the application of the knowledge gained to address real-world problems and make a positive difference.

But psychology is only one of a broad range of disciplines that constitute the human sciences. To get a fuller sense of this diversity, you could thumb through a university catalogue. Depending on the size of the university these may be collected together in one department, called anything from the social sciences to the humanities and including (or not) history and philosophy. However, traditionally philosophy and history each have separate faculty departments and research agendas so they are not included in this chapter. (Chapter 4.5 **History** has its own chapter in this book).

Activity 1

In the chart below, try to write a word or phrase on the right that defines the discipline on the left.

Field of study	Definition
Sociology	
Economics	e.g. *The study of how human beings allocate scarce resources.*
Anthropology	
Psychology	
Economic history	
Political science	
Communication	
Urban planning	
Criminology	
Women's studies	
Military science	
Linguistics	
Human geography	
International relations	
LGBT studies	

How did you find this exercise? Perhaps it was not so easy in some cases.

Laws of human behaviour?

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? Calling a pattern of human behaviour a 'law' seems to suggest that there are no exceptions – but human beings are agents and can decide to act against any such pattern if they want to. It would not make the evening news if someone were to break a law in the human sciences; say a person broke the law of opportunity cost by choosing to buy the more expensive of two identical items. However, if something broke the laws of physics, say by defying gravity; now that really would be something to make the front-page headlines. Laws of human behaviour, if they exist, seem to be different from laws in the natural sciences.

Let's take a closer look at this difference between the idea of 'law' in the human sciences and the natural sciences. The difference is not simply whether laws can be broken or whether they are universal and absolute; it is also about the role these laws play in *explanation*. In the natural sciences, laws occur at the end of the explanation. Explaining a phenomenon in many cases amounts to showing how it is the result of a law of nature applied to a given situation. Explaining the movement of a pendulum involves showing that Newton's laws of motion, applied to the mechanical structure of the pendulum, result in the motion that we observe.

In the human sciences on the other hand, a law (or 'effect') is something that needs explanation. It is the beginning of the explanatory chain. For example, psychologists talk of Fitts's Law, which describes the trade-off between the speed at which we reach for something and the accuracy of the movement. This is seen as the beginning of the investigation by psychologists, who want to explain this 'law' by appealing to more basic facts about the functioning of our sensory apparatus and motor mechanisms. A similar situation is encountered in economics. The student meeting the subject for the first time is often set an exercise to explain the 'law of demand' in terms of rational decisions by a consumer hoping to maximise the usefulness of their resources. In the human sciences, robust regularities such as these are patterns requiring explanation; they are not, as in the natural sciences, the end of the story.

The role of human agency and the role 'laws' play in explanation are two major differences between the human sciences and the natural sciences. But are there others?

The human sciences and prediction

Generally speaking, the natural sciences are good at prediction. That is one of their main uses. The human sciences, on the whole, are not known for making accurate predictions. In fact, sociologists and anthropologists do not seem to be in the business of predicting at all. And while economics makes predictions, frequently they do not turn out to be so accurate. Few people predicted the financial crisis that hit the developed world in 2008 and the sharp global recession that followed. Those who did, like Nouriel Roubini, now have superstar status. Here is an important task for the TOK student. Why are the human sciences so bad at prediction? If we want to cure social problems and make a better world, prediction seems to be a useful, even necessary, tool. Understanding why the human sciences cannot provide prediction with any reliability is key to understanding their nature.

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. As investigators, human beings introduce an element of subjectivity. But this is no different to the natural sciences – the average chemist is just as subjective as the average sociologist. Then, also, human beings are the target of the investigation and so the question is whether human will is sufficient to disrupt the patterns of behaviour that the human sciences seek to track. There is a further question about whether we can draw on our own experiences in an investigation; that is, can we examine ourselves as a target of investigation? These questions will be taken up in the next section.

How scientific are the human sciences?

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. Below is an example in anthropology.

In an article in *American Anthropologist* Peter Peregrine of Lawrence University writes:

The governing documents of the American Anthropological Association repeatedly refer to anthropology as a 'science.' What does science mean in this context? And is it true that anthropology is a 'science'? These are questions with which anthropologists have wrestled for generations, yet no clear answer has emerged. That these questions are still important was demonstrated following the 2010 AAA annual meeting. The executive board removed the word science from the association's long-range plan and sparked a brief, though widely publicized, controversy. The important point is that if members of the AAA did not find 'science' in anthropology important, the changes to the long-range plan would not have been controversial.

Later in the article he writes:

Although definitions of science in anthropology may be incongruous, there does seem to be a general agreement that at least two opposing modes of thought are present in anthropology: one focusing on logical, reasoned argumentation; the other on more inventive, insightful exploration. The former tends to be called a 'scientific' approach, the latter a 'humanistic' or 'interpretive' approach. But one has to question whether these two modes of thought are truly different. Are 'humanistic' approaches devoid of logic or reasoned argument? Are 'scientific' approaches devoid of insight and inventiveness? These kinds of dichotomies are found elsewhere in discussions of science in anthropology and raise similar questions. Science is said to be concerned with generalizations rather than particulars; science is concerned with exploring evolution rather than history; science emphasizes theory at the expense of context; science uses measurements and statistics rather than words and interpretations; science employs a hypothetico-deductivc approach; science is empirical; science is replicable, science is . . . what? What is science in anthropology?

(Peter Peregrine, 2012, What is Science in Anthropology, *American Anthropologist*, Vol. 114, No. 4, p.593)

Interestingly the IB Subject Guide for Cultural and Social Anthropology does not use the word *science* or *scientific* in its description of the course, but it does use *understanding* and *exploration*.

While the human sciences and the natural sciences might not share subject matter, there may be other differences that arise from the possibility of differences of intention or perspective. We turn to this in the next section.

Things to think about

- Write down a 'law' in the human sciences. Is it something that explains human behaviour, or is it in need of explanation itself?
- Consider the following quote from Nils Bohr, Nobel Prize-winning physicist: 'Prediction is very difficult, especially if it's about the future.'
  Perhaps this quote is also relevant to the human sciences. It's often easy to

find a model that fits the past data well, but it's another matter to find a model that correctly identifies those features of the past data which will be replicated in the future. Can you think of an example in the human sciences where it is easy to have 20-20 hindsight but difficult to make predictions? Why do you think that so few predicted the financial crisis in 2008? Some phenomena in the natural sciences are also difficult to predict, such as the occurrence of earthquakes. Why is this? Are the factors the same here as in the case of making predictions in economics?

- Go back to the list of human sciences at the beginning of this section (see Activity 1 on page 247) and place them on a spectrum between 'scientific' and 'non-scientific'. Which discipline turns out to be the most scientific and which the least? How do you understand 'scientific' at this point in the chapter?
- 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 areas of knowledge as being fundamentally different? If so, in what way?
- Do you think anthropology is a science? Does it matter?
- John Searle asks the question, 'Why are the human sciences so boring?' He is being deliberately provocative in comparing them with the natural sciences. Is he being unfair to the human sciences? Or is there a sense in which knowledge produced in the human sciences pales in comparison with the extraordinary discoveries made by the natural sciences?
- Why do you think we are fairly good at understanding and curing physical illness but are still rather poor at understanding and curing mental illness?
- 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. (For an interesting discussion about the status of economics use the QR code to see Brian Leiter's excellent blog.)
- **Challenge** Economists derive some of their laws from a basic set of assumptions. The law of demand (as the price of a good increases, the quantity demanded decreases) is derived from the following three premises.
  1. Buying the good has an opportunity cost (you could have bought something else with the money).
  2. Marginal utility is decreasing – that the satisfaction produced by the consumption of each extra chocolate bar (say) decreases.
  3. Human beings are rational maximisers of utility (we want to get the best satisfaction for our money).

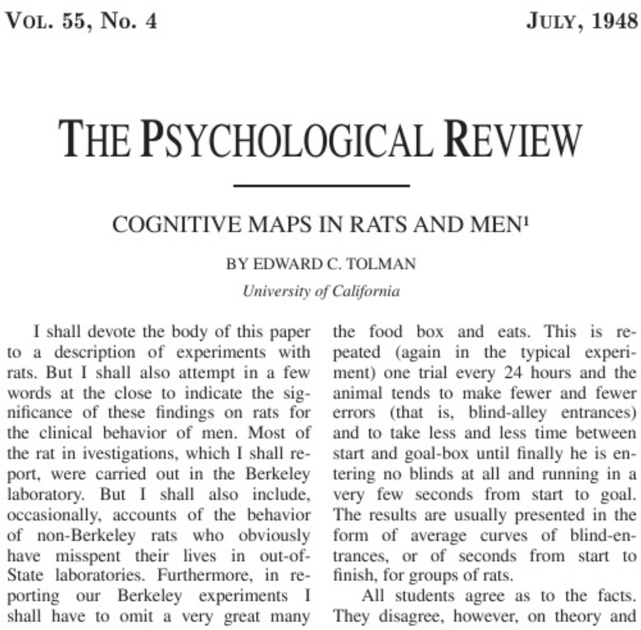
  For an exception to the law, one (or more) of these assumptions must be violated. Think of a real-world example where the law of demand is broken. Now work out which of these assumptions is not true.
- Economists often just shrug off exceptions to the law – they just conclude that one of the basic assumptions does not hold. But if we encountered an exception to the law of physics – that the speed of light is a universal speed limit – then it would (and did) become front-page news. We are stuck with a fundamental contradiction between observation and theory that threatens the whole of physics.

Knowledge questions

- How do we decide whether a particular discipline should be regarded as a human science?
- Do the human sciences and literature provide different types of knowledge about human existence and behaviour?
- Are predictions in the human sciences inevitably unreliable?
- What are the main difficulties that human scientists encounter when trying to provide explanations of human behaviour?
- Is human behaviour too unpredictable to study scientifically?
- Do the boundaries between different disciplines and different areas of knowledge help or hinder understanding?
- Is it possible to discover laws of human behaviour in the same way that the natural sciences discover laws of nature?

Perspectives

Behaviourism vs humanism


VOL. 55, No. 4 JULY, 1948

THE PSYCHOLOGICAL REVIEW

COGNITIVE MAPS IN RATS AND MEN[1]

BY EDWARD C. TOLMAN

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I shall devote the body of this paper to a description of experiments with rats. But I shall also attempt in a few words at the close to indicate the significance of these findings on rats for the clinical behavior of men. Most of the rat in iestigations, which I shall report, were carried out in the Berkeley laboratory. But I shall also include, occasionally, accounts of the behavior of non-Berkeley rats who obviously have misspent their lives in out-of-State laboratories. Furthermore, in reporting our Berkeley experiments I shall have to omit a very great many the food box and eats. This is repeated (again in the typical experiment) one trial every 24 hours and the animal tends to make fewer and fewer errors (that is, blind-alley entrances) and to take less and less time between start and goal-box until finally he is entering no blinds at all and running in a very few seconds from start to goal. The results are usually presented in the form of average curves of blind-entrances, or of seconds from start to finish, for groups of rats.

All students agree as to the facts. They disagree, however, on theory and

Figure 2 This article marks a crucial moment in the evolution of psychology as a discipline.

Figure 2 shows a picture of an influential paper by the American psychologist Edward Chace Tolman, published in the journal *The Psychological Review* in 1948. The article is important because it marks a crucial moment in the evolution of psychology as a discipline where the doctrine of *behaviourism*, in place since the beginning of the 20th century, encountered a serious challenge.

The behaviourist perspective is rooted in an idea that the only thing that could be measured in the human sciences was behaviour. It was radical in that behaviourists took concepts like 'mind', 'belief', or 'desire' to be just a convenient shorthand for talking about certain types of behaviour. One might think that the concept of 'mind' was central to psychology, so it struck many as ironic that the behaviourists should treat it as a fiction.

With BF Skinner in the 1930s the doctrine became more radical. Skinner laid the foundations for logical behaviourism: the idea that thinking *was just* behaviour. There was nothing more to be added. Naturally, there were objections to this line of thought, not least questions about how the behaviourists could account for normal mental activities such as learning. But they had an answer for this. They argued that learning was an entirely behavioural process called *classical conditioning*. Picture Pavlov's experiment where a bell was rung just before a dog was given food. After training the dog in this manner for a while, the bell was rung without the subsequent production of food; but still the dog salivated. This and its close cousin *operant conditioning* were what learning was for the behaviourist.

Tolman was interested to know whether this is really what happens. He ran a series of experiments with rats navigating a maze in search of food. According to the behaviourist, the rat simply learns the sequence of moves it has to make: left, left, right, left, and so on through conditioning. Tolman reasoned that, if this were the case, then if you started the rat in a different part of the maze it would repeat the same sequence of moves and get hopelessly lost. Instead what he found was, roughly speaking, that the rats were able to take short cuts across the maze and find the food anyway. This finding seemed to suggest that the rat had an internal map of the maze that it could use to solve the problem of finding the food. Tolman described the rat's behaviour as being goal-oriented and referred to the internal map as being a *cognitive map*. Tolman was initially mocked for suggesting such an idea. Internal maps and goals were not available concepts for the behaviourist. Despite referring to his theory as a variety of behaviourism, Tolman's ideas were radically different. Nowadays, we not only know that he was right, but we know roughly where the map is in the hippocampus of the rat's brain. Tolman's experiment was the first of many challenges for behaviourism. Rats, and humans too, had goals which informed their behaviour. Behaviour only had significance in the light of these goals, so there was more to psychology than just behaviour. By the 1960s classical behaviourism was waning as a perspective in psychology and cognitive science.

Tolman was a behaviourist in name only. By suggesting that rats were guided by an inner map he was returning to a world-view in which internal non-behavioural processes formed a significant part of human cognition. Indeed, the divide between Skinner and Tolman illustrates a more general divide in the human sciences, between those who distrust any explanation that posits things that cannot be observed (*positivism*) and those who happily talk of goals, beliefs, desires, emotions, and so on being part of an explanation of behaviour: a perspective that we shall label *humanism*.

These two positions can be illustrated by the simple example of observing someone drinking. Consider the following two extracts.

> 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.
>
> (BF Skinner, a behaviourist psychologist)

> There is a man and a glass of wine. Either he drinks or he does not. If he drinks, this act might be (among many) an expression of politeness, a show of loyalty or honour, a religious observance, a gesture of despair, an act of pleasure, a taste test, an attempt to seduce, corrupt, summon up courage, and so on. Any of these possibilities can be accepted as a good explanation, but to find the meaning of the action we may have to know the reason for its performance. That is, perhaps the action can be explained only in terms of someone's intention, or by reference to social norms and conventions, or some combination of the two.
>
> (AJ Ayer, philosopher)

The quote from Skinner represents the most radical attempt to eliminate from an explanation of human behaviour 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 the second quote shows, the strictly behaviourist approach may well miss the point or the purpose, namely what is human about this act, by confusing movement and action – an important distinction in human behaviour but somewhat of a difficulty in human science.

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.

> 'Why did you hit Johnny?'
>
> '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.

> 'Why did Katie hit Johnny?'
>
> 'Because she was annoyed.'
>
> 'How do you know she was annoyed?'
>
> 'Because she hit Johnny.'

> **Info box**
>
> **Reason and cause**
>
> 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) and the second has a **cause**.
>
> Depending on the context, the question 'Why did X happen?' might be asking for either a reason or a cause. 'Why did you pull the trigger?' might be answered in one context by 'because of activation of the auxiliary motor area of my brain and the subsequent activation of the motor cortex', and in another by 'because I hated him'. The first is a cause and the second a reason. In a court of law it is likely that the reason is what is being sought.

If we are not careful, this becomes circular. If Katie's annoyance is constituted by her behaviour it cannot also be a cause of it!

So behaviourists and positivists argue that only when social behaviour can be analysed and stripped of all its meaning will we be able to speak of social sciences as sciences, since meaning is not *observable*. The humanist perspective asserts that meaning is essential in decoding human behaviour.

What would an alien landing on our planet make of the following examples?

- A crowd making a lot of noise while 22 men or women chase and kick a spherical object on a rectangular patch of grass.
- Someone with a bag standing by the side of the road with their arm outstretched and their thumb pointing up.
- People mumbling with their heads bowed as a box is lowered into the ground.
- 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.

Introspection

The previous section suggested that there was a tension between the behaviourist and the humanist approaches to the methodology of the human sciences. The two approaches seem irreconcilable. But there is one person who can directly observe reasons for action: the experimental subject themselves. If we use their 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 summarise it with the phrase 'what was it like for me?'.

This method underlies much research that is conducted using surveys and questionnaires. The expectation is that the experimental subject will give direct 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. Modern psychology suggests that not all of our motivations are directly available to us – that much remains below the conscious radar.

And then there is always the question of whether the responder answered the questions honestly. In some situations where the questions are about delicate or sensitive matters, the responder might be too embarrassed to own up to an uncomfortable or awkward answer, even if, as is often the case, 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. We hear reports of facts such as in a sample of European males, 95 per cent thought they were better drivers than average. If by 'average', we mean the median (the middle value) then by definition only 50 per cent can be better than 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. Human sciences that rely on self-reporting do so at their own considerable risk. Are there other areas in life where people tend to over- and underestimate? Do most people underestimate how much work is required for any particular task in the IB?

Things to think about

- 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.
- **Challenge** The German thinker Hans-Georg Gadamer (*Truth and Method*, Gadamer, 1960) 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 one more aware of the foundations of one's own culture, a process he calls the fusing of horizons. To what extent do you agree with Gadamer? What evidence do you have for your view? How does the anthropologist perhaps of a privileged background integrate themselves into the lives of the group they are studying? How would their status affect their work as they went about investigating the question above about the Haitian refugee community? 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?

Knowledge questions

- To what extent is it legitimate for a researcher to draw on their own experiences as evidence in their investigations in the human sciences?
- Is it possible to eliminate the effect of the observer in the pursuit of knowledge in the human sciences?
- How might the beliefs and interests of human scientists influence their conclusions? How can we know when we have made progress in the search for knowledge in the human sciences?
- If two competing paradigms give different explanations of a phenomenon, how can we decide which explanation to accept?
- What forms of protection against research error and bias are available to human scientists?

Methods and tools

Recall in the Introduction to the book that there were three distinct types of knowledge that were expected to make an appearance in each chapter: map-like knowledge, propositional knowledge, and procedural knowledge. In this section we shall examine how these three types of knowledge are present and produced in the human sciences.

V

Heuristic

The word *heuristic* means 'rule of thumb'. This means a simple rule, often to guide some type of behaviour, that works in most common cases – but does not work all the time.

Info box

Heuristics and TOK

Given two conflicting knowledge claims, it is usually a good idea to accept the one that has most evidence in favour of it. As we know, in TOK this does not always work (try to think of a counter-example) – but it is a useful guide.

Heuristic is sometimes used as an adjective, as in *heuristic methods*. Here the contrast might be with a more rigorous procedure such as *deductive methods*.

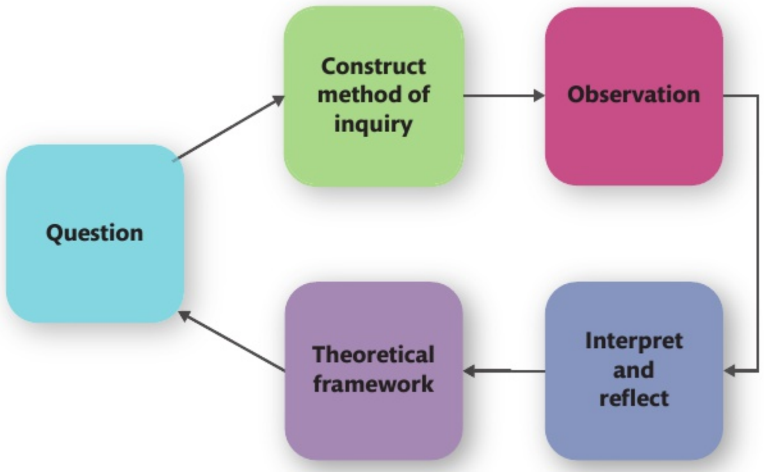
Behavioural economics identifies a number of rules of thumb that human beings use to guide their decision making which are counter to logical reasoning. For example, we are more likely to take a straight gain and gamble a loss, or ascribe positive motives to oneself but negative ones to others for doing the same things. More is said about these heuristics in the **Methods and tools** section.

Observation and theory in the human sciences

The starting point for the human sciences is human behaviour, so the first thing to be done by any discipline within this area of knowledge will be to observe this behaviour. Before we go on, let us just pause and see how observation fits with the three types of knowledge running through TOK. Observation seems to take on some action in the world and convert it into *map-like* or *propositional* knowledge. Imagine a scenario where a human scientist – let us say a social psychologist – wants to investigate how learning happens in the TOK classroom. Teachers, of course, see certain repeated events in the classroom, so draw the inference that this is a pattern of human behaviour. They do this all day long, one way or the other, even if they do not formalise it in the manner of social scientists. A social psychologist might take a more methodical approach to observation through the use of video of a live lesson, say. Observation itself requires skill and judgement that might reasonably be labelled *procedural knowledge*. Good teachers are doing this all the time informally. The preparation of the video recording the analysis of the results will need to be set up carefully. What behaviour will be deemed significant and what will be just background behaviour? These are questions that will need to be decided from experience and likely from the hypothesis being tested. After the raw data is analysed it will need to be interpreted through a psychological theory. Only then will the psychologist be able to map the processes that are taking place in the classroom and make some statements about the effectiveness of the teaching. So procedural knowledge is used by the observer, while propositional and map-like knowledge are used to state and interpret the results. If this example is typical of what goes on in the human sciences, then we see that their methods combine all three types of knowledge.

As with the natural sciences, these observations need to be slotted into some sort of theory in order to make sense of them. 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. Just as with the natural sciences, the human sciences require both observation and theory in mutual interaction. The model might look something like Figure 3.

Figure 3 A simple model for production of knowledge in the human sciences



Activity 2

1. Recall the learner profile attributes: inquirers, knowledgeable, caring, principled, risk-takers, reflective, thinkers, balanced, communicators, open-minded. Draw arrows on the diagram in Figure 3 showing where these attributes apply in the production of knowledge.
2. How well does this model apply to the process of producing an extended essay in the IB diploma programme?

The observer as part of the system

In Chapter 4.2 **Natural sciences**, we discussed the basic problem of observation – that any observation necessarily requires an interaction with the system being observed, and therefore changes 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'.

Many of the foundational studies conformed somewhat to the stereotypical picture of the study of small groups far from the university centres where research began. Today however, both in sociology and anthropology, the fieldwork is just as likely to be set within an urban environment, or focus on how people live together in nursing homes, prisons, small artisanal farming communities, a team of ecologists at the edge of the rainforest, or a navigation team in a naval vessel.

In attending to the fundamental goal of the anthropologist – 'seeking an understanding of humankind in all its diversity' – and the specific questions guiding the study, the anthropologist becomes a *participant observer*. This means that they spend time with the subjects of their study integrated into their daily life and joining in with their activities, habits, and rituals. From this perspective they gather information, both wide ranging and detailed, that eventually is published as an *ethnography* – a text describing a people and their customs and traditions.

By intention, the ethnographer brings their own subjectivity and experience to bear on the study, which reminds us that observation is shaped by social and psychological assumptions and value judgements. In short, the observer is the instrument, so to speak, 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 as an anthropologist or ethnographer.

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 change in a refugee Haitians' community as a result of new surroundings in a new country?'

The cultural anthropologist Margaret Mead (1901–1978) made 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 was highly influential, drawing 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.

The role of experiment in the human sciences

What is an experiment? And do the human sciences do experiments? As a rough guide one could think of an experiment as a sort of ideal replica of a real-world situation in a controlled environment. This means that the experimenter can fix the values of most variables and manipulate only a few (ideally just one) and note the effect on the phenomenon. 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.

It is an interesting question to what extent the different human sciences perform experiments. In macroeconomics – the study of the whole economy of a geographical or political region – it is neither practical nor ethical to carry out experiments. How can economic variables be held constant while others are allowed to vary? Imagine setting up an experiment where the number of people out of work is kept the same but we increase the amount of money spent on domestic consumption. Is it ethical to experiment with people's lives – in the example – keeping those people out of work in order to see what happens to the economy?

However, in microeconomics – the study of individual economic decisions made by individuals and firms – experiments are sometimes a possibility. Esther Duflo, mentioned at the beginning of the chapter, devised some practical experiments to do with the decisions that poor people make. In general, experimentation is possible in some human sciences such as psychology, and not others such as social and cultural anthropology. Can you work out what determines whether a field can experiment or not? What exactly do you mean by experiment? How many statements are made in the media about 'studies suggest…' as if experiments had taken place?

These questions are not easy, partly because a large variety of activities fall under the umbrella term 'experiment'.

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 the following 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 variables in the experiment.
- It must be possible to interpret the results of the experiment back in the real world.
- Since we are dealing with human subjects, the experiment must be ethically permissible.

Experimenting on the whole economy is not possible for three of the four reasons above (which three?). Although there are some interesting economic games and simulations that mimic aspects of the real world, it is more likely that economists will use mathematical models to try to understand how the economy could evolve given certain interventions. 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 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. Instead it relies on mathematical modelling found in areas like cliometrics – the statistical study of economic history. Using these methods, economic historians are able to do impressive things such as calculate world GDP back to the time of Homer (*c.* 800 BCE).

Perhaps the discipline that is most amenable to experiment is psychology. Unlike the Freudian or Jungian psychology that 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 subject. These can be carried out in the lab and, especially with modern information technology, many of the important variables can be controlled.

The role of models in the human sciences

The key to understanding the role of models in the human sciences is the awareness that models can be used for gaining a general understanding of a phenomenon without being complex or detailed enough to provide predictions. We might describe these models as *explanatory models*.

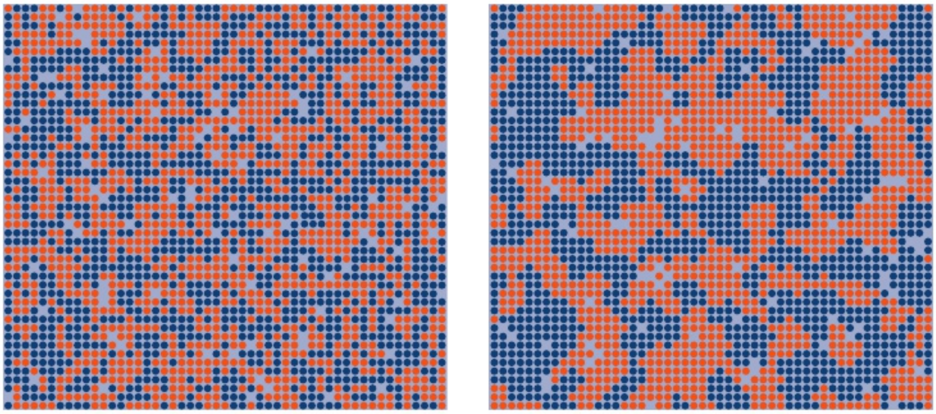


Figure 4(a) and 4(b) Stills from a simulation based on the Schelling segregation model. Figure 4(a) shows the initial random configuration. Figure 4(b) shows the situation after a few thousand iterations of the model.

The pictures in Figure 4(a) and 4(b) are taken from a simple model in the social sciences called the Schelling model, which was designed to investigate the phenomenon of social segregation: how people of two different ethnicities tend, over time, to form communities that are homogeneous. It is a simple model that with minimal coding skills you could program yourself. The orange and the blue dots represent people of the two ethnicities. Initially they are placed at random; then a simple rule is applied to derive the next picture. If a blue dot is surrounded by a majority of orange dots then it is moved randomly, otherwise it stays put. A similar rule applies to the orange dots. After applying the rule many times, separate blue and orange areas form – the model equivalent of ghettos. What is striking about this model is that despite the simplicity of its design and the assumptions built into it (that people prefer to be surrounded by their own type and when they are a minority want to move), its qualitative behaviour is lifelike. It is a good example of a category of models that help us to understand complex phenomena by retaining their essential elements despite considerable simplification.

The Schelling model suggests a set of features that we might expect models to possess.

1. The model is a representation of reality.
2. It is highly simplified and only represents the most significant details of the situation.
3. The construction of the model embodies assumptions and some theory about the real-world situation.
4. The model is symmetrical and tidy. It abstracts away real-world messiness.
5. The model can be manipulated to yield knowledge about how the real-world situation might develop over time.
6. The results of the model must be interpreted in the real-world situation to be useful. They are, after all, only representations.

Models will need to trade off accuracy and simplicity. A simple model might give us understanding about the features of a real-world situation but not yield accurate predictions and vice versa. The Schelling model is simple and cannot yield predictions about ghetto formation in a particular city. On the other hand, the UK Treasury model is used to map the whole of the UK economy. It is precise but complex. Is it true that the human sciences prefer models that are more explanatory than predictive?

Economics is well known for its use of models. In the 19th and early 20th centuries it 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 Phillips 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 the tanks were designed to represent the different time lags that held 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 pen-chart to record the dynamic behaviour of the model.

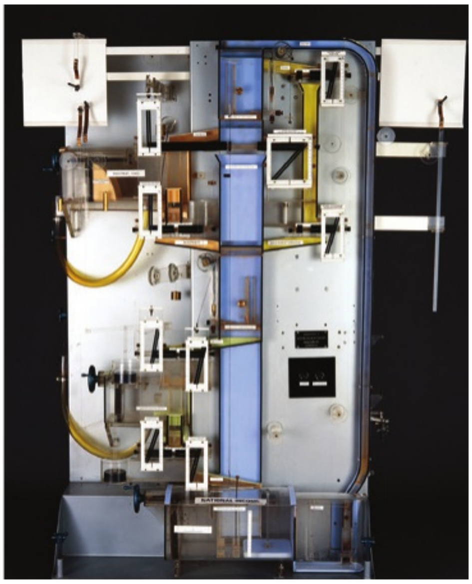


Figure 5 Newlyn-Phillips water model of the UK Economy (Leeds University Economics department)

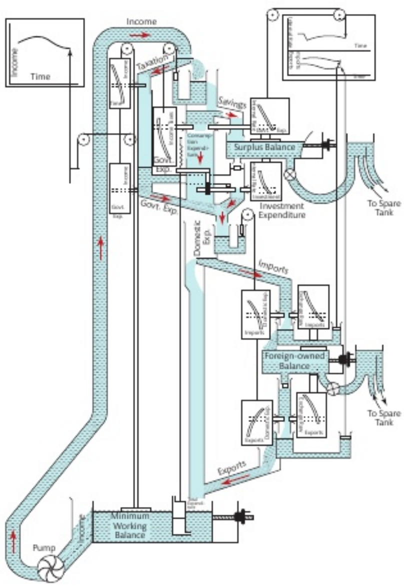


Figure 6 A diagram of the Newlyn-Phillips model

Today such a physical model would be implemented by a computer program. The program would simulate the flow of water that itself represented the variables important to understanding a national economy. There is a sense in which the water model is an elaborate metaphor for the UK economy.

Modern economic models, many of them statistical, reflect the idea that the fundamental relationships are not deterministic and law-like, such as those of classical physics, but are susceptible to chance. They reflect the intuition that although we are all free to act as we wish, within certain limits, generally speaking our behaviour follows statistical patterns.

It is not only in economics that we find statistical modelling. Almost every human science employs statistical models of one sort or another. Figure 7 shows an example of the use of mathematical models in basketball, by Jennifer Fewell and Dieter Armbruster of Arizona State University (see www.wired.com/playbook/2012/12/basketball-network-analysis/).

The research team used network analysis to analyse basketball games. Having turned the players into nodes in a network and passes into paths, they then 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 is the chart from the Chicago Bulls in their game against the LA Lakers in the 2010 NBA playoffs.

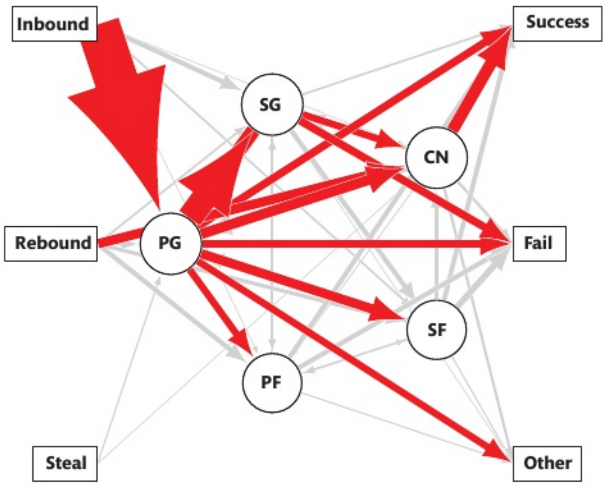


Figure 7 Network analysis of the Chicago Bulls, showing the majority of ball interaction remained with the point guard. *Image: Jennifer Fewell and Dieter Armbruster.*

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?

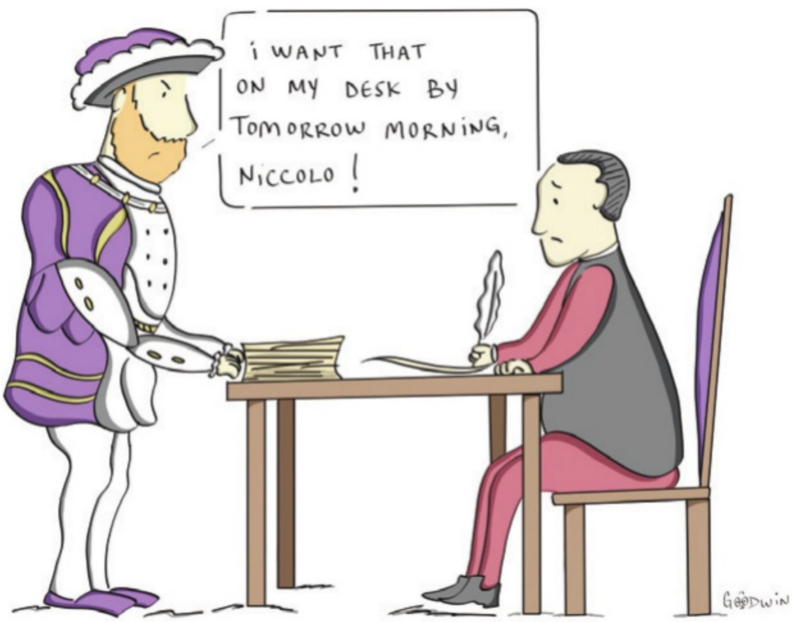
But it is not only in sport where statistical modelling produces highly effective real-world strategy. In the world of political forecasting, modelling is proving far more effective than traditional political pundits. In the December 2019 General Election in the UK, the Exit Poll (based on an elaborate model incorporating features of each constituency) predicted the Conservative party would end up with 368 seats. In the event they took 365 seats. A result accurate to within 1 per cent.

Assumptions underlying the methodology of the human sciences

We saw in Chapter 4.2 **Natural sciences** 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, to all intents and purposes, uniform and that our particular part of the universe is not somehow special. Yet, when human beings form the subject matter of our investigation then we do not need to make assumptions about what happens elsewhere in the universe. 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 and social structures like the state. For example, the Florentine political theorist Niccolò 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 and that would motivate us to form a political society to protect ourselves from each other. Jean-Jacques Rousseau (1712–1778) had a more positive view of human beings in the state of nature as a somewhat solitary peaceable figures: the noble savage. It was the effect of social institutions (such as money and social status) that was corrupting. The fathers of modern economics, Adam Smith and David Ricardo, argued that man was essentially selfish but rational and that the market system was a device to transform man's intrinsic selfishness into a process that always moved towards a socially optimal equilibrium.



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* (or 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 1970s, that socialisation was the only cause of differences between the 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 that men and women have the same nature (or no nature at all). Even if psychology tells us that there are differences in nature, and depending on who you ask they might be, men and women should still possess the same rights and freedoms. Moreover, the psychologist Steven Pinker (b. 1954) points out that the notion that there is no human nature and that all human capacities are purely a product of the environment, is incoherent. If we are to learn from the environment, he argues, then we should at least have an inbuilt capacity for learning. In the event, evolution, he says, has equipped us at birth with a large number of systems to enable us to survive and flourish as human beings. As an appendix to his book *The Blank Slate* he quotes a list of 320 features of human beings observed by anthropologists in every known human society (Pinker, 2002, p. 435). Some features of the list are reproduced in the grid below, along with some more human universals observed in every known human society. Each box represents a separate trait. The implication is that the features and capacities we all share are far from being negligible and that the blank slate theory is false.

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
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 TOK programme recognises 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? Let us consider the everyday occurrence: making a decision. One model might be that each decision comes with a set of options. 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*.

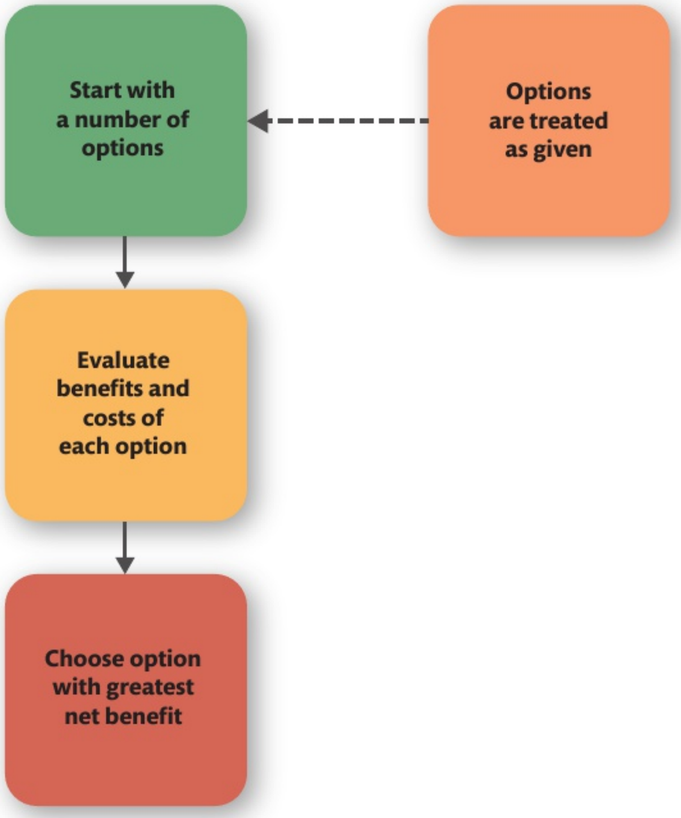


Figure 8 The classical model of judgement

An alternative model is that the production of the options to be considered is part of the decision-making process. When faced with a decision, you might have to spend some time first producing the options to be considered. How someone produces a particular set of options out of the almost infinite set available is clearly linked to human creativity. It is rather like an artist producing one artwork rather than a different one. Once the options are in place, the individual first judges which of them 'feels right' and only then provides reasons *after the event*.

The individual might then discuss the judgement with others and modify it in the light of this discussion. This model is called the *Social intuitionist model* precisely because the intuitive decision is rationalised *post hoc* and then discussed and modified socially.

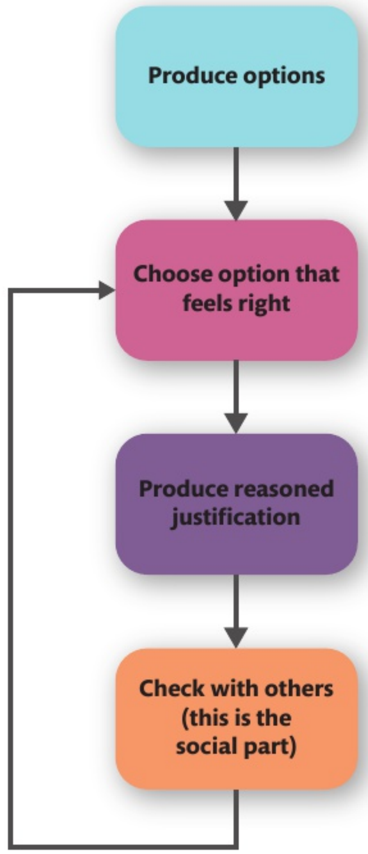


Figure 9 The social intuitionist model of judgement

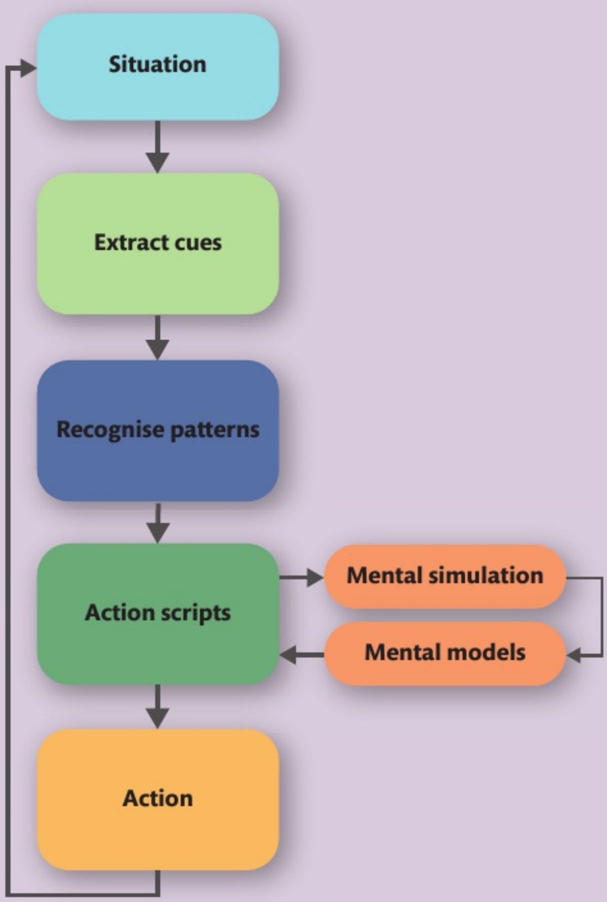
What is interesting about this model is that in some cases, especially when having to make judgements or decisions in stressful situations, more reliance is placed on intuition and experience than on mathematical reasoning. This is well demonstrated not only in everyday decision making but also when we make moral or ethical judgements.

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 experience, the facts that make the judgement 'feel right'.

Activity 3

Gary Klein is a psychologist who has developed an explanation of how we make rapid decisions under pressure, such as those made by firefighters called to a fire. Search on the internet for more about his model: the recognition primed decision model (RPD).

Recognition primed decision model (Klein)



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?

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 (1937–1996) and Daniel Kahneman (b. 1934) in the late 1960s. Kahneman, the author of *Thinking Fast and Slow* (2011), won the Nobel Prize for Economics in 2002 for this work under the general title of 'Prospect Theory' – which is explained briefly below.

What did Kahneman 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:

System 1 – automatic system	System 2 – reflective system
Uncontrolled	Controlled
Effortless	Effortful
Associative	Deductive
Fast	Slow
Unconscious	Self-aware
Skilled	Rule-following

The automatic system – system 1 – saves our lives. If something is coming rapidly towards us, with staring eyes and its mouth open baring large fangs, we could sit down and reason about it: 'it might be dangerous but on the other hand it might be benign', but by this time we would be dead. No, the automatic system cuts in and says: 'run!' It does this primarily by invoking the emotion of fear (thinking fast). That is why we might sometimes be afraid of a perfectly harmless spider or even a piece of string. It is better, in evolutionary terms, to make the error of thinking the piece of string is a snake than the other way around. Through evolution, organisms with developed fast intuitive automatic systems have been selected for, for example, us humans.

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 more than a ball and they cost \$1.10 together how much does the ball cost.
- The patch covered by waterlilies 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 four men four days to make four 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. If the ball costs \$0.10 then the bat costs \$1.10 (\$1 more) and together they cost \$1.20. So, the correct answer is that the ball costs 5 cents.

The automatic system relies on *heuristics* – rules of thumb (see page 255). They are at work when you make any sort of judgement.

Here is an example. What would you prefer?

Option A	**Option B**
Receive \$200 cash	Play a game where you have $\frac{1}{5}$ probability of receiving \$1200?

The expected payout is \$200 for option A and \$240 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. Let us suppose that we have committed a minor motoring offence such as parking the car in a no-parking zone. The parking attendant happens to be interested in behavioural economics and offers us two choices:

What would you prefer?

Option A	**Option B**
Pay \$200 cash fine	$\frac{1}{5}$ probability of paying \$1200

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, the reflective system, 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 the following offers in two different shops *for exactly the same item*. Which do you go for?

Figure 10 Which offer would you go for?

Classical (system 2) reasoning suggests that it doesn't matter which we go for since they both cost the same. It is a 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 that is made tends to be used as a reference bid against which concessions can be measured. This is the principle 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 on the way in which 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 now we come to the big 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 that has a big impact on our behaviour.

How well are the human sciences adapting to these developments concerning human reasoning? Contemporary microeconomics, as might be expected, reflects many of these developments and builds in realistic heuristic models of human decision making.

Psychology and sociology are safe – they have never assumed that humans were classically rational! Finally, we should not underestimate the role that habit plays in forming our judgements and controlling our actions.

Things to think about

- Is it a strength or a weakness of the methods of economics that there is room for political intuitions to play a role?
- Can you identify a real-life situation where political considerations play a role in the actual methodology of the natural sciences?
- Why might political considerations play a smaller role in the natural sciences than in the human sciences?
- Find out about the 'halo effect' in psychology. What is the experimental evidence for this effect?
- In general, how can we assess how well an experiment replicates the significant features of the real-world situation we are interested in?
- Use the QR code to find and then read the article on statistical models and predictive policing in *The Economist* 20 July 2013. Identify the benefits stated in the article for directing police resources to the 'pink' squares identified by the model. What are the risks associated with such a policy? What are the ethical issues of using statistical models for making decisions to do with parole or the profiling of potential offenders?
- Does the use of mathematical models in baseball, basketball, football, cricket, rugby, or Australian rules in any sense detract from the enjoyment of the sport?

- Use the QR code to take a look at Dan Ariely's entertaining TED talk about cheating. 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? Do you agree with the comments of the nurse?
- 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. Which of these heuristics do you recognise in your own behaviour?

Knowledge questions

- What role do models play in the acquisition of knowledge in the human sciences?
- Are observation and experimentation the only two ways in which human scientists produce knowledge?
- What assumptions underlie the methods used in the human sciences?
- To what extent are the methods used to gain knowledge in the human sciences 'scientific'?
- How does the use of numbers, statistics, graphs, and other quantitative instruments affect the way knowledge in the human sciences is valued?
- To what extent can the human sciences use mathematical techniques to make accurate predictions?

Ethics

As in the other areas of knowledge, there are ethical responsibilities attached to the way knowledge is produced in the human sciences, and also to the uses to which it is put. But unlike other areas there is a third theme that connects the human sciences to the practice of ethics itself: human psychology plays a big role in making real-life ethical decisions.

Let's start with the responsibilities carried by the human scientist. An obvious place to start is psychology, where there are clear ethical guidelines regarding experiments on humans and animals.

The IB Psychology Guide gives a number of guidelines for the conduct of the internal assessment activity in experimental psychology. Here is an excerpt from the guidelines in the 2019 Psychology Subject Guide.

> Any experimental study that creates anxiety, stress, pain or discomfort for participants is not permitted. Experiments involving deception, conformity, obedience, or any other form of harm are not permitted. The experiment must be appropriate to the sensitivities of the particular school, community and country.
>
> 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.

Partial deception may be allowed for some experiments where full knowledge of the experiment would fundamentally affect the outcome—such experiments are permissible provided they do no harm and participants are fully debriefed at the end. Participants retain their right to withdraw their data at this point. The only exception is a conformity or obedience study; these are not permitted under any circumstances. The teacher should be ready and willing to explain why conformity and obedience experiments are not appropriate for students at this level of study.

Consent must be explicitly gained from participants through the use of a consent form. Implied consent is not acceptable.

All participants must be informed of the aims and objectives of the experiment.

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.

Young children (under 12 years) must not be used as participants as they cannot give informed consent. Experimental studies involving older children (from 12 years up to 16 years) 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 even after the experiment has finished.

Participants must be shown the results of the research and if reasonable deception was involved, the participants must have the deception explained and justified to them.

Teachers and students must exercise the greatest sensitivity to local and international cultures.

Students must not conduct research with any participant who is not in a fit state of mind and cannot respond freely and independently.

If any participant shows stress 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 the experimental study.

All data collected must be kept in a confidential and responsible manner and not disclosed to any other person.

Data must not be used for purposes other than that agreed to by the participants.

For the experiment to be considered ethical, it must do no harm to anyone. This includes participants, researchers, bystanders, teachers/supervisors, moderators, and eventual readers. Teachers should be prepared to discuss and explain what 'harm' means. It can mean a number of things: hurt, injure, torment, tease, torture, traumatize, impair, wound, mistreat, punish, maltreat, misuse, abuse, molest, damage, or adversely affect. Harm manifests in many ways, not only in a physical sense. High standards of ethical practice are central to the IB philosophy and should therefore be promoted and supported by the entire IB community.

What are your reactions to these guidelines? What do you make of the guideline that partial deception is permitted for the purposes of the experiment? Is partial deception a white lie?

Activity 4

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. Zimbardo *et al.*: Stanford Prison experiment
6. David Reimer case
7. Asch conformity experiment
8. Watson: 'Little Albert' experiment

You might assume that an ethical code similar to that of psychology operates in other human sciences. Behavioural economics, having much in common with psychology, might be expected to require the same standards to protect participants against harm. Other fields have obligations not to cause harm to the environment and to those who live in it. The participant observer in social anthropology surely has an obligation not to change the society in which they are embedded, and the physical geographer has a duty to leave the landscape in which they work as they found it.

Let's turn to another set of responsibilities, that of the knower: obligations that accompany the use to which their knowledge is put. While economics and sociology, based more on observation than experiment, are less likely to harm participants in their studies, the knowledge that these fields generate could be used in ways that are potentially harmful. What do any of us do with the knowledge we come to accept?

Economics informs many decisions that make a vast difference to people's lives. Moreover, much of the blame for the current climate crisis can be laid at the door of the economic priorities adopted by those in power over the last 100 years or so. If their economic thinking is shaped by an economic theory that, for example, treats the resources of the planet as income rather than capital, something that is not depleted when it is used, then it should be no surprise to find that these resources are extracted at an ever increasing rate and that the environment suffers as a consequence. Similarly, if the emissions of greenhouse gases are treated as being external to the market that regulates them then, again, there is little surprise that firms make little effort to limit them. Economic theory and its supporters must shoulder some of the responsibility for these outcomes.

Similarly, students of business management will need to think hard about what is sometimes called the *ecology* of business decisions. Responsible management is not only concerned with the viability of the business and the well-being of the workforce, but also with the wider consequences of its decision making on the community at local and global levels. If you were given $50,000 and asked to invest it, would you maximise return on investment or consider first the ethical dimension of the investment?

Sociology as a pure study is concerned with theories of social structure and evolution. However, applied sociology touches us all through advertising. In some countries advertising falls under strict regulation. In Sweden, for example, there is a blanket ban on advertisements targeted at children. In most countries, cigarette advertising is banned. But a there is a deeper question here. To what extent is it ethically acceptable to use sociological and psychological knowledge to attempt to manipulate people into buying things that they may not need or want? The specialist knowledge of the sociologist is used to target those most vulnerable to being manipulated, while that of the psychologist is used to find the most effective way to elicit a positive response. All this is done without revealing the methods used. Is it important to know when we are being manipulated and for what? If we do not know what is controlling our behaviour, can we be held responsible for it? Lastly, psychology is used extensively in modern police work. Those involved in violent crime are pursued using sophisticated psychological models. Surely the use of such knowledge is justified if it puts violent criminals behind bars. Yet there are worries raised about methods based on sociological principles such as racial profiling. If crime statistics reveal that people from a particular social or ethnic group are more likely to commit certain crimes does this justify the police targeting such groups in their everyday policing? These are difficult questions, but they underline the importance of taking due care with the ethical responsibilities that go with having and using knowledge produced by the human sciences.

Finally let us explore the role the human sciences – psychology in particular – plays in ethical decision making. Classical ethics tends to assume that human beings make ethical decisions according to the rational application of a set of rules. However, in the previous section we saw that human psychology did not operate like this. Our decision making is guided by quick and dirty rules of thumb – heuristics – rather than carefully thought-out reflective reasoning. Contemporary ethics is beginning to catch up and question the classical basis on which ethical judgements were supposed to rest. There are many new studies taking place where human beings are actually placed in the situations where they must make split-second ethical judgements under pressure. For example, Peter König and his team at Osnabrück University have constructed a virtual reality city called 'Westdrive Unity City' in which they can run experiments including those concerning the ethics of self-drive vehicles. In these experiments the subject dons a set of VR goggles and actually drives a car around the city populated by avatars. The virtual reality environment allows the experiments to present the subject with difficult ethical decisions. The details of these are controlled by the experimenters. Should the driver run over a child on the street or drive on the pavement and kill a dog? (Most opt for the dog.) What do the subjects tend to do when presented with a choice between running over two people on the street or one on the pavement? (Interestingly, most subjects opted for the two on the street since it just does not feel right driving on the pavement.) These results and the impact of these details are not normally taken into account in a classical ethical analysis of decision making. Additionally these questions are of crucial importance with the increase of autonomous self-driving vehicles on the road.

Figure 11 A scene from the Project Westdrive virtual reality experiment

Figure 12 A collection of the avatars crossing the road in the Project Westdrive experiment

Things to think about

- 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?
- Are there any rules that you would want to take away? Why?
- 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?
- Why is it not always possible to tell the subject the aim of the experiment beforehand?
- **Challenge** Jonathan Haidt suggests that we have evolved five moral capacities that control our moral natures: caring, fairness, ingroup loyalty, respect for authority, and purity. The first two are particularly valued by political liberals, while the remaining three capacities are more characteristic of political conservatives and might be more representative of Machiavelli (see Jonathan Haidt's excellent TED talk).
- What is your reaction to Haidt's proposal? Is he right to suggest that ethics is actually about the psychology of decision making rather than about how things ought to be?

Knowledge questions

- To what extent are the methods used in the human sciences limited by the ethical considerations involved in studying human beings?
- Do researchers have different ethical responsibilities when they are working with human subjects compared to when they are working with animals?
- What are the moral implications of possessing knowledge about human behaviour?
- Should key events in the historical development of the human sciences always be judged by the standards of their time?
- What values determine what counts as legitimate inquiry in the human sciences? Can knowledge be divorced from the values embedded in the process of creating it?
- Is the role of the human scientist only to describe what is the case, or also to make judgements about what should be the case?

Conclusion

In this chapter we have explored the human sciences; what they are and what they do. There are differences between the natural sciences and the human sciences. We have seen that the raw material of the human sciences, by definition, is the wilful human subject rather than inert matter obedient to laws of nature. Nonetheless, there is more than a passing resemblance between the methods used by both areas of knowledge. The human sciences make observations about the world of human beings and then make sense of these observations using theories. Yet, patterns play a role in both the human and natural sciences. There is talk of 'laws' of human behaviour in psychology, sociology, economics, anthropology, and so forth, yet these laws are different from those of the natural sciences. This difference is partly because the human sciences bridge more exceptions but also because they tend to occur at the beginning of the explanatory chain rather than at the end. Moreover, as we have tried to explain, the human sciences are less confident in making predictions than the natural sciences, which can affect their status in the world of knowledge making and knowledge status.

All three types of knowledge discussed in the introductory chapter, *knowing that*, *knowing how* and *map-like knowledge*, are present and healthy in the human sciences. Laws are usually formulated as simple propositions; psychology and sociology map out the nature of the human being in their physical and social context. The human scientists need to master certain skills in order to produce their knowledge, too. There is an art to devising a questionnaire or constructing a psychology experiment that requires procedural knowledge. But, perhaps most importantly, we deploy our (largely unspoken) knowledge of human psychology and sociology to navigate through this complex social world in which we spend most of our time.

This knowledge carries ethical responsibilities, both in production and at the point of use. It is precisely because it concerns the social world in which we live, that this knowledge is potent. It is important that psychologists gather the data for their inferences carefully, mindful of the harm that they could do their subjects. It is not merely of passing interest that most, if not all, the great experiments in the history of psychology would have failed the IB ethical guidelines. Moreover, the use of this knowledge implies a deep responsibility. While it is sometimes claimed that economists should be positive not normative, that they should be concerned only with the best way to achieve a particular economic end rather than asking whether the end is worth achieving in the first place, as TOK students we can challenge this. Like Esther Duflo, we might decide that the economist has an ethical duty to use their knowledge to improve the situation of people in the world. This is for us to discuss as we begin to understand life's complexities more fully.

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IB Social and Cultural Anthropology Subject Guide.

Mathematics 4.4

Introduction

7	12	1	14
2	13	8	11
16	3	10	5
9	6	15	4

Figure 1 A magic square – the figures in each vertical, horizontal, and diagonal row add up to the same value.

At the start of his wonderful book *Nature's Numbers*, the mathematician Ian Stewart writes that we live in a universe of patterns. He talks about the cycle of the seasons, the fact that no two snowflakes are the same, the patterns on the coats of tigers, zebras, leopards, and hyenas, etc.

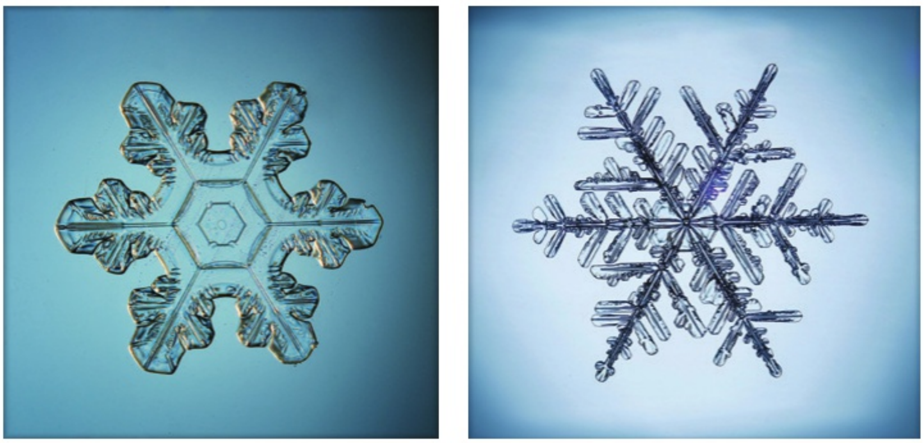


Figure 2 No two snowflakes are the same.

We could add human artefacts to Stewart's list. Wallpaper is patterned – there are surprisingly only 17 different patterns; buildings often exhibit mirror symmetry and their structure is carefully proportioned; the digital traces on memory sticks or hard drives are patterned in a way that makes them suitable for storing data; mechanical devices such as clocks and engines depend for their smooth movement on symmetry and patterning; the day is divided into equal parts that are represented on a clockface by angles or on a digital watch by numerical digits; music possesses horizontal and vertical symmetries. Human behaviour is patterned.

It is no accident that the world in which we live is full of patterns. Symmetry in a building is not only easy on the eye but it ensures that the design is simple. Pattern is a labour-saving strategy. The same plan can be used for each window, or the plan for one side of the building can be used in reverse for the other side. These informational shortcuts can be found in the human-made world and in nature. The same blueprint for generating twig patterns can be used for bigger branches or one plan can be used for all the petals in a flower. It is a sort of design efficiency. The wealth of patterns in the world are a series of cost-effective solutions to problems – and that is why these patterns are worth studying.

Mathematics is one way in which human beings formally study these patterns. While the natural sciences study them by going out into the world, collecting examples and analysing them, mathematics studies patterns in the abstract. Mathematics in its purest form does not do fieldwork or experiment. Its raw materials are abstract structures specified by symbols and the mathematician arrives at their results through manipulation. In this sense mathematics is a little 'other-worldly' – a characteristic that makes it interesting from a TOK perspective. It means that in some sense mathematics is more like an art than a science. There is in this suggestion more than a hint of a deep reliance on creativity and imagination. A comparison with the arts and the sciences is instructive and reveals the truly special place that mathematics occupies in human knowledge.

In this chapter, like the others, we shall investigate mathematics using the basic structure of the knowledge framework: scope, perspectives, methods and tools, and ethics.

Under **Scope** we shall look at the orientation of mathematics within academia. The key question to answer here is, 'what is mathematics about?'.

Surprisingly there are different ways of thinking about mathematics, which are discussed in the **Perspectives** section. How can it be that there are different perspectives on mathematics? These concern the sort of thing that is going on when we do mathematics. Are we constructing something or are we discovering something that already exists in the world? And why is mathematics so useful?

Under **Methods and tools** we shall discuss what exactly mathematicians do; how do they arrive at mathematical knowledge and what counts as facts and truth in mathematics? This is where we unpack the key conceptual building bricks of mathematical thought.

The final section, **Ethics**, deals with mathematics and values. What is the link between mathematics and supposedly subjective phenomena such as beauty? Is mathematics a personal journey or is it something that we collaborate on? And what responsibilities do mathematicians face for the use that is made of their work?

On the way, we shall have fun with infinite numbers, self-similar patterns, and security codes. While it might be removed from the physical world, the world of mathematics is just as fascinating, if not more so.

Scope

Mathematics and reality

As a first approximation then, let us say that mathematics is the formal study of patterns. In this section we shall see how far this basic idea takes us.

Imagine a simple pattern in the world – a set of similar objects – for example, a field of animals. Let us say that the animals are of the same kind – they are cows. To recognise that a group of different things all belong to the same kind is remarkable. It means ignoring all the things that mark out individual animals and focusing only on what they have in common. Grouping a set of things together by common characteristics is a powerful technique in the sciences. If such a classification is effective it might yield understanding, generalisations, and predictions. We call groups that have these properties *natural kinds* – it is something that might be expected to happen in biology. But mathematics goes one stage further. Suppose that we make a mark 'I' on a clay tablet for every cow in the field. We end up with a mark 'IIIIIIII'. What we have done now is to abstract away everything about the animals in the field; the fact that they are animals, the fact that they are cows, the fact that they are eating grass. What is left is their number.

The simplest pattern that we can deal with abstractly is number. In a somewhat magical way, the inscriptions of the tablet represent the cows in the field. They are a convenient stand-in for the real world. If we want to find out what happens when we remove 'III' cows from the field, we can either move them physically or we simply separate the 'cow' symbols: 'IIIII III'. Manipulating the symbols is clearly easier to perform. Mathematics manipulates representations rather than the real world because it is easier.

We do not know exactly if something like this story is historically accurate at the beginning of the long history of mathematics. But we do know that imprints on a Sumerian clay tablet led eventually to the astounding sophistication of the proof of Fermat's last theorem and to modern algebra, analysis, and geometry. Mathematics has been shaped by the job it is expected to perform and through countless quirks of culture. Improvised methods designed to deliver a temporary solution to an unforeseen problem become permanent. If they work well, they get passed on and take on a life of their own. Less good solutions eventually fall into disuse in a sort of Darwinian selection of competing ideas. For example, some of the great discoveries of Greek mathematics came about because of the practical questions posed by the engineering of the time. The Greek solution worked well within this context, but broke down when faced with more general problems that Arabic mathematicians wanted to think about. Algebra was a response to these more general problems. We could call histories like this *cultural evolution*.

But has the counting of cows in a field really got anything to do with modern mathematics? Let us examine the example more closely. We add a 'I' on the tablet for each cow in the field subject to two strict rules: no cow should be 'counted' more than once, and all the cows in the field should be counted. Although these rules are natural to us, they are mathematically sophisticated. Mathematically, we are establishing a mapping between the marks on the tablet and the cows in the field, which is a *one–one correspondence*. This means a mapping connects a mark to a unique cow (injective) and that all cows in the field are connected (surjective). While these early users of mathematics might not have understood it in these terms, they needed to use these properties when counting. But there is something else at work here. The compound symbol 'IIIIIII' stands for the whole field of cows. It is a property of the whole set. It expresses the size of the set – the number of things in it, called its *cardinality*. The counting of cows in a field has a lot to do with the deep nature of mathematics itself.

There are three more ideas illustrated by this simple example. The first is the power of numbers to create ordering: I II III IIII is such an ordering. This is called the *ordinal* property of number. Secondly, it illustrates the special place of sets and mappings in mathematics. We focused on the set of cows and the set of marks on the tablet. Thirdly, we counted the set of cows by establishing a one–one correspondence with the set of marks on the tablet. This is a technique that works with any sets including those that have infinitely many members. Mathematics is truly about sets and the mappings between them.

Through representing the real world by marks bearing a special relationship to their targets, human beings initiated perhaps the most extraordinary technical advance in their history: the invention of symbolic representation. A symbolic representation is a set of symbols that act as stand-ins for things in the world. Rather than manipulating things in the world, which can be unwieldy like cows, the symbols can be manipulated instead. Symbols allow information to be communicated over distance and over time. But the most powerful feature of symbols is that they can be used to represent states of affairs that are not physically present. Symbols can represent past worlds, possible worlds, and desired future worlds. Symbols allow us to tell stories, write histories, and make plans. Symbols that do not actually correspond with the world are called *counterfactuals*. They describe 'what if' situations. What if the Allies had lost World War II? What if we add sulfuric acid to copper? What if we wake up one morning to discover that we have been transformed into a giant insect? What if parallel lines could actually meet? What if there was a solution to the equation $x^2 = -1$? The power of symbolic representation is that it allows us to build abstract worlds – virtual realities where the 'what if' conditions are true.

What if you wake up transformed into a giant insect?

There is a sense in which the world of mathematics is one such virtual universe containing an endless list of exciting and weird things. Mathematicians discuss 11 dimensional hypercubes, infinite sets of numbers, infinite numbers, surfaces that turn you from being right-handed to left-handed as you traverse them, spaces where the angles of the triangle add up to more than 180 degrees or where parallel lines diverge, systems where the order of the operation matters so A*B is not the same as B*A, vectors in infinite dimensional space, series that go on forever, geometric figures that are self-similar called fractals (where you can take a small piece of the original figure then enlarge it and it looks identical – and I mean identical – to the original). The list is endless. And all this started with the making of a simple mark on a clay tablet.

Mathematics uses symbols to describe these amazing structures in the basic language of sets and the mappings between them. Because symbols are abstract and not limited to representing things in the world, mathematicians can use their imagination to create a virtual reality following its own rule system unhindered by what the world is really like – a *counterfactual world*. In this world mathematicians can explore the patterns they encounter.

Yet mathematics is remarkably useful in this world. From building bridges to controlling big data touchline strategy in football, mathematics lies at the heart of the modern world. For example, the square root of -1 might seem like a part of an abstract mathematical game, but it turns out to be really useful for modelling electrical circuits.

If mathematics really is so other-worldly, how come it has so much to say about this one? This question is an important one that motivates much of what follows.

Purpose: mathematics for its own sake

Recall the map metaphor from Chapter 1.1 **Knowledge and the knower**. Knowledge and the knower is taken to be like a map that is used for a particular purpose such as solving a particular problem or answering a question. The map is a simplified picture of the world whose simplicity is its strength. It ensures that we get the job done with the least cognitive cost. If this is right, then it is natural to ask about the purpose of the particular map. What problems does it solve or what questions does it answer? For mathematics there seem to be two categories: those questions which occur strictly within the virtual reality of mathematics itself (mathematics for its own sake); and those that occur in the world outside (mathematics as a tool). These categories broadly correspond to two subdivisions of mathematics itself that are often two different departments within a university: *pure mathematics* and *applied mathematics.*

This section deals with pure mathematics.

An example of a problem in pure mathematics might be how to solve the equation

1. $$x^3 - 2x^2 - x + 2 = 0$$

The task is to find a value for x that satisfies the equation. An initial strategy might be to try a value for x to see whether it fits. If we try $x = 0$ then equation (1) gives us that

2. $$0^3 - 2.0^2 - 0 + 2 = 0 \qquad \text{i.e. } 2 = 0$$

which is clearly not true. So, we can say that $x = 0$ is **not** a solution to the equation. But if we try $x = 1$ equation (1) gives us

3. $$1^3 - 2.1^2 - 1 + 2 = 0$$

In other words, $1 - 2 - 1 + 2 = 0$ which is true. So, $x = 1$ is a solution to the equation.

The trick now, as the mathematics HL students will know, is to factor out $(x - 1)$ from the equation (1) to give:

4. $$(x - 1)(x^2 - x - 2) = 0$$

We can now try to find values of x that make the second bracket in equation (4) equal to 0. This can be done either by trying out hopeful values of x (2 seems to be a good bet, for example), or using the quadratic formula. We end up with $x = 2$ or $x = -1$.

The equation therefore has three solutions: $x = 1$ or $x = -1$ or $x = 2$.

The history of problems like this illustrates the great attraction of doing pure mathematics. Certainly, these problems were of interest from the 7th century onwards in what is now the Middle East – the home of algebra. The great 11th-century Persian mathematician-poet, Omar Khayyam, wrote a treatise about similar so-called cubic equations and realised they could have more than one solution.

By the 16th century, cubic equations were of public interest. In Italy contests were held to showcase the ability of mathematicians to solve cubic equations, often with a great deal of money at stake. One such contest took place in 1635 between Antonio Fior and Niccolò Tartaglia. Fior was a student of Scipione del Ferro who had found a method for solving equations of the type $x^3 + ax = b$ known as the 'unknowns and cubes problem' (where a and b are given numbers). Del Ferro kept his method secret until just before his death when he passed the method on to his rather mediocre student Antonio Fior. Fior began to boast that he knew how to solve cubics. In 1535, Niccolò Tartaglia (1500–1557) announced that he had been able to solve a number of cubic equations successfully. Fior immediately challenged him to a contest. Each was to give the other a set of 30 problems and put up a sum of money. The person who had solved the most after 30 days would take all the money. Tartaglia had produced a method to solve a different type of cubic $x^3 + ax^2 = b$. Fior was confident that his ability to solve cubic equations would defeat Tartaglia and submitted 30 problems of the 'unknowns and cubes' type, but Tartaglia submitted a variety of different problems. Although Tartaglia could not initially solve the 'unknowns and cubes' type of equation he worked hard. On the night of 13 February 1535, Tartaglia discovered a method to solve this type of problem. He then managed to solve all of Fior's problems in less than two hours. In the meantime, Fior had made little progress with Tartaglia's problems and it was obvious who was the winner. Tartaglia did not take Fior's money though; the honour of winning was enough.

Figure 3 Niccolò Fontana Tartaglia (1499–1557)

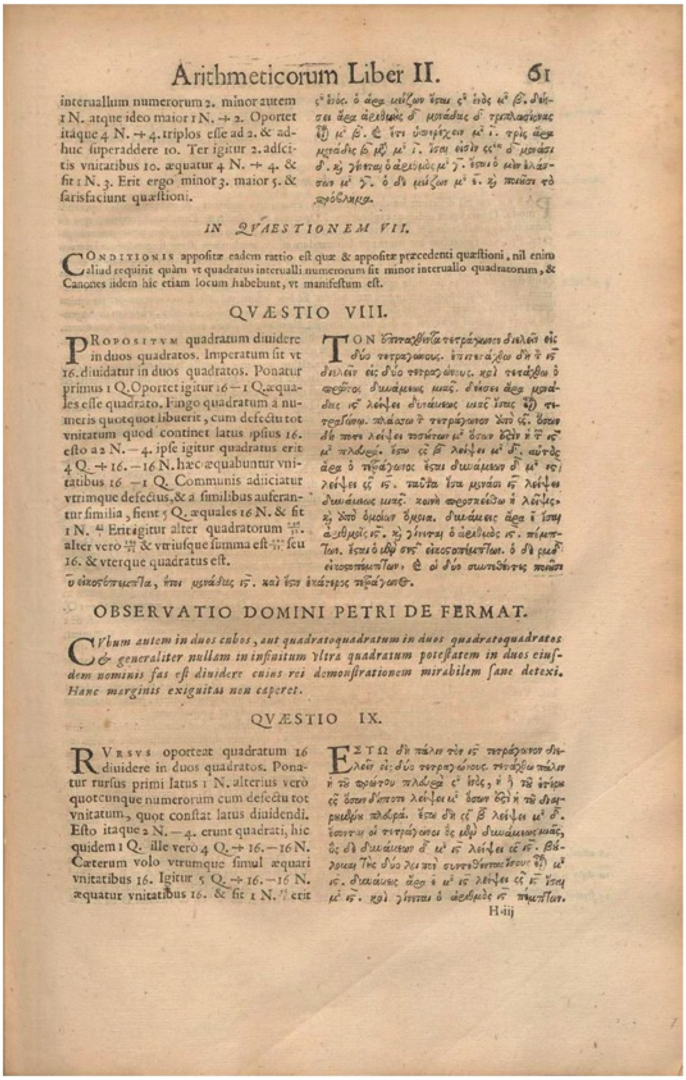
Tartaglia represents the essence of the pure mathematician: someone who is intrigued by puzzles and has the deep urge to solve them. It is the problem itself that is the motivation, not the possible real-world applications.

A modern example is the proof of Fermat's conjecture by Andrew Wiles. A conjecture is a piece of mathematics that is thought to be true but is not yet proved. The French mathematician Pierre de Fermat wrote the conjecture in 1637 as a short observation in his copy of the *Arithmetics of Diophantus*.

The conjecture is that the equation

$$A^n + B^n = C^n$$

where A, B, C are positive integers and $n > 2$, has no solution. Despite a large number of attempts to prove it the conjecture remained unproved for 358 years until Wiles published his successful proof in 1995. A proof is a piece of mathematical reasoning that establishes the truth of a mathematical statement. We shall examine proof a little later in this chapter. Wiles's proof is advanced and way beyond the scope of this book, but there have been a number of interesting books written and TV programmes made about it (see Simon Singh *Fermat's Last Theorem* (1997) and the BBC Horizon programme *Fermat's Last Theorem* (1996)). As mathematician Roger Penrose remarked: 'Q.E.D.: how to solve the greatest mathematical puzzle of your age. Lock self in room. Emerge seven years later.'



Arithmeticorum Liber II. 61

interuallum numerorum 2. minor autem 1 N. atque ideo maior 1 N. + 2. Oportet itaque 4 N. + 4. triplos esse ad 2. & adhuc superaddere 10. Ter igitur 2. adscitis vnitatibus 10. æquatur 4 N. + 4. & fit 1 N. 3. Erit ergo minor 3. maior 5. & satisfaciunt quæstioni.

IN QVAESTIONEM VII.

CONDITIONIS appositæ eadem ratio est quæ & appositæ præcedenti quæstioni, nil enim aliud requirit quàm vt quadratus interualli numerorum sit minor interuallo quadratorum, & Canones iidem hic etiam locum habebunt, vt manifestum est.

QVÆSTIO VIII.

PROPOSITVM quadratum diuidere in duos quadratos. Imperatum sit vt 16. diuidatur in duos quadratos. Ponatur primus 1 Q. Oportet igitur 16 − 1 Q. æquales esse quadrato. Fingo quadratum a numeris quotquot libuerit, cum defectu tot vnitatum quod continet latus ipsius 16. esto a 2 N. − 4. ipse igitur quadratus erit 4 Q. + 16. − 16 N. hæc æquabuntur vnitatibus 16 − 1 Q. Communis adiiciatur vtrimque defectus, & a similibus auferantur similia, fient 5 Q. æquales 16 N. & fit 1 N. [illegible] Erit igitur alter quadratorum 256/25. alter vero 144/25 & vtriusque summa est 400/25 seu 16. & vterque quadratus est.

OBSERVATIO DOMINI PETRI DE FERMAT.

CVbum autem in duos cubos, aut quadratoquadratum in duos quadratoquadratos & generaliter nullam in infinitum vltra quadratum potestatem in duos eiusdem nominis fas est diuidere cuius rei demonstrationem mirabilem sane detexi. Hanc marginis exiguitas non caperet.

QVÆSTIO IX.

RVRSVS oporteat quadratum 16 diuidere in duos quadratos. Ponatur rursus primi latus 1 N. alterius verò quotcunque numerorum cum defectu tot vnitatum, quot constat latus diuidendi. Esto itaque 2 N. − 4. erunt quadrati, hic quidem 1 Q. ille verò 4 Q. + 16. − 16 N. Cæterum volo vtrumque simul æquari vnitatibus 16. Igitur 5 Q. + 16. − 16 N. æquatur vnitatibus 16. & fit 1 N. [illegible] erit

H iij

Figure 4 Fermat's last theorem in a commentary on Diophantus ('Observatio Domini Petri de Fermat')

Purpose: mathematical models

Unlike pure mathematics, which is about the solution of exclusively mathematical puzzles, applied mathematics is about solving 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 a piece of applied mathematics is judged by whether it can be usefully applied in the world.

Here is an example of applied mathematics at work. This is a problem that could have been posed in a physics course.

Problem: A stone is dropped down a 30 metre well. How long will it take the object to reach the bottom of the well neglecting the effect of air resistance?

The usual way to solve this type of problem is to use what we call a *mathematical* model. The essence of mathematical modelling is to produce a description of the problem where the main physical features become variables in an equation. The equation is then solved and translated back into the real world.

To model the situation above:

We know that the acceleration due to gravity is $9.8\,\mathrm{m\,s^{-2}}$, 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 and get

$30 = \frac{1}{2}(9.8)t^2$

Rearranging the equation gives us:

$\frac{60}{9.8} = t^2$ so $t = \sqrt{\frac{60}{9.8}} = 2.47$ s

Time (s) t	Speed ($\mathrm{m\,s^{-1}}$) $v = 9.8.t$	Distance (m) $s = \frac{1}{2} \times 9.8.t^2$
0	0	0
0.5	4.9	1.2
1.0	9.8	4.9
1.5	14.7	11
2.0	19.6	19.6
2.48	24.3	30

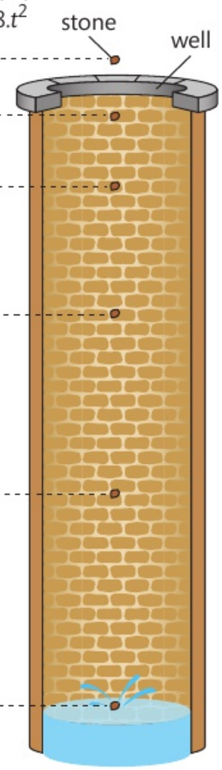


Figure 5 Using mathematics to model the real world – a stone falling down a well

There are three points to make about the process here that are typical of mathematical models.

1. The model neglects factors that are known to operate in the real-world situation. There are two big assumptions made here: that the stone will not experience air resistance, which would act as a significant drag force; and that the acceleration due to gravity is constant.
2. The model appeals to a law of nature. In this case the law of acceleration due to gravity.
3. There are values in the model (such as the acceleration due to gravity) that are established by experiment.

We know that neither of the assumptions in (1) is true. The effect of air resistance can be highly significant. We know that if you have the misfortune to fall from an plane above 100 m or so, the height does not matter – the speed of impact with the ground will be the same, around 150 km/h because of the effect of air resistance (although it matters *how* you fall). The changing strength of gravitational force is a less important factor for normal wells. But if we were dealing with a well that was 4000 km deep then this factor would be significant. The point is that the model is actually fictional (it even breaks a major law of physics!). It could *never* be true in the sense of exactly corresponding to reality. However, it is a sort of idealisation that we accept because the model provides an approximation to the behaviour of the stone (although for deeper wells not such a good one) and more importantly it gives us *understanding* of the system. If we were to make the modelling assumptions more realistic, the mathematics in the model would become too complicated to solve easily. Points (2) and (3) show us that the actual content of the model depends on something outside mathematics – namely some well-established results in physics. The mathematics is only a tool, albeit an important one. A model is a mathematical map – it is a simplified picture of reality that is useful.

Another beautiful example is the Lotka–Volterra model of predator–prey population dynamics in biology. This model was proposed by Alfred Lotka in 1925 and independently by Vito Volterra in 1926.

The model assumes a closed environment where there are only two species: prey and predator and no other factors. The rate of growth of prey is assumed to be a constant proportion A of the population. The rate at which predators eat prey is B, which is assumed to be a constant proportion of the product of predators and prey. The death rate of predators is assumed to be a constant proportion of the population C and there is a rate of generation of new predators dependent on the product of prey and predators.

These modelling assumptions give rise to a pair of coupled differential equations:

1. $$\frac{dx}{dt} = Ax - Bxy$$
2. $$\frac{dy}{dt} = -Cy + Dxy$$

A modern computer package gives the following evolution over time of prey and predators:

It is interesting to look at a diagram that represents (x, y) with each point as a combination of numbers of prey and predators. Here the evolution of the system

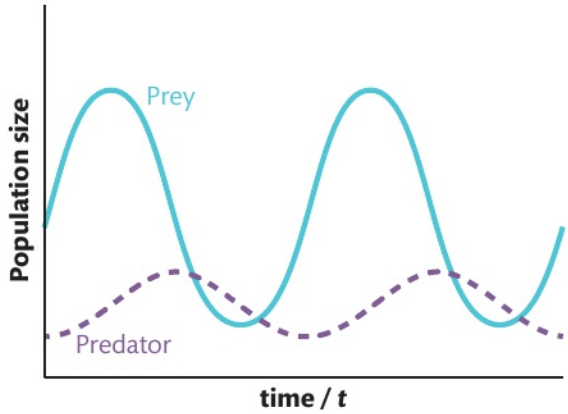


Figure 6 Evolution of prey and predator populations over time

over time appears as a closed loop around the stationary point (C/D, A/B) which is an 'attractor' of the dynamical system. (Mathematics higher level students should try to prove that this is a stationary point). The position of an orbit around the attractor depends on the initial numbers of prey and predator. Notice that starting the model with too great a population of prey could end up with an extinction of predators because the high prey numbers leads to overpopulation of predators, for whom there is not enough prey left to eat. The system itself is a nice example of circular causality where the number of prey causes a change in the number of predators, in turn, causing a change in the number of prey.

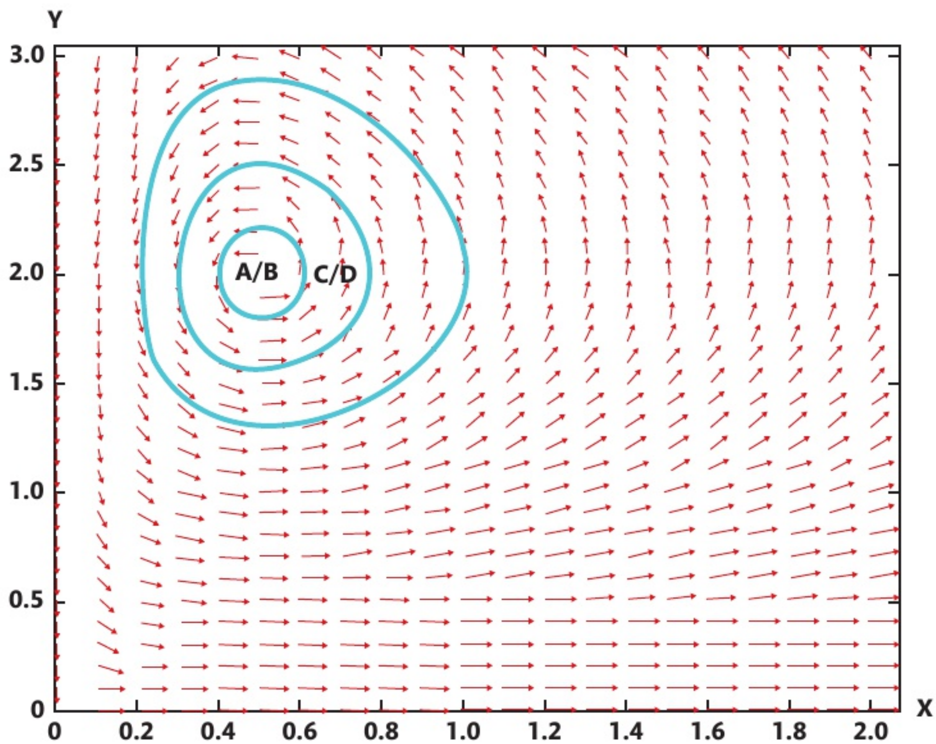
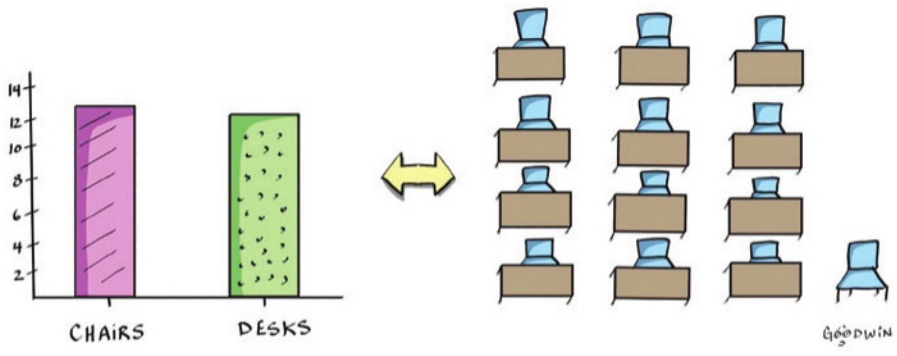


Figure 7 A phase space diagram with the number of prey (in units of 1000) on the *x*-axis, and the number of predators on the *y*-axis.

As with the previous example, the modelling assumptions ensure that the mathematics remains simple enough to solve but the cost is that the model is not realistic. It is assumed that the prey do not die from natural causes, or that the predators do not come into existence except through the provision of food. There is no competition between either prey or predators. Nonetheless, the model provides some important and powerful insights about the nature of population dynamics. As the model becomes more sophisticated and more factors are taken into consideration, not only does the mathematics become rapidly more difficult, but we lose sight of clear trends in the model (such as orbits around stationary points in phase space). We gain accuracy but lose understanding. This is a characteristic of both models and maps. A map that is as detailed as the territory it depicts is no use to anyone. It is precisely the simplification (literally what makes it false) that makes it useful.



Maps must simplify to be useful.

The distinction between pure and applied mathematics becomes blurred in the hands of someone like the great Carl Friedrich Gauss (1777–1855). He was perhaps happiest in the realm of number theory which he called the 'Queen of mathematics', and the idea that queens stay in their ivory towers and do not dirty their hands in the ways of the world was perhaps not so far from his thinking. He found great satisfaction in working with patterns and sequences of numbers. But then this is the same Gauss who, as a young man, had enabled astronomers to rediscover the minor planet Ceres (after they had lost it in glare of the sun) by calculating 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 real scientific problem.

Who would have guessed that recent work in prime number theory would give rise to a system of encoding data that is used by banks all over the world? This is a wonderful example of a piece of pure mathematics inspiring a useful piece of technology. (See Chapter 2.2 **Knowledge and technology**.) The system is called *dual key cryptography*. The clever part is that the key to the code is a very large number which is the product of two 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. For example, present computer programs would take longer than the 13.8 billion years since the big bang to find the two prime factors of the number:

25,195,908,475,657,893,494,027,183,240,048,398,571,429,282,126,204,032,027,777,137,836,0
43,662,020,707,595,556,264,018,525,880,784,406,918,290,641,249,515,082,189,298,559,149,1
76,184,502,808,489,120,072,844,992,687,392,807,287,776,735,971,418,347,270,261,896,375,0
14,971,824,691,165,077,613,379,859,095,700,097,330,459,748,808,428,401,797,429,100,642,4
58,691,817,195,118,746,121,515,172,654,632,282,216,869,987,549,182,422,433,637,259,085,1
41,865,462,043,576,798,423,387,184,774,447,920,739,934,236,584,823,824,281,198,163,815,0
10,674,810,451,660,377,306,056,201,619,676,256,133,844,143,603,833,904,414,952,634,432,1
90,114,657,544,454,178,424,020,924,616,515,723,350,778,707,749,817,125,772,467,962,926,3
86,356,373,289,912,154,831,438,167,899,885,040,445,364,023,527,381,951,378,636,564,391,2
12,010,397,122,822,120,720,357. (du Sautoy, 2004)

But this number is indeed 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.

Just as we found in the natural sciences that pure research produced results 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 useful techniques for solving problems with strong applications in the world outside mathematics. Mathematicians often practise their art as art for its own sake. They are motivated by the internal beauty and elegance of their subject. Nevertheless, it often happens that pure mathematics created for no other purpose than solving internal mathematical problems, turns out to have some extraordinary and practical applications.

Things to think about

- Design your own high school curriculum. What subjects do you think should be available for students to study at the age of 16? What subjects, if any, should be compulsory? If you included mathematics as part of your curriculum, why did you do so?
- Reflect on the role that mathematics plays in your life.
- Do you think it is possible to be creative in mathematics?
- Why do you think it is so difficult to pin down what mathematics, as an area of knowledge, is about? Show an older person your maths textbook. Has the mathematics taught in school changed over the generations? Are the claims made in earlier textbooks still true? What explains differences in mathematics syllabi over time?
- Should society allocate resources to making advances in pure mathematics? How could you justify the use of public money for this purpose?

Knowledge questions

- Why is mathematics so important in other areas of knowledge, particularly the natural sciences?
- How have technological innovations, such as developments in computing, affected the scope and nature of mathematics as an area of knowledge?
- Is absolute certainty attainable in mathematics?
- Is mathematics better defined by its subject matter or its method?
- Does mathematics only yield knowledge about the real world when it is combined with other areas of knowledge?
- Is there a hierarchy of areas of knowledge in terms of their usefulness in solving problems?

Perspectives

In this section we shall look at some different perspectives on mathematics. Most of the section will be concerned with two contrasting views of the nature of mathematics itself. The final part will discuss the role of the perspective of the individual in the production of mathematical knowledge.

Mathematics is perhaps unique in the sense that mathematicians themselves disagree about what it is they are doing and what sort of thing mathematics is. There are, roughly speaking, two broad approaches to this question: the *constructivist* and the *Platonist* views. Here is a brief summary of these perspectives to get us started:

	Constructivist	**Platonist**
What is mathematics?	Mathematics is constructed by human beings. The objects of mathematics do not exist independently of us.	Mathematics is out there in the world. It exists independently of human beings.
Do mathematical objects exist?	No, not outside the human imagination.	Yes, they exist in the world independently of human beings.
What do mathematicians do?	They construct mathematics.	They discover the mathematics that exists out there in the world.
What is a good metaphor for doing mathematics?	Playing an elaborate game.	Doing science: finding out what is out there in the world.
What is a mathematical proof?	It is a sequence of moves in the game of mathematics.	It is a rigorous logical deduction based on realistic premises.
What is a mathematical truth (theorem)?	An endpoint in the mathematical game played by humans.	An eternal truth about the universe.
What are the main advantages of the view?	Captures the essentially human character of maths as being a virtual world made by us.	Explains why mathematics is so useful in understanding the world – because it underlies it!
What are the main problems of the view?	Explaining why mathematics is so useful.	Explaining where mathematics is in the world – it is not obvious.

Constructivist view of mathematics

Broadly speaking, the constructivist sees mathematics as a human invention. The vision we had of mathematics as a vast virtual reality, limited only by the imagination and a special set of 'rules of the game', is a constructivist view. However, we are then bound to ask why mathematics has so many useful applications in the *real* world. Why is mathematics important when it comes to building bridges, doing science and medicine, economics, and even playing basketball? Chess is also a game invented by humans, but it does not tell us how to build bridges. Can constructivism account for the success of mathematics in the outside world?

On this view mathematics is what might be called a social fact. A social fact is true by virtue of the role that it plays in our social lives. Social facts do have real causal power in the world. That a particular piece of paper is money is a social fact. But, as we know, money can make things happen. That piece of paper acquires its status ultimately from a set of *language acts* – performances that change the social world (see Chapter 2.3 **Knowledge and language**).

The mathematician Reuben Hersh argued that numbers and other mathematical objects are social facts and that the whole of mathematics is a social or cultural construction – a view that he called *humanism*. Here he is, defending this view:

> [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 other things which are very real, but only as part of collective human consciousness. That's what math is.
>
> (Reuben Hersch, 2018)

Hersh called his theory of mathematics humanism because it's saying that maths is something human. 'There's no math without people. 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.'

He pointed out that we do use numbers to describe physical reality and that this seems to contradict the idea that numbers are a social construction. It is important to note here 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 thought 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 mathematics game – our deduction from axioms – that is, the self-evident starting points of mathematical reasoning. It is a human creation.

It is perhaps surprising that Hersh thought that his view carried both political and educational implications. He thought that a humanistic vision of mathematics chimed 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 mathematics is constructed – the institutions that build and maintain the area of knowledge of mathematics – become important. These arrangements are political. Particularly interesting for us is how a different view of mathematics can bring about changes in teaching and learning.

Here is Hersh again, criticising the conception of mathematics in schools as being based on algorithms – basic rule following.

> 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 [...] 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. There is a widespread view that mathematics polarises society into two distinct groups: those who can do it and those who cannot. Those who cannot do it often feel the stigma of failure and that there is an exclusive club whose membership they have been denied. Those who can do it often find themselves labelled as 'nerds' or as people who are, in some sense, socially deficient. Was Hersh right in attributing this to a formalistic or Platonist view? Was he right to suggest that if mathematics is just a meaningless set of formal exercises, then it will not be valued by society? If we deny that mathematics is out there to be discovered, it takes the stigma away from the particular individual who does not make the discovery. It is interesting to speculate what consequences in the classroom flow from a constructivist view of mathematics.

Platonist view of mathematics

One way to explain why mathematics applies so well to things like bridges and planets is simply to take mathematics as being out there in the world, independent of human beings. As with other things in the natural world it is our task to discover it (literally to 'lift the cover'). This is called the *Platonist* view because the philosopher Plato (427–347 BCE) took the view that mathematical objects belong to the real world underlying the world of appearances in which we live. Mathematical objects such as perfect circles and numbers exist in this real world; circles on Earth were mere inferior copies of them. Many mathematicians have at least some sympathy with this view. They talk about mathematical objects as though they have an existence independent of us and that we 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 that they are trying to discover truths about it, much like natural science discovers truth about the physical world.

This view is not without problems. In TOK we might want to ask: 'If maths is out there in the world, where is it?' We do not see circles, triangles, $\sqrt{2}$, π, i, e, and other

Figure 8 A Tennessee cicada

mathematical objects obviously floating around in the world. We have to do a great deal of work to find them through inference and abstraction.

While this might be true, there is some evidence that mathematics is hidden not too far below the surface of our reality. Take prime numbers as an example. They are the building blocks out of which all numbers are made. It would be a boost to the Platonist view if they could be found somewhere in nature.

One place to 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 then dying. The cycle is then repeated. There is another type of cicada that has the same cycle and no fewer than 12 types that have a cycle of 17 years. There are none that have cycles of 12, 14, 15, 16, or 18 years. The cicada seems to ‘know’ about prime numbers. How is this?

One theory is that prime numbers are part of a predator avoidance strategy. The cicadas emerge at about the same time, leading to high densities of the organism (as many as 1.5 million per acre according to Dybas and Davis (1962)). This is a strategy called *predator satiation*. The predators will have enough of the cicadas to satisfy them and therefore many will be left to complete their life cycle. The only threat to this strategy is that the numbers of predators are boosted by the extra prey and are able to coincide with the cicadas in the next cycle. But this would mean that the predators would have to have a cycle that was exactly the same as the cicada, for example 17 years, because no other numbers divide into 17 because it is prime. (If a predator had a lifecycle of six years, a particular batch of prey and the predator would only meet every $6 \times 17 = 102$ years). On this theory, nature has discovered prime numbers by evolutionary trial and error.

The relationship of nature to geometry is explored by the Scottish biologist D’Arcy Wentworth Thompson in his magnificent book of 1917 *On Growth and Form*. He explores the formation of shells and the wings of dragonflies, examines the skeletons of dinosaurs through the eyes of a civil engineer constructing bridges, and wonders about the formation of bee cells and the arrangement of sunflower seeds.

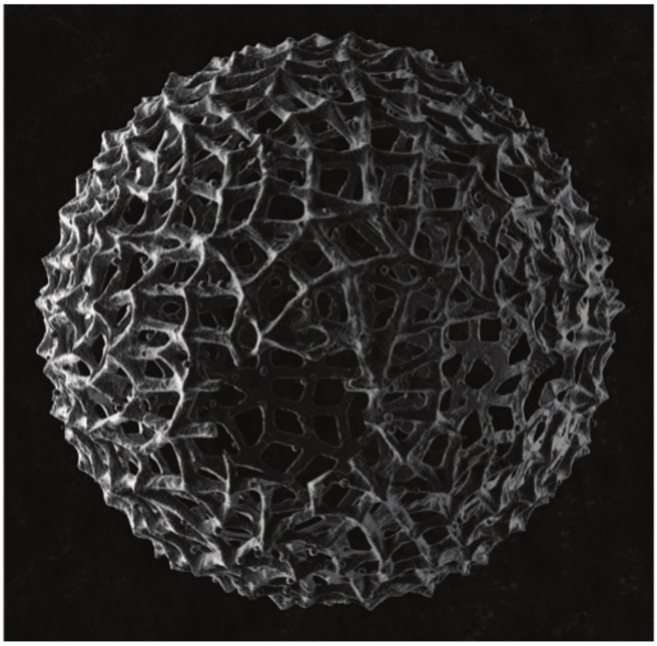


Figure 9 The shell of the radiolarian *Aulonia hexagona*

Certainly, examples like these could be taken by the Platonist as evidence for mathematics underlying our natural world.

An individual perspective

Another aspect of perspectives in mathematics is the role played by great individuals. Perhaps more than in other fields, mathematicians tend to work on their own without collaborating with others. Individual mathematicians have qualities that allow them to make unique contributions to the field. Are there qualities that mathematicians should possess to be good knowers?

There are undoubtedly special qualities well suited to doing mathematics. There are a host of great mathematicians from Archimedes, Euclid, Hypatia, through to Andrew Wiles, Grigori Perelman, and Maryam Mirzakhani, who contributed significantly to the area. Although mathematics is collaborative in the sense that mathematicians build on the work of others and take on the challenges that the area itself has recognised as being important, 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 difficult 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.

Here is the late Maryam Mirzakhani, who won the Fields Medal (the equivalent of the Nobel Prize in mathematics) in 2014 and was the first woman to do so.

Figure 10 Maryam Mirzakhani (1977–2017)

I don't have any particular recipe [for creating new proofs], it is the reason why doing research is challenging as well as attractive. It is like being lost in a jungle and trying to use all the knowledge that you can gather to come up with some new tricks, and with some luck you might find a way out.

This is a great honor. I will be happy if it encourages young female scientists and mathematicians, I am sure there will be many more women winning this kind of award in coming years.

Things to think about

- Why is it that the common view is that mathematics is a good indicator of intelligence? Do you think this view is correct?
- Why is it OK in many Western societies to say that you are hopeless at maths, but not OK to say that you are illiterate? (Politicians often boast about how little maths they know but it would be political suicide to admit that you had never heard of Shakespeare.)
- Was Hersh right in dividing society into maths-friendly sociopaths and mathematical illiterates, and attributing this division to formalistic Platonist teaching?
- Why is stigma often attached to poor performance in mathematics rather than, say, in the arts?
- To what extent is mathematical knowledge *knowing how* rather than *knowing that*?

Knowledge questions

- What is it about mathematics that enables mathematical results to remain unchanged over time?
- How significant have notable individuals been in shaping the nature and development of mathematics as an area of knowledge?
- What is the role of the mathematical community in determining the validity of a mathematical proof?
- Is mathematical knowledge embedded in particular cultures or traditions?
- Does personal experience play any role in the formation of claims in mathematics?
- Is progress harder to make in mathematics than in other areas of knowledge?
- If mathematics is created by humans, is it still possible to accept mathematical truths as objective facts about the world?
- Are all of the areas of knowledge in the TOK course themselves embedded in a particular tradition or bound to a particular culture?

Methods and tools

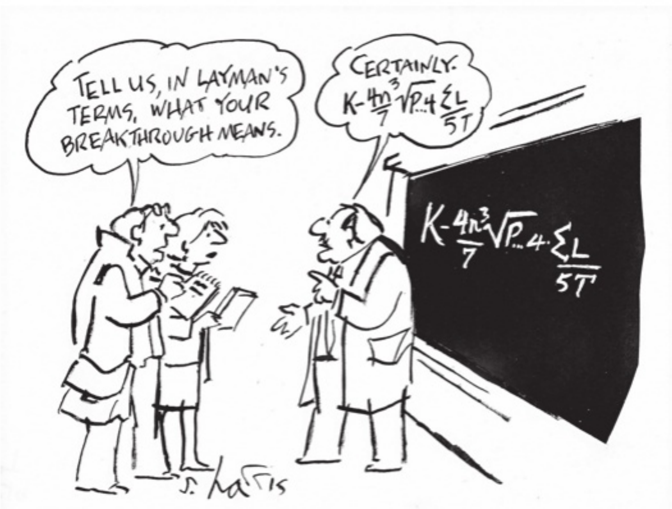
The language and concepts of mathematics

Knowledge in mathematics could be like a map representing some aspect of the world. Like other areas of knowledge, then, it possesses a specialised vocabulary naming important concepts to build this map. Unlike some areas, this vocabulary is precisely defined. This makes sense. If the world of mathematics is populated by some rather esoteric objects that are literally like nothing on Earth, then it is important that these objects are precisely specified.

Notation

Since mathematical objects are abstract and we cannot point to them, we have to represent them with symbols. But the symbol and the idea that it represents are different things – there is a danger that we confuse them. Take representations of fractions. The symbols $\frac{1}{3}$, $\frac{2}{6}$, $\frac{3}{9}$, 0.3333… all name the same number despite appearing to be different. Some symbols such as $\frac{1}{0}$, $\sin^{-1}(1.2)$ or $\log(-2)$ have no meaning at all. More worrying is that an expression such as 'the smallest real number bigger than 1' doesn't actually mean anything either. This is because there is no smallest real number bigger than 1 (think carefully about this).

Similarly, the fact that there are different conventions for writing mathematics does not mean that the mathematics is different. Some conventions represent the number $\frac{3}{10}$ by the decimal 0.3, others by 0,3 – either way the mathematics is the same and these do not really count as different mathematical cultures. Carl Friedrich Gauss, according to many the greatest mathematician ever to have lived, said, '*non notationes, sed notiones* (not notations but notions).'



Basic concepts: Sets and mappings

This chapter started with the idea of counting cows in a field. The suggestion was that counting is actually a special type of *mapping* between two sets: numbers in the first set and cows in the second.

Figure 11 Counting is a one–one correspondence mapping between sets.

Each number in the set on the left, maps to only one cow on the right and every cow has an arrow pointing to it. This is called a *one–one correspondence*. This notion can be used to count sets that are very large. Indeed, some sets are *infinite*. This means that they have a cardinality (number of things in them) that cannot be represented by a finite number. The set of even numbers is infinite. So is the set of all positive whole numbers. In fact, the set of even numbers has then same cardinality as the set of positive whole numbers – these sets have the same size – there are as many even numbers as there are positive numbers. We can see this by showing a one–one correspondence (see Figure 12).

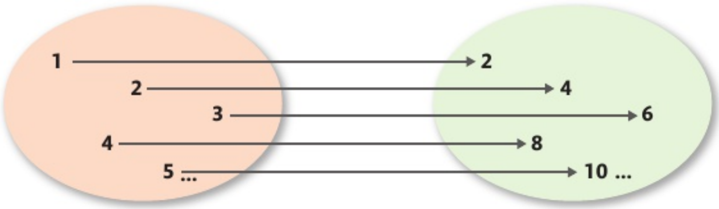


Figure 12 This one–one correspondence shows there are as many even numbers as there are positive whole numbers. The dots indicate that there are infinite numbers missed out on the diagram.

You might realise that there is something mysterious about this. The even numbers are actually a proper subset of the positive whole numbers. Yet there are equally as many of them. In other words, the set of positive whole numbers can be put in a one–one correspondence with a proper subset of itself. This is impossible for finite sets but is a characteristic of infinite sets.

In this way, using sets and mappings, mathematicians can count sets including infinite sets. A nice proof by the German mathematician Georg Cantor (1845–1918) showed using a counting argument that the set of real numbers between 0 and 1 is bigger than the set of positive whole numbers (the proof is beautiful – the interested student should check it out). But they are both infinite sets, suggesting that there are different types of infinity and that the set of real numbers between 0 and 1 is a bigger infinity than the set of positive whole numbers. In fact there are actually an infinite number of different infinities and these 'outnumber' (in a specific mathematical sense) the number of finite numbers. This is an example of *transfinite set theory*, which is studied in most mathematics degree courses at university.

Fractals

Part of the power of mathematics derives from its ability to handle infinite objects like infinite sets. Cantor investigated the properties of the set formed by following the recipe below.

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.

5. Repeat stages 3 and 4 indefinitely.

When you have done this an infinite number of times, what is left over?

The end points of any line segment at any stage in the process are never deleted. So there are some points left over. Moreover since we have repeated the dividing process an infinite number of times there must be an infinite number of points left over. It is impossible to draw the left-over set (the limit set) accurately. In addition, if you zoom in on any small part of the limit set it looks the same as the whole set. (Hint: think about the process of construction.) Furthermore, there are more points in the limit set than the positive whole numbers and no point is connected to any other point.

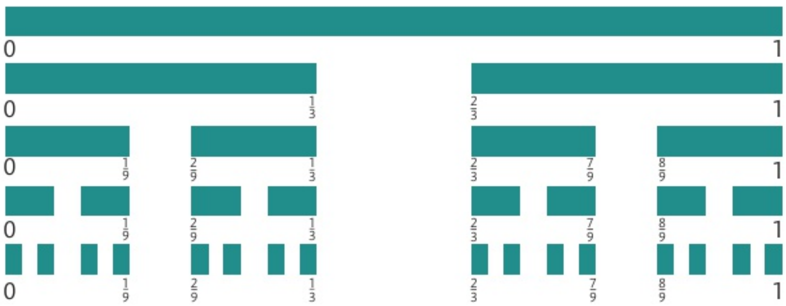


Figure 13 How to produce a Cantor set

The Cantor set is an example of a fractal. That is a set that has so-called 'fractional dimension'. Most fractals have the property of the Cantor set that a small part of the set 'looks' exactly like the whole (is in a special one–one correspondence with the whole). We say that the set is *self-similar*.

Figure 14 is a 3-D Cantor set of a cube. It is sliced up in the same way as the 1-D cantor set and the middle slice is removed at each stage.

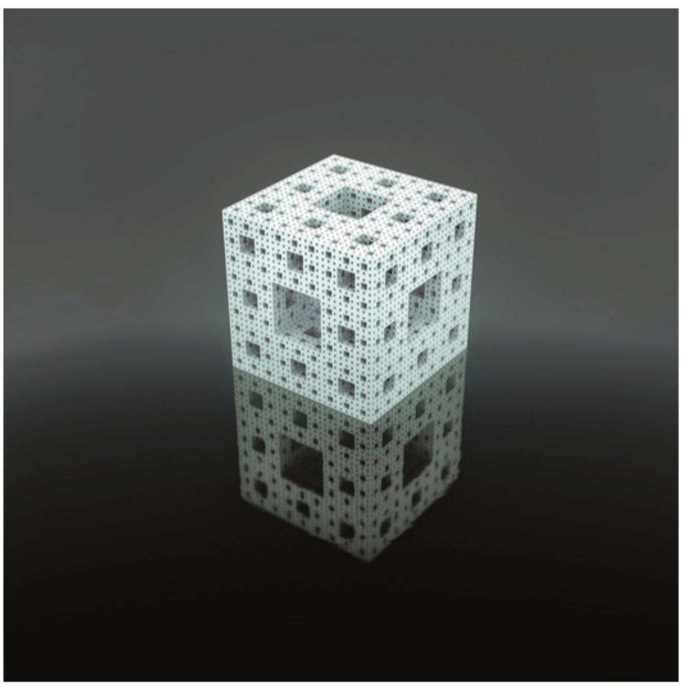


Figure 14 This 3-D Cantor set of a cube is made by deleting the middle slice an infinite number of times.

We can use similar methods to produce 2-D fractals such as the famous Koch snowflake (Figure 15).

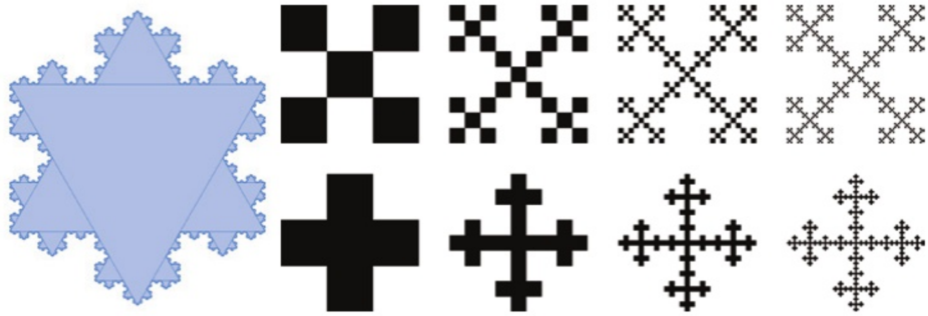


Figure 15 2-D fractals

The production of fractals illustrates the importance of three deep notions in mathematics. We have discussed sets and mappings between sets. The third notion is that of invariance – an invariant is some feature that does not change under a mathematical mapping. The endpoints of the intervals in the construction of the production of the Cantor set do not move (are not removed) during the infinite number of applications of the 'remove the middle third' rule. Generally, given a mapping of a set to itself, mathematicians are interested in those aspects of a set that stay the same under the mapping. These invariants tell us a lot about the sort of mapping it is. So, looking at mappings on the plane, a rotation mapping leaves the centre of rotation invariant, while a reflection keeps the mirror line invariant. It is fair to say that all mathematics is concerned with sets, mappings, and invariance at a deep level – even counting cows.

So far we have collected together some useful concepts and notation. But what about the actual process of doing mathematics? How is mathematical knowledge made? In the rest of this section we shall focus on the methods of mathematics.

Algebra

A staple method used in mathematics is the substitution of letters for numbers. In fact, not just numbers; mathematicians use letters for many sorts of mathematical objects. The reason is that they want to make generalised statements. By using a letter they do not have to commit to making a statement about a specific number but instead can make one about all numbers (an infinite number of them!) of a particular kind at once. This is a powerful tool.

Let us illustrate this by a worked example. Imagine that we want to prove that if we add an odd number to another odd number we get an even number. We hope to show that this is true for any choice of odd numbers. We could proceed by trying out different pairs of odd numbers and checking that the result is even:

$$1 + 3 = 4 \quad \text{even}$$

$$5 + 7 = 12 \quad \text{even}$$

$$13 + 9 = 22 \quad \text{even}$$

$$131 + 257 = 388 \quad \text{even}$$

But you can see that this method will not do as a proof because we would have to check every possible pair of odd numbers and since this set is infinite we would never finish. What we need is to define a general odd number without committing to a particular one. For example, we can define 'odd' by being one more than an even number.

If k is an even number, then we can write $k = 2j$ for some whole number j.

If m is an odd number, then we can write $m = 2j + 1$ for some whole number j.

All we have to do now is to add two of these general odd numbers together.

So, we want to take two odd numbers – let us say $m = 2j + 1$ and $n = 2i + 1$ where j and i are whole numbers. There is a subtlety here because we use different letters j and i for the whole numbers in the expressions above because we want to allow m and n the possibility of being different odd numbers. If we used the same, say j, in the expressions for m and n then we would be making our odd numbers equal and we would only have proved that if we add together two equal odd numbers, then the result is even.

Now we have to use some symbolic rules.

$$m + n = (2j + 1) + (2i + 1)$$

We can remove the brackets and rearrange to give:

$$m + n = 2j + 2i + 2$$

Finally, we can use the fact that 2 is a common factor of all terms in the expression to place it outside a bracket.

$$m + n = 2(j + i + 1)$$

But j, i, and 1 are all whole numbers so $j + i + 1$ is also a whole number (technically, this comes from the fact that the whole numbers are *closed under the operation of addition* because they form an important structure called a *group*). Let us call this whole number p.

So, we have that $m + n = 2p$. But this is precisely the definition of an even number that we started with. An even number is 2 times a whole number. So, this proves that any two odd numbers added together makes an even number.

The big chain of reasoning above is called *a proof*. It is immensely powerful because it covers an infinity of situations. There is an infinity of possible pairs of odd numbers to which the result applies. This is the power and beauty of using letters for numbers – a practice that was developed in Baghdad and Damascus about 1000 years ago.

Proof

Proof is the central concept in mathematics because it guarantees mathematical truth. If, and only if, something is proved can we say that it is true.

This type of truth is independent of place and time. In contrast to the science of the day, the mathematical truths of Pythagoras are just as true today as they were then, indeed his famous theorem is still taught today to 6th graders. But the science of the time has long been rejected. There were four chemical elements in the 4th century BCE and Aristotle thought that the heart was the organ for thinking. Actually, we do not have to go far back in time to find textbooks in the natural sciences that contain statements that we would dispute today. The truths of the natural sciences are always subject to revision but mathematical truths are eternal.

But there is something even more striking about mathematical truths – that is, mathematical statements that have been proved. A statement such as 'odd + odd = even' has such power that we can say that it is *certain*. Certain does not just mean that we feel confident about it – this is not psychological certainty. It is certain because *it cannot be otherwise*. The negation of a mathematical truth, to say that 'odd + odd = odd', is to utter a self-contradiction or absurdity. Take a moment to reflect on the sheer power of this statement. This means that there is no *possible* world in which odd + odd = odd (given the standard meanings of these terms). A story that makes this statement is describing a world that is self-contradictory; that is, an absurd and unintelligible world. Such a story is just not credible. But this means that mathematics is radically different from other areas of knowledge, including the natural sciences. It is not a contradiction to say that the Moon is composed of green cheese. There could be universes where this is true but it just happens not to be in ours. Mathematics deals in what we call *necessary truths* while the sciences deal mainly in *contingent truth*.

Info box

Necessary and contingent

A truth is **necessary** if it cannot be otherwise without self-contradiction. It is a necessary truth that all bachelors are unmarried, or that $1 + 1 = 2$. A truth is **contingent** if it could be otherwise without self-contradiction. 'The capital of Australia is Canberra' is a contingent truth. In different circumstances it may have been Sydney. There is no self-contradiction in saying that the capital of Australia is not Canberra. It is just not true, as it happens. Most scientific results are contingent truths about the world.

This is something that students of TOK should think about carefully. What is it about mathematical truth that makes it immune to revision and provides the basis for certainty, and makes the negation of a mathematical truth a contradiction?

Recall that the constructivist sees mathematics as a big abstract game played by human beings according to invented rules. The hero of *The Glass Bead Game*, a novel by the German writer Hermann Hesse, must learn music, mathematics, and cultural history to play the game. On this view, mathematics is just like the glass bead game. There are parallels we can draw between a game like chess and mathematical proof. First, chess is played on a special board with pieces that each can move in a particular way. The pieces have to be set up on the board in a particular fashion before the game can begin. The same is true of mathematical proof. It starts with a collection of statements in mathematical language called *axioms*. They themselves cannot be proved. They are simply taken as self-evidently true and form the starting point for mathematical reasoning.

Once the game is set up we can start playing. A move in chess means transforming the position of the pieces on the board by applying one of the rules of the game governing movement. Typically, in chess a move involves the movement of only one piece. (Can you think of an exception?) If the state of the pieces before the move was legitimate and the move was made according to the rules of the game, then the state of the pieces after the move is also legitimate. The same is true of a mathematical proof. One applies the rules (these are rules of algebra, typically) to a line in the proof to get the next line. The whole proof is a chain of such moves.

Info box

Theorem

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.

Finally, in chess the game ends. Either one of the players has achieved checkmate, or a stalemate or draw has been agreed. Similarly, a mathematical proof has an end. This is a point where the proof arrives at the required result at the end of the chain of reasoning. This result is called a *theorem*.

Once a proof of a mathematical statement is produced we have a logical duty to believe the result, however unlikely. Let us illustrate this with a famous example.

Many people do not believe that $1 = 0.99999999\ldots$ (the three dots indicate that the 9s continue indefinitely). Let us prove it.

The proof is straightforward.

Let	$x = 0.99999999\ldots$
Then	$10x = 9.99999999\ldots$
Subtract both equations	$10x - x = 9.99999999\ldots - 0.99999999\ldots$
This implies	$9x = 9$

Giving $x = 1$ as required.

$0.99999999\ldots$ really does look different from 1 but if the proof works then we are forced to believe that they are the same. (Mathematics higher level students: are you happy with every stage of the proof?)

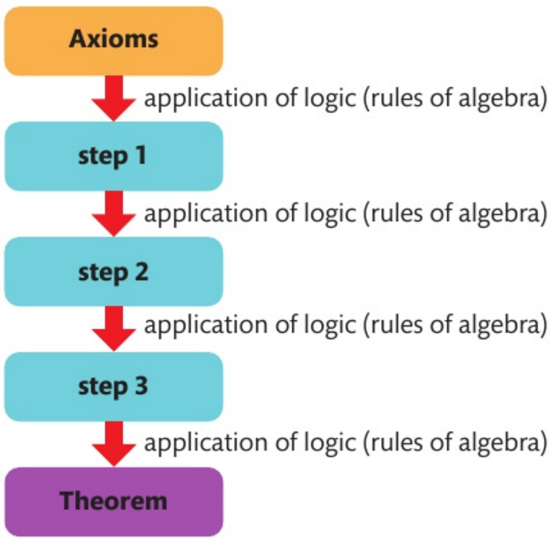


Figure 16 A model of a mathematical proof

Activity 1

One way to illustrate mathematical proof is the following game. Write down the four-letter English word 'SHIP' at the top of a sheet of paper. Your job is to write a list of four-letter English words subject to the rule that each word may differ only in one letter from the word above it. This means three of the letters must be identical to (and in the same position as) those in the word above. Only one letter can be changed. Your aim is to get to the word 'DOCK' – this should be the last word in your list. So you might start

SHIP
SHOP

Try to solve the puzzle. While you are working on it try to be aware of your own thought processes and emotions.

(a) What strategies did you use? Did you try working forwards and backwards? If so, how do you get them to meet in the middle?
(b) Do you think you are being creative in your solution? What is the role of reason?

(c) Are your emotions playing any role in the process?
(d) How do you feel when you have solved it? How do you feel if you cannot solve it?
(e) The game is intended to simulate a mathematical proof. Label the following on your solution: *axiom, theorem, chain reasoning.*
(f) How many solutions to the puzzle are there?
(g) Prove that every solution must contain a word with two vowels.

Things to think about

- What is it about the methods of mathematics that give us a cast-iron guarantee that its results are absolutely certain and there is not a glimmer of doubt attached to them?
- Is it irrational to doubt a mathematical statement that has been proved satisfactorily (say that $1 = 0.99999999\ldots$)?
- 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) Try to construct a situation that satisfies these axioms (this is called a *model in logic*).
  (b) Is yours the only model of these axioms?
- If the axioms of mathematics are simply made-up abstract rules, 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?
- Are there any differences in mathematical conventions in your class? Do you all do long division in the same way? Does it matter?
- Are there cultural variations in mathematics? (Do not count differences in notation as true variations.)
- Do you think that maths textbooks reflect the way mathematics is actually produced?

Knowledge questions

- Is mathematical reasoning different from scientific reasoning, or reasoning in other areas of knowledge?
- What is meant by the term 'proof' in mathematics – and how is this different from, or similar to, what is meant by this term in other areas of knowledge?
- How do mathematicians reconcile the fact that some conclusions seem to conflict with our intuitions?
- What does it mean to say that mathematics is an axiomatic system?
- How is an axiomatic system of knowledge different from, or similar to, other systems of knowledge?
- Do mathematical symbols have meaning in the same way that words have meaning? Is personal experience more important or less important in mathematics compared to other areas of knowledge?

Ethics

Beauty is truth, truth beauty,—that is all / Ye know on earth, and all ye need to know.

(John Keats)

Let us take ethics in its broadest possible interpretation as the search for a good life. This section will investigate how mathematics might contribute to that; not only in a practical sense but also, surprisingly perhaps, in an aesthetic one. The link between mathematics and aesthetic value will be explored first in this section, followed by a discussion of the responsibilities of the mathematician and those who use mathematics to change the world in some way.

Mathematics and aesthetic value

There is a 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. Mathematics seems to endow beauty with a certain eternal objectivity. Things are beautiful because of the mathematical relationships between their parts. This is a public beauty because the mathematical features of an object are available to all. It is a radical idea and opposes traditional subjective theories of beauty, in which aesthetic value depends on the tastes and preferences of the individual observer.

Let us take as an example the builders of the Parthenon on the Acropolis in Athens. They were profoundly impressed by symmetry and proportion. In particular, they were interested in how you could divide a line so that the proportion of the shorter part to the longer part is the same as that of the longer part to the whole. You can check that you get the quadratic equation $x^2 + x - 1 = 0$. The solution to this equation is the *golden section ratio* $X = \frac{-1 + \sqrt{5}}{2} = 0.61803398875\ldots = \phi$. This proportion features significantly in the design of the Parthenon and many other buildings of the period. Since it is also related to the Fibonacci sequence you will find ϕ turning up anywhere where there are spirals. It is used quite self-consciously in painting (Piet Mondrian, for example) and in music (particularly the music of Claude Debussy). There are those who go as far as saying that it is present in the proportions of the perfect human figure and that we have a predisposition towards this ratio.

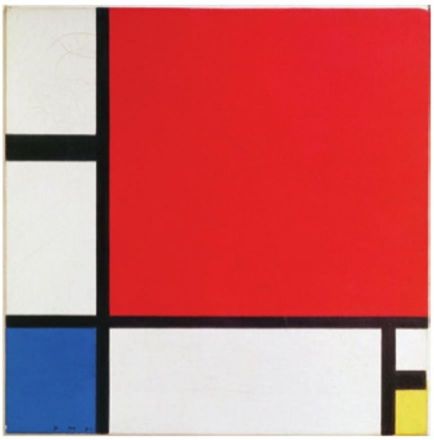


Figure 17 *Composition with Red, Blue, and Yellow* (1930) by Piet Mondrian. The proportion of some of the rectangles in this painting is ϕ.

For the Greeks and Mondrian, mathematics was the key to beauty. But could this work the other way round? Could beauty be the key to truth in mathematics, or anything else for that matter? Ancient Greek thought takes this step. Something that was false could never be beautiful. This view came increasingly under threat from examples, in literature and the arts, of the beautiful (often beautiful women) that were anything but true. Shakespeare writes in Hamlet: 'one may smile, and smile, and be a villain.' Nonetheless many mathematicians allow themselves to be guided to truth in mathematics because of the beauty of the equations. They look for beauty and elegance as an indicator of truth.

Physics is a science that depends on mathematics for its existence, so it is not surprising that this discipline, too, includes many who are guided by considerations of beauty and elegance. Not only is it possible to describe the universe in mathematical terms but the mathematics we need to do this is mostly simple, elegant, and even beautiful. As an illustration let us look at some of the famous equations of physics. Some of you will be familiar with Einstein's field equation and Maxwell's equations.

EINSTEIN FIELD EQUATION
for General Relativity

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

1. $\nabla \cdot \mathbf{D} = \rho_V$
2. $\nabla \cdot \mathbf{B} = 0$
3. $\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
4. $\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t} + \mathbf{J}$

Figure 18 Einstein's field equation and Maxwell's equations.

It is striking 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 rather well. It is difficult to believe that mathematics is just a mind game that we humans have invented.

Figure 19 For Dirac, beauty was an indicator of truth.

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. The physicist Paul Dirac said: '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:

$$(i\partial\!\!\!/ - m)\,\psi = 0$$

Figure 20 Dirac's equation of the electron

The physicist and mathematician, Palle Jorgensen, wrote: '[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.

Mathematics and morality

> My first long haul flight that didn't fill up and an empty row for me 😮 I have been blessed by the algorithm 🙏
>
> (tweet, anonymised, from 2018)

Given the complexity of much mathematics and the inability of many people to understand it, mathematicians might seem to bear a responsibility not only for getting it right but also for making sure that it is used in an ethical manner. Mathematics is ubiquitous in the modern world. It underlies most areas of everyday life, from life insurance premium calculations to airline seating algorithms – complex programs used by computers for assigning seats on aircraft. Mathematical algorithms determine much of the content on your phone, the adverts you see, and the order of results presented to you by a search engine. Mathematics determines the online price of many items, including train and flight tickets; mathematics controls traffic lights, air traffic control, and flight navigation. And, of course, mathematics underlies engineering and scientific applications. It seems fair to say that nothing can be built in this world without mathematics. Mathematicians are indirectly in control of large parts of our lives.

To what extent then are mathematicians responsible for the use that is made of their work? The problem here is similar to that in the natural sciences. Mathematicians are often far in time and space from the applications of their work. They produce it, like much pure research, in the spirit of pushing back the boundaries of human knowledge. At the point of production they do not know how it is to be used.

An example here is a general algorithm that underlies a lot of online applications, called the Bellman–Ford algorithm. It is a result that gives a systematic way of finding out how to navigate a set of points joined by lines in an optimal way (for example, visiting all the points but minimising the distance travelled). Richard Bellman and Lester Ford published their results in 1958 based on earlier work by Alfonso Shimbel. At that point they could have had no idea that their algorithm would have so many applications. After all, in 1958 the internet did not exist and digital computers were in their infancy. They were motivated by a general abstract problem, not by any potential applications. It does not seem reasonable that they should be held responsible for any misuse of their algorithm. Yet in many cases it promotes discriminatory and predatory pricing for online goods and services and underlies the more complex algorithms that place content, say advertisements, on your phone.

There are many more examples like this where pure mathematics plays a key role in new technologies having the potential to disrupt people's lives. Think of the number theory that is required to mine bitcoin for example. But there are also more obvious cases. Mathematicians work in areas such as the production of military hardware, or the building of drones and robots designed ultimately to kill human beings. In these areas the link between the knowledge of mathematics and the final application is more direct and it is easier to apportion praise or blame; that is, to make ethical judgements.

Things to think about

- What assumptions underlie the claim that beauty and truth are correlated?
- Do mathematicians bear any extra responsibility over and above their responsibility as producers of knowledge for the quality of knowledge that they produce?
- What personal qualities are required to be a good mathematician? Produce your own list of learner profile attributes for mathematicians.
- To what extent is mathematics a collaborative area of knowledge?
- Should mathematicians or statisticians take the blame for the misuse or misrepresentation of statistical data?
- **Challenge** To what extent are mathematicians responsible for the 'measurement problem' – the idea that anything worthwhile in life has to be measurable?

Knowledge questions

- If mathematical knowledge is highly valued, does this place special ethical responsibilities on mathematicians when they are making claims?
- On what criteria could we decide whether mathematicians should be held responsible for unethical applications of their work?
- Is it ethically justifiable for academic mathematicians to spend time doing research that does not have immediate useful applications?
- Do mathematical judgements and ethical judgements face similar challenges in terms of the evidence available to support them?

Conclusion

We have seen that mathematics is one of the crowning achievements of human civilisation. Its ancient art has been responsible not only for some of the most extraordinary intellectual journeys taken by the human race, but its methods have allowed the building of great cities, the production of great art, and it has been the language of great science.

From a TOK perspective, mathematics, with its absolute and unchanging notion of necessary truth, makes a good contrast to the natural sciences with their reliance on observation of the external world, experimental method, and the provisional nature of their results.

Two countering arguments should be set against this view of mathematics. The idea that the axioms of mathematics, the rules of the game, are arbitrary deprives mathematics of its status as something independent of human beings and also makes it vulnerable to the charge that its results cannot ever be entirely relevant to the world outside mathematics.

Platonists would certainly argue that mathematics is there in the universe with or without human beings. 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.

Both views produce challenging questions in TOK. The constructivist is a victim of the success of mathematics in fields such as the natural sciences. They have to account for just why mathematics is so supremely good at describing the outside world to which, according to this view, it should ultimately be blind. The Platonist, on the other hand, finds it hard to identify mathematical structures embedded in the world or has a hard time explaining why they are there.

We have seen how mathematics is closely related to artistic thinking. Perhaps because both are abstract areas of knowledge indirectly linked to the world and not held to account through experiment and observation. Rather, both are open to thought experiment and leaps of imagination. Mathematics can challenge our intuitions and 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 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 to do ever more powerful things using ever more sophisticated tools.

Because mathematics is powerful it has applications in almost every area of human life and raises questions about where the responsibility lies in the use of these tools. Often the mathematician creates them in the spirit of the production of pure knowledge, decades away from their application in the modern world. Under these circumstances, it seems that responsibility for the use of this mathematics lies more with those who fashion the application than those who came up with the idea in the first place.

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 the human race could apprehend the eternal forms only accessible to pure unembodied intellect. They thought that in mathematics they could glimpse the framework on which the world and its myriad processes rested. Maybe they were right.

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4.5 History

Introduction

History is more or less bunk. It's tradition. We don't want tradition. We want to live in the present, and the only history that is worth a tinker's damn is the history that we make today.

(Henry Ford, *Chicago Tribune*, 1916)

DP Coordinator: I think you should choose the History HL course.
Prospective DP student: No way - it's all about remembering dates of pointless battles and listening to boring stories about dead people...

What would it be like to live in a society where very little value was placed on recording or preserving knowledge of the past? Would it matter? What would be lost? How would we know the routes by which our current knowledge was produced? Lacking accounts of the struggles and achievements of our predecessors, how could we make sense of the present, or orient our quest for new knowledge? (Everything would seem new!) Some might say we would lose our guide to the future. We would not fully understand why or how we made the mistakes that we did, and hence would tend to repeat them. We would lack a context to appraise or even understand what part of our surroundings have endured, such as historical art works or possibly longstanding alliances or feuds with others – both political and cultural.

It is hard to see what knowledge we would be left with at all. Can you think of anything that you know that does not depend in some way on what you, or other people, knew before? Even the apparently simplest act of recognition of what you see in front of you relies on prior experience. If you were to claim some item of new knowledge that arrived as a 'bolt from the blue', how would you or anyone else be able to evaluate it?

Scope

History and the past

It seems rather too obvious to say that history as a discipline is about the past. Henry Ford's famous dismissal of the value of history is based on his perspective as an entrepreneur looking resolutely towards the future. In fact, we might find ourselves siding with his conclusion on the basis that the past is irretrievably gone, so how can it be an object of study? Yet if we agree that knowledge of the past is of great importance, we need to address how events from the past can actually be accessed and put into a form that gives us meaning *about the past* and, perhaps, a vision of the future.

Common sense

Sir – May I express some last minute thoughts before the election? Now that we have had a period of financial stringency and an attempt to put the national accounts in better order, not to mention a degree of unemployment higher than any of our neighbours, surely it is time for a change.

Disregarding the Labour Party and its misguided schemes, the alternative is clearly to support the Alliance. Its membership may be miscellaneous, as has been said, but it is unquestionably united. Its clear-cut policies include the Keynesian formula to reduce unemployment, giving Scotland a much greater control of her own affairs, and restoring democracy by refashioning the voting system. Isn't that just plain common sense?

Yours etc.,
William Kitching,
Alangrange Lodge,
Bridge of Allan

Handel Operas

Alangrange Lodge,
Bridge of Allan,
Stirlingshire,
September 15, 1982.

Sir, – After listening to *Ariodante* at the King's Theatre, Edinburgh, may I be allowed to second Mr Cedric Thorpe Davie's arguments, expressed in these columns some weeks ago, for a production of one of Handel's operas by Scottish Opera? Surely it is time to follow up those who have pioneered revivals in London, Birmingham, and particularly in Abingdon.

There are more than 30, many with good translations, to choose from all with small casts. If considered too small-scale for Glasgow's Theatre Royal, they would be ideal for touring, and their suitability can be measured by the warm response given to the excellent Piccolo Scala production last week.

William Kitching.

Sc 16-IX-82

Figure 1 Documents related to William Walrond Kitching

The father of the author of this chapter was born in 1912. Neither he nor his contemporaries are around any more, but there are younger people who remember him. The author's house is full of documents and artifacts that are directly associated with him, and the author himself is replete with relevant memories. Yet, all of these sources about the past – about the man – lie in the present: the documents, the witness accounts, the memories, and so on. Thus, we seem to be forced to admit that history is actually some part of the present as a sort of proxy for the past. So, as a starting point could we say that history as written is about evidence at a step removed from its true object of study – the present stands simultaneously as a bridge and a barrier. This situation calls for some particular methods and approaches that we shall examine later.

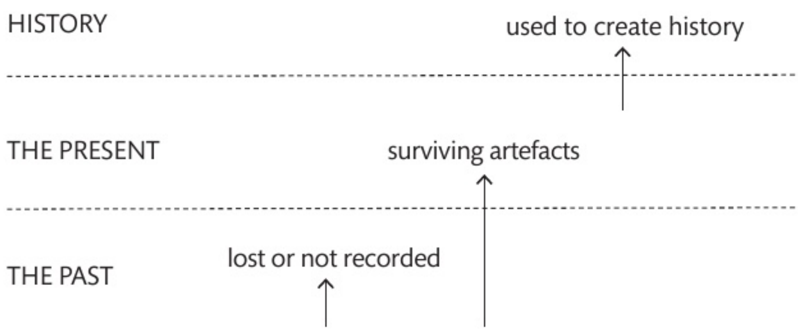


Figure 2 Relationship between the past, the present, and history

Arguably, everything we know today is because of what we have known in the past. Past instances of present phenomena are needed to make sense of the world around us; remembered events and moments for sustained relationships with others; knowledge for building new knowledge. It is clear why illnesses that interfere with the functions of memory are such feared conditions.

Would you agree that all knowledge is in some sense historical knowledge? Not just personal knowledge being dependent on prior experience, but also knowledge produced across the range of disciplines and areas of knowledge, themes, and beyond. All of these fields have a historical background – think of the history of science, mathematics, or art; or of religion, technology, or politics.

Here are two justifications for the special treatment of history in the TOK course:

1. **Methodology:** The need to recognise the particular **challenges of the subject matter** (the gap between evidence in the present and ultimate object of study in the past).
2. **Ubiquity:** the recognition that **every field of knowledge is the product of historical development**.

But how strong is the first justification? There are historical sciences ranging from palaeontology to cosmology that need to investigate the past. Fossils can be observed directly in the attempt to reconstruct evolutionary developments, but cosmologists are unable to access even many of the present traces of the past directly. Many disciplines labour under the challenges of dealing with indirect evidence, but at least in some cases, such as particle physics, the objects of investigation can be perturbed in some way in order to determine their nature or behaviour. Yet would you agree that no such access is permitted to the historian?

It is interesting also to acknowledge here that the methodologies of the historian are geared only to the subset of the past that is traditionally considered appropriate for the discipline – namely the history of (some) humans over time periods recent enough for there to be any surviving evidence. In the movement towards more interdisciplinary approaches to scholarship, we now have something called 'Big History'. This addresses every possible part of the past, from the Big Bang to modern civilisation, and so the traditional boundaries of history as a discipline may be overstepped.

Assuming some validity for the second justification – that every field of knowledge has a history – it would then be a logical extension to ask if you think there is enough emphasis in your other DP courses on the historical development of the knowledge you are being taught?

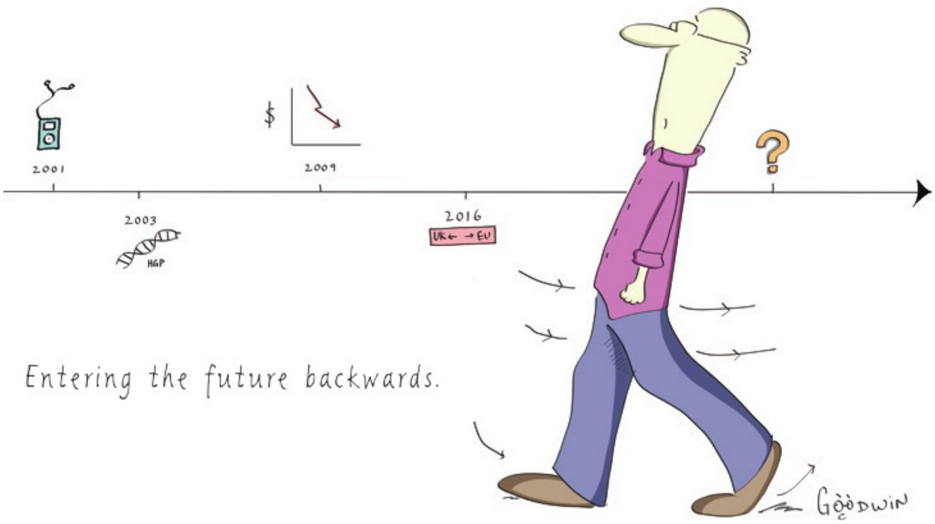
Perhaps there are those who would challenge this second justification. Is it possible to produce new knowledge in science without knowing the history of science? Do you need to know the history of art to be an artist or to enjoy art? Do you need to know how mathematics has developed in order to be a mathematician? Are the histories of areas of knowledge equally important for the production of knowledge in the present?

> If by some 'big lie' we manage to eradicate knowledge of some of the laws of physics [...], it is possible that at a later date it can be recovered; the objective truth will be there waiting for us and we can reason our way back to it. But if we seek to eradicate from the world knowledge or memory of what happened in human affairs [...], if we suppress all witness and evidence of what happened [...] then there is no reasoning back to such knowledge. That is the thing about human freedom and human action – it need not have happened, but it did. Brute, contingent, unreasonable fact. Unless we keep alive the memory that it happened – that this contingency actually occurred – then it can be lost for ever.
>
> (Jeremy Waldron: www.lrb.co.uk/v33/n01/jeremy-waldron/what-to-tell-the-axe-man)

- Are these comments more about knowledge of the past or knowledge accumulated from the past?
- Do you agree with the conclusion that the storage of knowledge is more important in some areas of knowledge than others?

History in the IB diploma

The French poet Paul Valéry said: 'We enter the future backwards.' Without that backward gaze we forfeit an understanding of how we got here, we surrender the opportunity to empathise with our forebears and understand their perspectives. More simply, we are deprived of context for current affairs, and arguably of the ability to predict and even transform the future. We seem to be a long way from the dismissal by the hypothetical IB student created at the top of the chapter.



- Given the comments above, do you think it is defensible that history is an optional subject in the IB diploma?
- What arguments can be advanced for and against its status as a subject in Group 3?
- If you were the DP Coordinator at the start of this chapter, what arguments would you use in order to convince the hesitant prospective student to enrol in history?

History and the future

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'. It 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. The following extract is from *Foundation*. It is set on the planet Trantor, capital of the Galactic Empire, where 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'.

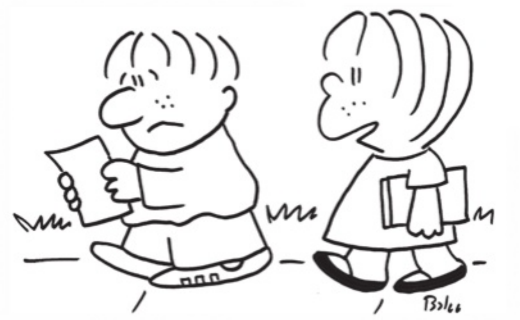
(Asimov, 1951, pp. 18–19)

- 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?
- 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 the future. Which of these goals might be more realistic?
- Is psychohistory more about prediction or transformation?
- Are there other disciplines that are better equipped than history to predict the human future? If so, which and why?
- Is history
  (a) just about how things were/are
  (b) also about how things will be
  (c) also how things ought to be?

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 civilisation. To do this, he has to plan a series of interventions that will produce more favourable outcomes; for these interventions to be successful, the findings of psychohistory must not be known to anyone other than the psychohistorians themselves. As the passage above shows, those who can predict may be empowered to transform the future, but if those predictions are widely known they can alter the course of events and undermine the attempts at transformation.

In a milder form, these issues connect with the world of the 'real' historian. The attempt to make sense of the past can lead to speculations about the future that form the basis for attempts by politicians and others to control it.

As for psychohistory, you will have to read the books to find out what happens! Of course this is fiction, and one must be careful with such examples as illustrations of real processes. But we can regard it as a stimulating thought experiment.

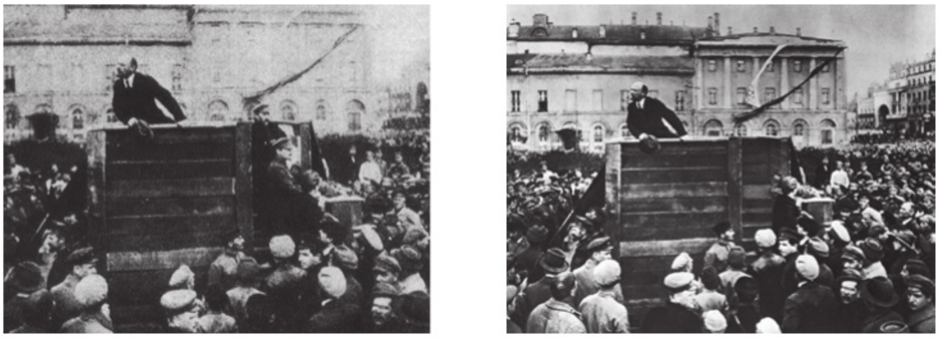


We might argue that, for historical knowledge to be applicable to the present or the future, factual accuracy is a prerequisite. The ancient Greek historian Thucydides was perhaps one of the first scholars that we know of to pursue the objective search for facts about the past. But for the purposes of extrapolation or application, it is tempting to give the past a shape, such as a story of progress or decline. Whether this is possible or desirable is a controversial matter among historians. And even if historians succeed in applying a shape, there remains the question of whether it is being recognised because it is a genuine aspect of the past, or imposed on the account of the past produced by the historian as a result of their particular perspective. This is a theme to which we will return.

History and the present

> History is the projection of ideology into the past.
>
> (Anon)

Beyond its core academic aims, history plays a role in the formation and reinforcement of political viewpoints and policies. History can be presented to citizens in forms that 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 in Figure 3:



▲

Figure 3 Left: Lenin addressing the troops, 5 May 1920. Right: Leon Trotsky and Lev Kamenev have been removed by censor.

"Son, history is important because it's the story of our past that we rewrite to understand our present."

If prediction from history is too hard, if attempts to transform the future are easily undermined, and if history is sometimes hijacked by others (such as politicians) for their own purposes, perhaps we should look for more modest applications for history. Nevertheless, 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 important. The examples and arguments that arise from this section may provide some enlightenment as to not only the proper reach of history, but also the ways in which history can be put to use.

Things to think about

- 'History is part hope, part myth, and part reality.' (Sue Bastian) Would you agree?
- Is 'Big History' all really history? Offer arguments on both sides for this question.

Knowledge questions

- Is it possible to have knowledge of the past?
- Is knowledge about the past different from other kinds of knowledge?
- Are all areas of knowledge concerned with knowledge of the past to some extent?
- Why does history enjoy a privileged position as its own dedicated area of knowledge in the TOK curriculum?

- Is all knowledge in some sense historical knowledge?
- Is truth the goal of all historical inquiry?
- Is certainty about the past more difficult to attain than certainty about the present or the future?
- What counts as a fact in history?

Perspectives

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, pp. 16–17)

History: the lies of the victors?

'History is the lies of the victors.' Here in Julian Barnes's novel, *The Sense of an Ending*, **Webster** repeats a line much beloved of TOK students and others, and one which Hermann Göring, definitely on the wrong side of history, seemed to endorse: 'We will go down in history either as the world's greatest statesmen or its worst villains.'

But to what extent is the claim true? Is history disproportionately written by 'victors' and is what they have written deliberately false? Such a sweeping claim would need some powerful support. More broadly, to what extent does history reflect the circumstances of the historian, and does the historian permit those circumstances to govern what they write?

There are certainly examples where the volume of historical literature seems skewed towards 'winners' and hence the balance seems to favour the side that came out on top after some military, economic, social, or other series of events. In recent times, one might cite triumphalist accounts from Western sources of the end of the Cold War – accounts that are only now exhibiting some underestimation of the extent of Russian humiliation and patronising of formerly captive nations in the Warsaw Pact. But at the same time, we have counterexamples – Roman historical accounts (from the losing side) of the demise of the Byzantine Empire by Ottoman invasion of Constantinople allegedly cast the Ottomans in a sharply negative light that remained dominant for centuries. Some unreliable American military and government accounts of the Vietnam War have successfully found their way into mainstream historical perspective. More fundamentally, who gets to decide who the 'winners' and 'losers' are?

It is probably wise to conclude that the categorisation of the actors of history into winners and losers is deeply simplistic and a very blunt tool for assessing history in the context of its authors. The conclusion here seems to be that Webster's claim is unconvincing at best.

While the identity of the historian is a key variable that can affect deeply the perspective from which history is produced, let's focus for now on the products of the perspectives themselves. Here are four accounts of modern African history which were written by my colleague, John Kamau, a TOK teacher. They were inspired by four accounts of British history written by Professor Margaret Macmillan, which can be found at news.bbc.co.uk/2/hi/8097607.stm.

Version A

The colonial powers' adventure and civilising mission were finally over. The African continent, once considered the white man's graveyard, finally had functioning roads, vibrant churches, railways, and growing economies. There was no more work left for the European in the continent for he had successfully lifted his burden and developed Africa. While independence restored power in Africa to Africans, the new rulers proved incapable of sustaining the new institutions. In the first two decades after independence, there were 40 successful military coups and many failed ones. It was clear that Africa was too important to be left to Africans. The French, in an attempt to bring a semblance of peace and economic prosperity back to Africa, created a new currency, the CFA. The British created the Commonwealth. Some Francophone countries wanted to remain part of the French empire. The Europeans had voluntarily given power to Africans, but were forced to take it back when Africans proved incapable of governing themselves. Africa was independent in name only.

Version B

African nationalist leaders brought about African independence. Different leaders, scattered across the African continent, demanded the end of colonial rule by organising meetings in Western and African capitals. Out of this emerged the most important body, the Pan African Congress, made up of African intellectuals who made demands for the end of colonial rule and racial discrimination. Individuals such as Jomo Kenyatta of Kenya, Hastings Banda of Malawi, Kwame Nkrumah of Ghana, and Obafemi Awolowo from Nigeria inculcated a sense of nationalism and desire for independence in their citizens. European countries had no choice but to let go of subjects who no longer wanted them as masters. Africa gained independence from the West because their leaders had demanded independence. African nationalist leaders brought about the 'wind of change' of which Harold McMillan had spoken that was blowing across the African continent.

Version C

African independence, like her partition in the first place, had nothing to do with Africa or Africans. It came as a result of the geopolitical realities of the time. The Second World War had devastated Europe, with France and Britain especially losing their glory and global dominance. Though France and Britain were on the winning side of the war, they became wrecked countries, unable to administer their empires effectively due to high costs. Africa was to all intents and purposes a business arrangement for the colonial powers. Private and semi-public companies such as the British South Africa Company, German East Africa company, and many others that had been absorbed into the European states were no longer viable entities and were a drain to the European taxpayer. Decolonisation was the next logical step. Similarly, the Second World War led to the emergence of superpowers: America and the Soviet Union. African countries found new allies in the newly created body, the United Nations. The superpowers wanted global dominance by finding proxies in their new war, the Cold War, and free African countries were vital in this endeavour. The geopolitical realities of the 1960s and 1970s resulted in African countries becoming independent.

Version D

African independence was attained by the African masses. For hundreds of years, the European had hidden behind a cloak of invisibility. The African did not have access to the Berlin Conference and the division of his continent, where the main aim was to avoid Europeans fighting each other. To the African, the European had been superior. This all changed with the advent of the Second World War. 375,000 Africans fought on behalf of Europe, with the aim of defeating the Germans, who were painted as fascist and intent on taking over the whole world. 50,000 Africans died in Burma, Japan, India, France, and many other countries defending European democracy and way of life. Back in Africa, there was abject poverty. When Africans returned home, the superior image of the European way of life was challenged. The African had seen the white man die in battle; he was human after all. Africans became fully aware of the irony of the Second World War: they were fighting for European democracy, but they were a colonised people. This is when Africans started fighting for independence in earnest. African independence was as a result of grass root movements by the masses who wanted to address the paradoxes of the time.

Activity 1

Is each of these histories written from a coherent perspective?

If so, from what perspective does each derive? Give each perspective a name.

Speculate on the circumstances of historians who would be likely to write from each of these perspectives.

Why must we be careful with such speculations?

On what concepts is each perspective built? Identify four or five for each.

In what ways does each viewpoint alter the significance accorded to various historical events?

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?

Is it the case that we can more or less write history however we like – impose whatever shape appeals to us according to whim, or to whichever facts we happen to encounter first? Should we be seeking to minimise the role of perspectives in history in an attempt to narrow the range of interpretations, gravitating towards something that we can agree on as an approximation to the truth, or should we encourage or at least celebrate the diversity as a positive feature of historical scholarship? Can we learn more about modern African history by taking the trouble to read all these different accounts or does it lead us into confusion?

History: the past has a shape?

'History just repeats – the same old story.' It is important to note that **Simpson**, in his response to Old Joe Hunt's question (page 320), is referring to the subject matter of history rather than the discipline itself here. He means that there are patterns in past events that seem to recur. Once you've studied one bit of history you will not be much surprised by any other part. Is it possible to support such a claim? Like Webster's response, maybe it needs to be toned down – are there any recognisable patterns and, if so, what shape do these patterns describe? Consider the graphs in Figure 4.

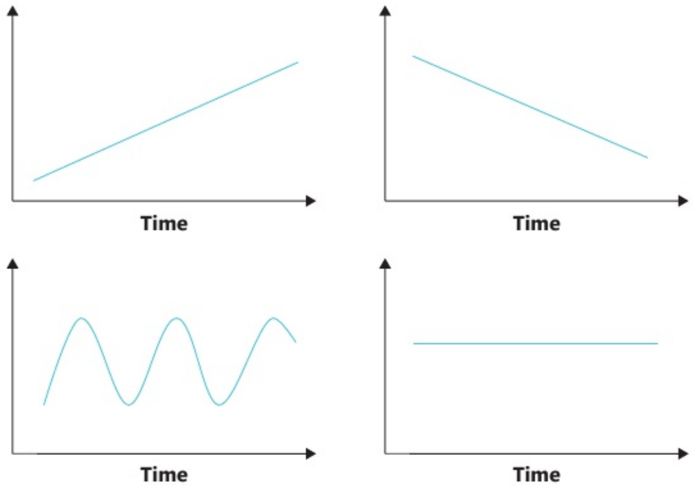


Figure 4 What variable could we put on the vertical axis?

The horizontal axis represents time, but what variable could we put on the vertical axis? How would we know what to measure as a benchmark for progress or decline? How could we agree on it? We might decide to pick something quite easily defined, such as life expectancy or some quantifiable aspect of 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 a very daunting task.

According to Alexis de Tocqueville, 'History is a gallery of pictures in which there are many copies and few originals.' Just as in many other areas of knowledge, metaphors are powerful tools in the attempt to create order and understanding in history. Many historians who detect traces of recurrence in the events of the past have been attracted by the metaphor of the seasons, with cultures or civilisations following a sequence analogous from 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. Perhaps the most alluring shape for the past is not recurrence or decline, but progress.

For example, Whigs were members of one of the two dominant political parties in Britain during the 18th and 19th century. Their perspective on Britain's past was one influenced by a recognition of British dominance in the world at that time, viewed as a manifestation of progress. Whig history then became a term that represented the view that things continually got better over time. This perspective 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. There is often a tendency 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. Here is an example, with reference to the events at the end of the Cold War.

> 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.
>
> (Timothy Garton Ash: www.nybooks.com/articles/archives/2009/nov/05/1989/)

Support for this thesis has taken many forms: from early anthropology that offered racist interpretations of human culture; to the claim by Francis Fukuyama that humanity was reaching a final successful method of governance (see Chapter 2.1 **Knowledge and politics**); to Steven Pinker's 2011 book *The Better Angels of our Nature*, in which he lays out evidence to show a continuous decline in violence.

Historians looking for patterns can of course make distinctions between places and cultures rather than risk universal assertions. Scottish historian Niall Ferguson refers to certain historical developments, such as the scientific revolution and the so-called Protestant work ethic, as peculiarly Western inventions. He refers to them as 'killer apps' that have made the difference between the 'Westerners' and others, and suggests that they may be 'downloaded' by 'Resterners' as he labels everyone else. Interestingly, he, like Oswald Spengler, has much to say about a possible decline of the West, but in contrast takes the view that this is an avoidable outcome.

- How might dividing the world into the 'West' and the 'Rest' shape thinking about the world? Does such a dichotomy help in gaining new insights into world history or does it entrench existing perspectives on it?
- 'History does not repeat but it does rhyme.' To what extent would you agree?

'History is just one damn thing after another' (obscure origin). It is ironic that this quotation is often attributed to the British historian Arnold Toynbee given that it is something with which he wholeheartedly disagreed (perhaps there is a lesson to be learned about history right here). His was one of the most comprehensive attempts in modern times to bring the past into a single overarching structure. Over a period of 20 years, he published a set of 12 volumes of *A Study of History*, in which he set out his grand theoretical vision; this was based on the idea that history could be organised in terms of the rise and fall of civilisations – 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 recognise a common pattern in these challenges and responses, which took the form outlined in Figure 5:

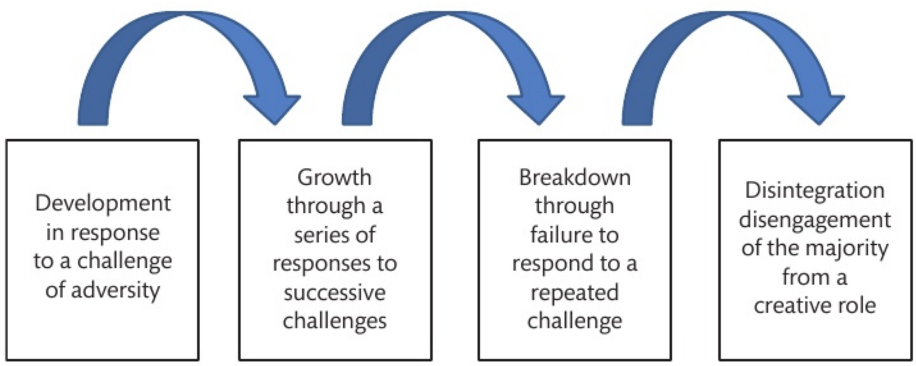


Figure 5 Arnold Toynbee recognised a common pattern in the rise and fall of civilisations.

Within this macro-structure, Toynbee elucidated a large number of what he called *laws of history*. Here are a few of them.

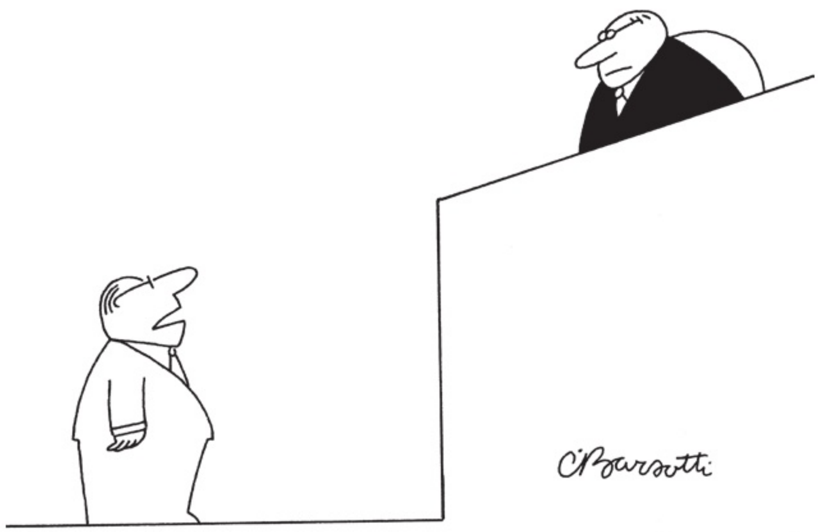
- The stimulating effect of breaking new ground is greatest when the new ground can only be reached by crossing the sea.
- The instability in a balance of power varies inversely with the number of contending states.
- The birth of civilisations requires creative contributions from more than one race.
- Spiritual achievement and material achievement are antithetical.

(Toynbee, 1960, pp. 32–54)

Of the more than 20 civilisations that he identified, only a few remained in existence during the period in which he was writing, with Western civilisation earmarked as the current dominant example.

- What is your first reaction to these laws of history?
- Do you think they can be used effectively in order to structure knowledge about the past?
- Assuming that these laws are accurate representations of the past, do you think they have predictive value? Or do they merely guide the responses we make to contemporary challenges?

'The past is a foreign country: they do things differently there.' (LP Hartley)



"The past, Your Honor, is a foreign country, and we did things differently there."

'Doing things differently' might be taken to refer to changes in things such as technology and the pace of globalisation, 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?

History: the historical development of the discipline

We have discussed in a previous section the shape of the past; but we can also consider the historical development of history as a discipline, which is a different thing. 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 providing moral guidance. 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.

A towering figure 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 – careful evaluation of source text in order to establish the veracity of what was written. Thus von 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 recognised as a crucial pivot in the historical development of history.

Von 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 prospects for sound historical knowledge came under an intellectual cloud from the influence of troubling developments in physics (relativity and quantum physics), which seemed to undermine the validity of a 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 a point, 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 a 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. We will return to this issue in the next part of this chapter.

History: dealing with uncertainty

'Certainty, memory, documentation…?' **Finn's** answer to Old Joe Hunt (page 320) demands some consideration of the methods of the historian, so it's time to move on to the next element of our knowledge framework.

Things to think about

- In the IB diploma history course, historical enquiry is not supposed to include the last ten years. For more recent events, the term *retrospective journalism* is sometimes used. What do you think is the purpose of the ten-year rule, and why might we need the retrospective version of journalism rather than just the regular variety?

Knowledge questions

- If it is difficult to establish proof in history, does that mean that all versions are equally acceptable?
- Are historians' accounts necessarily subjective?
- Is empathy more important in history than in other areas of knowledge?
- How might the existence of different historical perspectives be beneficial to historical knowledge?
- Can the historian be free of bias in the selection and interpretation of material?
- Is it inevitable that historians will be affected by their own cultural context?
- How can we gauge the extent to which history is being told from a cultural or national perspective?
- Are we more prone to particular cognitive biases (such as hindsight bias) in some disciplines and areas of knowledge than others?

Methods and tools

Consider the following timelines:

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

Figure 6 Two versions of the same period in history

Common knowledge *vs* history

A simple and sparse chronology, such as Timeline A in Figure 6, affords us a very limited window into a piece of history. It is a useful contribution to knowledge, but much too simple. Even the more elaborate version on the right 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 the Second World War. It existed for just over 40 years until the collapse of European communism and the reunification of Germany that it made possible. 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.

The amount of available source material

The methods of the historian involve digging deeper than common knowledge on a topic, and rely to a great extent on the source material that is available. But during the Cold War, those researching the DDR and the Soviet bloc more generally had to contend with a dearth of such source material as a result of the tight grip on information characteristic of these regimes. Accordingly, accounts of the development and state of the DDR from its formation through to the 1980s tended to be built on rather narrow foundations of personal experience and official statistics. For example, here is what the British journalist John Ardagh wrote in 1987.

> ... 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... (p. 319)
>
> 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. (p. 326)
>
> 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. (p. 338)
>
> (Ardagh, 1988, pp. 319–338)

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 DDR 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, p. 5). The implications for historians of this massive change of 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, 2002, p. v)

As the French poet and essayist Charles Péguy 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 DDR, historians found their object of study transported from 'ancient' to 'modern' world in the blink of an eye.

Figure 7 Erich Mielke: Stasi head 1957–1989

Figure 8 Hand-sorting of shredded document fragments

The nature of available source material

The collapse of the DDR 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, p. 74)

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 tonnes 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 in such an orderly fashion – whole drawers of documents put in the same bag – that now [...] it is possible for the puzzle [workers] to piece them back together.
>
> (Funder, 2003, p. 67)

However, it soon became clear that the sheer volume of files meant that it would take centuries to complete the task in this way. The introduction of software that can do the reassembly many times faster has taken over the bulk of the work.

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. 'Puzzle women' were employed to reconstitute shredded documents, piece by piece, in a painstakingly slow task that has now been taken over by scanners and software that can match fragments on screen.

Activity 2

Given the recruitment of collaborators and the priorities assigned to the destruction of the documentation, what do you think some of Fulbrook's 'problems of interpretation' might be?

How might historians attempt to overcome these problems?

This example of the DDR illustrates some basic relationships 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 the historian, who is of course working in the present, selecting material of interest and relevance to research, and adding their own inferences and interpretations to it. These processes are summarised in the elaborated diagram in Figure 9.

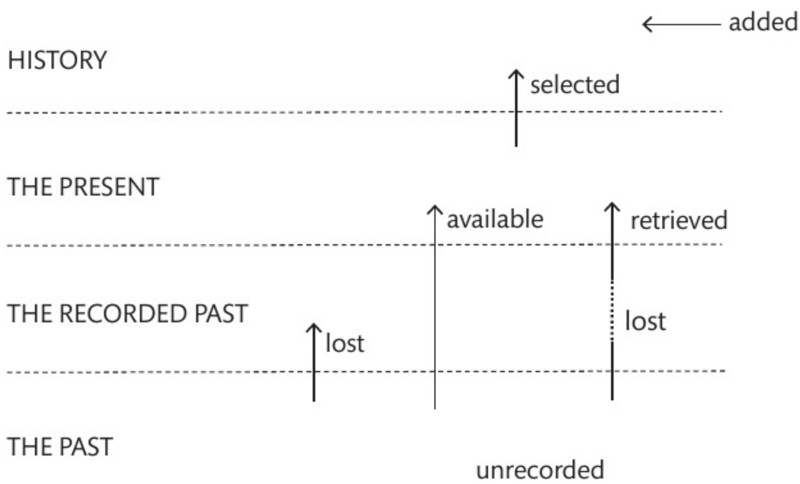


Figure 9 Some basic relationships between the present, past, and history

As we have noted already, the present is always wedged between history and its object of study, and the diagram in Figure 9 is set out in a way that tries to make this clear. How might the diagram help to clarify what George Orwell meant when he said: 'who controls the past controls the future; who controls the present controls the past'?

Historians are dependent on source material for their trade; without it history fades into myth, and thence to fiction. The DDR example shows how both a dearth and a glut of material can present serious challenges for historians, and in either case there is the further imperative of evaluating quality and reliability. The example also shows how the historian often works 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.

Using sources

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 their nature and how they should be approached.

The most obvious way of classifying those records is to distinguish between original authorities (as in eyewitness accounts) and derivative authorities (as in those accounts written afterwards by others). Nowadays we would 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 generalise 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 DDR 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 (Garraghan, 1946), for example, offers the following list of guidelines for criticism of sources:

1. Date: when was the source, written or unwritten, produced?
2. Localisation: where was it produced?
3. Authorship: by whom was it produced?
4. Analysis: from what pre-existing material was it produced?
5. Integrity: in what original form was it produced?
6. Credibility: what is the value of its contents?

Students of DP history are likely to be more familiar with the OPVL method, in which an evaluation is made of the origins, purposes, value, and limitations of documentary sources. 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?

There seem to be some differences here.

- How has the emphasis changed between Garraghan's advice and the standard current OPVL?
- Compare the OPVL method with those outlined in this book for other areas of knowledge.

History and the proliferation of data

It would be easy to leave the case study of the DDR above 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 are 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 'life-cams' and 'life-logging', and we are entering the age of 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.

- What methods do you think historians should adopt in response to these changes in the form, quantity, and availability of source material?

Facts, evidence, and interpretations

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. As with many aspects of the study of history, they had their differences with respect to one of the most important concepts in the discipline – what are historical facts and what roles do they play in the production of history?

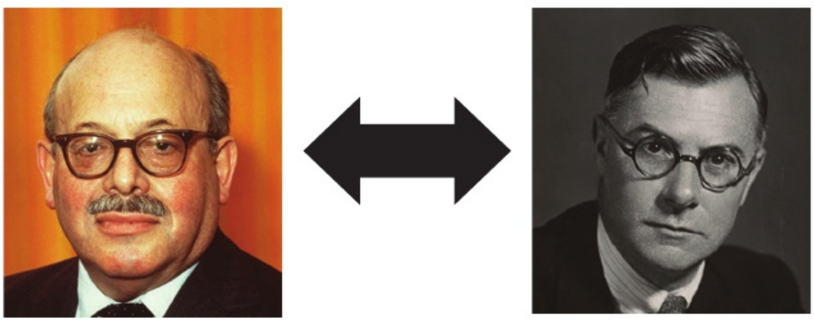


Figure 10 Sir Geoffrey Elton (left) and Edward Hallett (EH) Carr (right)

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.'

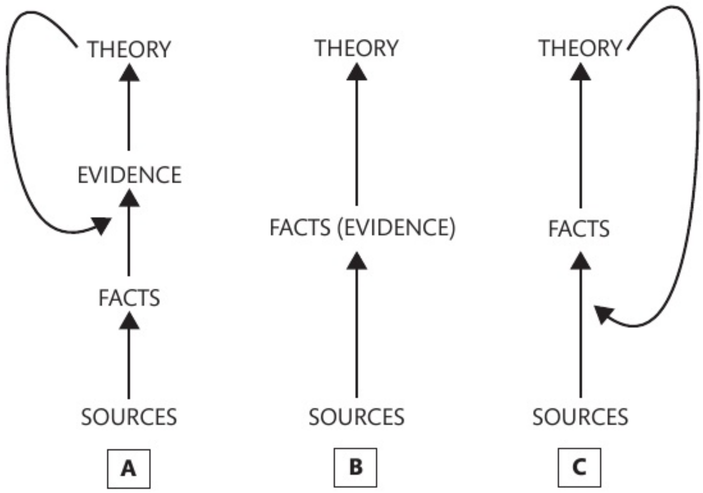
Edward Hallett (EH) Carr

'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.'

- Summarise in a single sentence the difference between Elton and Carr here. Can you give an example that could illustrate the difference?

> 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.
>
> (Richard Evans)

Try to connect each of the following diagrams to the views of the Elton, Carr, and Evans as presented in this section:



For each of the following two examples (both adapted from Rayner and Stapley, 2002), decide which statements to recruit in order to reach an answer to the question.

Historical question: Who was responsible for starting the Cold War?

1. From the start, Stalin had a poorer relationship with Truman than Roosevelt.
2. Stalin drained his sector of Germany of supplies and machinery from 1945 on.
3. The Allies failed to take Stalin fully into their confidence during the Second World War.
4. The Americans refused to grant Stalin a much-needed loan in 1945.
5. Truman ordered the atomic bombing of Hiroshima without informing the Soviets.
6. Churchill was a keen supporter of intervention against the Bolsheviks in 1918.
7. Marshall Aid was provided to Western Europe from 1947.

Historical question: When did South African apartheid start?

1. In his victorious campaign in the 1948 election, Malan proposed apartheid as a means of consolidating white wealth and power.
2. The Immorality Act of 1926 banned sexual relationships between people of different races.
3. 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.
4. In the 1930s, the black franchise was diminished to allow only limited voting, and only for white candidates.

5. Widespread legislation was passed in 1948 to establish apartheid.
6. Areas where non-whites were forbidden to live were specified by an act of parliament in 1923.

Let's consider your answer to be an interpretation. With regard to this process, try to decide which of the three models above you followed. What were you doing?

- Arranging facts in a balanced and dispassionate way in order to reach your interpretation?
- Adopting an interpretation and collecting facts in a balanced and dispassionate way to see if they provide convincing evidence for that interpretation?
- Adopting an interpretation and looking for facts that will provide evidence for that interpretation?

Did you reject some of the statements? If so, was this because:

- you didn't think they were reliable
- you didn't think they were relevant
- they didn't fit in with the interpretation you had already reached?

Are there differences between the two examples that make it difficult to reach an opinion about how the historian operates? Are there any important implications that arise from the choice of models?

The relationship between the individual facts and the interpretation that orders them and binds them together is an important topic in several areas of knowledge (in the natural and human sciences we might call the 'binding agent' a theory). In addition to summarising the issue of selection in history, Evans here captures the debate (first introduced under **Scope** on page 312) as to whether that order originates in the facts themselves, or is imposed by the interpretation that we apply to them.

> 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 is 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, [e-book])

The influences of other areas of knowledge in history

In Chapter 4.1 **Areas of knowledge**, we discussed CP Snow and his lament that intellectual life tended to fracture into the two camps of the sciences, and the humanities and arts. You may by now have developed an opinion about whether he had a worthwhile point that still persists today. Might history occupy some middle position or draw from both ends? The historian George Macaulay Trevelyan described his discipline thus: 'History is a mixture of the scientific (research), the imaginative or speculative (interpretation) and the literary (presentation).'

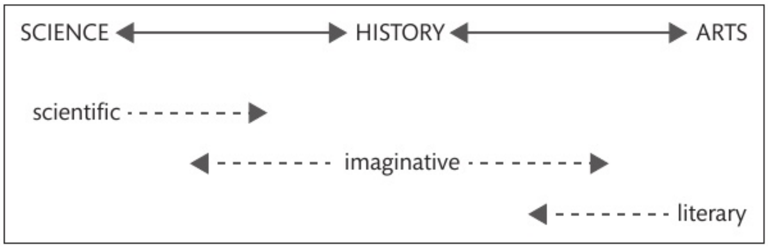


Figure 11 Areas of knowledge related to Trevelyan's description of history

Comparative approach

Let's try to use Trevelyan's description to steer the following discussion. For a start, there are traces of scientific **methodology** when the historian adopts a **comparative approach** to research. In the DP history course, one might, for instance, wish 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? In a sense, this is an attempt to limit the variables under consideration by selecting comparable events.

- To what extent do you think such comparisons can rank with those made in a scientific investigation?
- There is the possibility of confirmation bias in such an exercise – the tendency to lean towards evidence that supports a researcher's prior interpretation or belief. Perhaps the historian is predisposed to a theory that greed is uppermost in such conflicts, or alternatively a sense of grievance – how serious is this danger as compared with similar difficulties in the sciences?

Counterfactual approach

One problem with the comparative method is that the items under comparison are unlikely to be simultaneous, and so there are other factors at work that cannot be controlled or removed. So a second method – controversial among historians but appealing to the venerable tradition of thought experiments – goes by the name of *counterfactual history*. We know that the Japanese attack on Pearl Harbor marked the entry of the United States into the Second World War. But what if that attack had never taken place? Perhaps isolationist views in the USA would have prevailed and kept the country out of the conflict. In the absence of American forces in Europe, perhaps Nazi Germany would have succeeded in subduing the continent and the Japanese gained complete control of the Pacific theatre. Although this is a very simplistic analysis, the intention of placing the Pearl Harbor attack at a fork between what happened and what might otherwise have happened allows us to try to evaluate its historical importance. Here are some other examples for you to try:

- 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 Hitler had won at Stalingrad in 1942?
- 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 draw comparisons between the real past and one that never took place – all arising from the different possible outcomes of a single event.

- Is this a more reliable sort of comparison than the one in the previous (civil war) case?
- What is the central problem with counterfactual history and how might historians overcome it?

'Outside' approach

A different attempt to forefront the scientific dimension of Trevelyan's description of history would be to take a strongly empirical approach. To do this, some historians have focused on the 'outside' of events – scrutinising the past from an angle that emphasises the physical and geographical environments in which they took place. Ian Morris, a British historian writes as follows.

> [I]t 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 500 CE 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, 2010)

This has been coined the 'latitudes not attitudes' approach. It is somewhat back in fashion after many years of obscurity as a result of how 19th-century scholars tended to use environmental determinism as a justification for the 'hierarchy of success' enjoyed by different peoples and societies around the world.

- Researchers such as Morris have been accused of providing the 'how?' but not the 'why?' that is necessary in history. Do you think this might be a fair criticism?
- What counts as a historical 'event' can range from a very specific occurrence to a broad panorama of change. What kinds of events from the past do you think Morris's approach might fail to deal with satisfactorily?

Cliodynamics

Attempts to focus on empirically verifiable data as key to historical scholarship can be taken further. Led by the Russian-American scholar Peter Turchin, a field called *cliodynamics* has attained prominence, in which big quantifiable data is used in order to detect trends and correlations. This approach brings techniques from mathematics into play.

> I have nothing but deep respect for the giants of historical thought from Polybius and Ibn Khaldun to Fernand Braudel and William McNeill. But I argue that it is not enough. In addition to admirable research already performed by historians, we need a systematic effort addressed at translating verbal theories into mathematical models, putting together large collections of historical data, and testing model predictions on this empirical material. Contrasting predictions of rival theories with data will allow us to reject some theories in favor of others. This is one of the best measures of scientific progress, but rarely happens in history.
>
> (peterturchin.com/cliodynamics/why-do-we-need-mathematical-history/)

Turchin claims to have discovered historical cycles for variables such as 'political instability' that are replicated in different societies at different times. Figure 12, for example, is a presentation of data showing levels of violence in the United States over the last two centuries, with a distinct 50-year cycle.

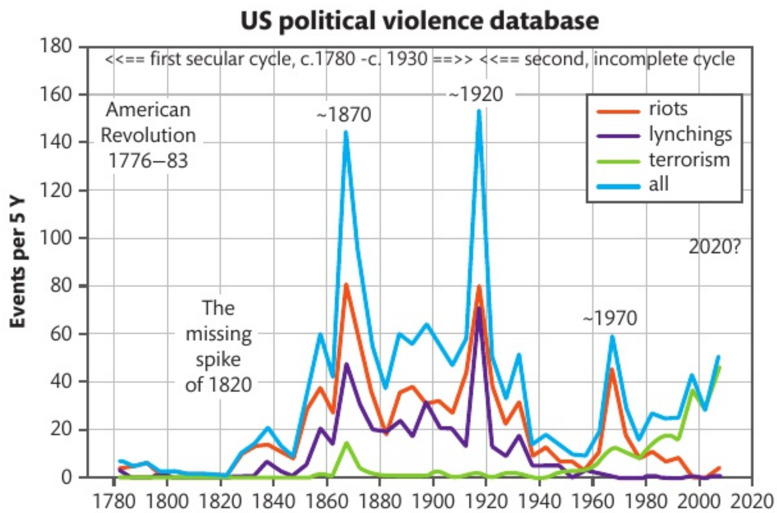


Figure 12 US political violence database graph

Worryingly, Turchin suggests from his data that there will be a spike in violence in the 2020s at least as severe as that of the 1970s, and possibly even as large as that of the 1920s.

Activity 3

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?

Do you think that Turchin and his followers will succeed in binding history more deeply into Group 3 of the IB diploma alongside the other subjects found there?

If so, would we be able to do away with history as a dedicated area of knowledge?

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?

In examining cliodynamics, have we basically just encountered a primitive version of psychohistory? Is cliodynamics as a method any more of a realistic proposition than psychohistory?

Interestingly, Turchin claims that our ability to predict the outcomes of our interventions is more important than our ability to make the original predictions on which the interventions would be based. We can connect these observations about prediction and transformation back to the questions about Asimov's psychohistory earlier in this chapter. But essentially Turchin's agenda in promoting cliodynamics is rooted in his criticism of traditional historical methods that produce alternative interpretations:

> As Turchin sees it, historians generally neglect the scientific method. The example he likes to use is the Roman Empire. More than 200 explanations have been proposed to explain its collapse, he says, and new ones keep coming. Turchin contrasts that with science. Biology had Lamarckism and Darwinism, two different theories of evolution. Biologists 'did experiments, collected data, and basically rejected Lamarckism in favor of Darwinism,' he says. 'In natural sciences, theories get rejected. But in history, that hasn't been happening.' Cliodynamics aims to change this. One belief unites the scholars who fall under its banner: Looking at the big picture reveals patterns that play out over millennia, says [Ian] Morris, 'without historical actors really knowing what's going on.'
>
> (Marc Parry: www.chronicle.com/article/Quantifying-the-Past/137419)

'Inside' approach

In summary, we've so far looked at some approaches that emphasise the first (scientific) element of Trevelyan's three-part description of history – the effort to make comparisons between similar events, a focus on empirical evidence, and a drive towards quantification that brings mathematical techniques into play. We can contrast these resolutely 'outside' approaches to history with the work of the English historian RG Collingwood, for whom a very different approach was key.

> The historian, investigating any event in the past, makes a distinction between what may be called the outside and the inside of an event. By the outside of the event I mean everything belonging to it which can be described in terms of bodies and their movements : the passage of Caesar, accompanied by certain men, across a river called the Rubicon at one date, or the spilling of his blood on the floor of the senate-house at another. By the inside of the event I mean that in it which can only be described in terms of thought: Caesar's defiance of Republican law, or the clash of constitutional policy between himself and his assassins. The historian is never concerned with either of these to the exclusion of the other. He is investigating not mere events (where by a mere event I mean one which has only an outside and no inside) but actions, and an action is the unity of the outside and inside of an event. He is interested in the crossing of the Rubicon only in its relation to Republican law, and in the spilling of Caesar's blood only in its relation to a constitutional conflict. His work may begin by discovering the outside of an event, but it can never end there; he must always remember that the event was an action, and that his main task is to think himself into this action, to discern the thought of its agent.
>
> (brocku.ca/MeadProject/Collingwood/1946_1.html)

Collingwood goes on to contrast the investigation of history with that of the natural world, in which events have no 'inside' in the sense that historical events do. While historians search for the 'inside' of events, scientists seek to compare events with other events in order to establish patterns that lead to theories and laws. Perhaps history is a harder discipline because of the need to imagine thoughts and motivations that are not directly accessible; perhaps easier because there is no imperative to seek general laws. Collingwood appeals to our common humanity in order to show that imaginative re-enactment is not mere fantasy but rather the 'insides' of events are partially accessible through our understanding of how people behave.

Literary approach

Collingwood's ideas add the second element of Trevelyan's 'formula' for history – we need the **imagination** as well as a **scientific** mindset. But what about the third element – the **literary**? Trevelyan couched this part as about presentation, but there are historians who see the use of language and literary structure as playing a more fundamental role. For instance, the American historian Hayden White was persuaded that the similarities between history and literature are greater than their differences. Richard Evans summarises the approach.

> 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 enquiry by selecting and evaluating the evidence with the very linguistic and imaginative tools that will be used in the construction of the resulting narrative.
>
> (White, 1975, pp. xi-xii, 5–7, in Evans, 1997, (e103))

And White expands on this view of history.

> Readers of histories and novels can hardly fail to be struck by their similarities. There are many histories that could pass for novels, and many novels that could pass for histories, considered in purely formal (or, I should say, formalist) terms. Viewed simply as verbal artifacts histories and novels are indistinguishable from one another. We cannot easily distinguish between them on formal grounds unless we approach them with specific preconceptions about the kinds of truths that each is supposed to deal in. But the aim of the writer of a novel must be the same as that of the writer of a history.
>
> (libquotes.com/hayden-white/quote/lbj9b2h)

In the **Scope** section we identified the historical dimension of other disciplines as a justification for giving history an elevated priority in TOK. Here we see that history itself draws on the traditions and protocols of some of those other disciplines, such that they have influence on the methods employed by the historian.

Things to think about

- 'Cleopatra's nose – if it had been shorter, the whole course of history would have changed' (Blaise Pascal). To what extent do you think Pascal was being serious?
- A distinction can be drawn between reasoning to and rationalising a conclusion accepted in advance – how might each be involved in the processes indicated in the diagram on page 336?

Knowledge questions

- What methods do historians use to gain knowledge?
- What is unique about the methodology of history compared to other areas of knowledge?
- On what criteria can a historian evaluate the reliability of their sources?
- If our senses are sometimes unreliable, does this mean that eyewitness testimony is an unreliable source of evidence?
- Have technological developments enabled us to observe the past more directly?
- What challenges does archive-based history emphasise about how knowledge is shared and preserved?
- Is there less emphasis on collaborative research in history than there is between researchers in other areas of knowledge? How do the methods and conventions of historians themselves change over time?

Ethics

As with all other areas of knowledge, history is concerned with the discovery of the truth. We have seen many of the obstacles that stand in the way of the historian and some of the methods employed to overcome them. In this final section of the chapter, we will focus on the obligations that apply to historians and those who supply the materials on which they rely in this endeavour.

Literal *vs* literary truth

> Journalism is the first rough draft of history.
>
> (origin unclear)

> When regard for truth has been broken down or even slightly weakened, all things will remain doubtful.
>
> (St Augustine)

While more of a correspondent than a historian, the journalistic output of Ryszard Kapuściński has been praised for its unique value – given that Kapuściński visited places and conversed with people that few other correspondents managed to do, and wrote about all of it with such 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, 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.

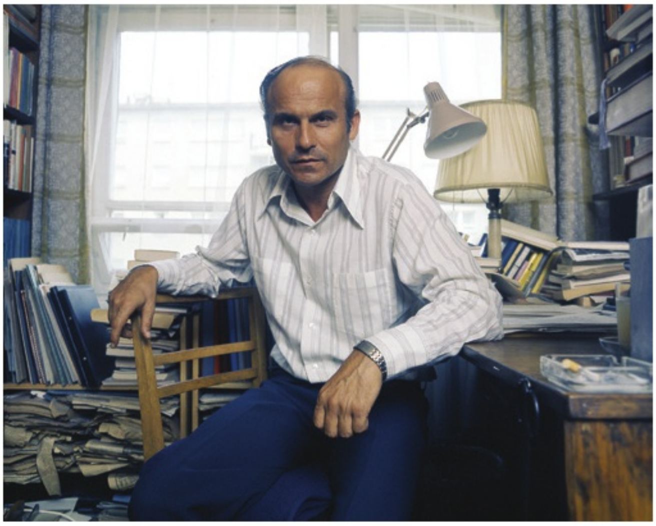


Figure 13 Polish writer Ryszard Kapuściński

Figure 14 Emperor Haile Selassie of Ethiopia

Eulogies for Kapuściński's work were widespread and effusive – for example, this one from *The Wall Street Journal*.

> 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.
>
> (www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0002fo)

Here are two extracts from *The Emperor* (Kapuściński, 1983).

> 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, pp. 7–8)

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, p. 5)

Some years after the publication of the book, American scholar Harold Marcus protested, in the following terms.

...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...

Harold Marcus; *History in Africa* **17** (1990), pp. 373–78. 374

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.

> 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.
>
> (Ian Jack: www.guardian.co.uk/books/2010/mar/06/ian-jack-ryszard-Kapuściński)

Is there a distinction between 'reporting' and 'history' that would make a difference to your response to the quotation above? Kapuściński's response to earlier criticisms of this nature was as follows.

> 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.
>
> (Ryszard Kapuściński, quoted by Jack Shafer: www.slate.com/id/2158315)

Activity 4

What is your view on this example? Was Kapuściński ethically obliged to report exactly what the courtiers told him (the 'literal truth'), or could he be justified in putting words into their mouths in the interests of conveying a deeper 'literary truth'?

There are strong indications that much of Kapuściński's work was allegorical in nature – he wished to comment discreetly 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 ethically justifiable? Consider the motivations for his work and the possible effects of it on those who read it.

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 speculate on what message Kapuściński might have been trying to convey about his own work at the end of his career.

The intimate relationship between history and language (sources in language; product in language) forces historians to consider with particular care how they express their findings. It might not just be a matter of studiously avoiding emotion-laden terms in the way that scientists are trained to do, as Mary Fulbrook explains:

> Although in the more extreme cases, [...] loaded language is quite evident and easily discounted, it is often more subtle and persuasive [...] as in the case of the 'developing countries' with all that this label implies. Conversely, in what may be held to be extreme situations (the Holocaust), the attempt to use neutral or non-loaded language may itself be seen as part of an attempt at sanitizing, rendering non-problematic, acceptable, 'normal'.
>
> (Fulbrook, 2002)

What might be the ethical implications of the use, or the avoidance, of 'loaded' language by the historian?

Fulbrook offers a number of solutions to these language problems for the historian, including trying to restrict discourse to the language and concepts current to the period under investigation, or developing a specialised vocabulary for history just as scientists have successfully achieved in their domains.

The integrity of the historian

Alongside the quality of source material lies the integrity of the historian. Discredited historian David Irving was shown not only to have made mistakes, as all scholars do, but to have breached expected professional norms. This has focused attention on the desirability of a common code of conduct for historians. This might include items such as the following, offered by Suzannah Lipscomb (www.historytoday.com/archive/code-conduct-historians).

- Use evidence to support your interpretation and seek to understand that evidence correctly.
- Do not cite evidence from sources that you elsewhere discount.
- Triangulate; search ardently for evidence that might undermine, as well as corroborate, your hypothesis.
- Avoid assumption creep: do not allow assertions to move from 'possibly' to 'probably' to 'definitely'; do not build more elaborate layers of interpretation on a foundation that is rocky.
- Do not rely on the secondary assertions of other historians. Go back to the original sources.
- Guard against confirmation bias; interrogate the 'facts' anew and bring a fresh analysis to them; do not mould the facts to your interpretation.
- Root out and resolve any internal inconsistencies in your argument.

Things to think about

- Have you ever sat in a room during a social event, not being asked about your past? How does it feel to be 'beneath notice'?
- Watch the film *Hidden Figures* about the work of Katherine Johnson and other female mathematicians in the NASA space programme of the 1960s. Who is responsible for the lack of recognition that they received for their contributions?

Knowledge questions

- Is it unfair to judge people and actions in the past by the standards of today?
- Should terms such as *atrocity* or *hero* be used when writing about history, or should value judgements be avoided?
- Do historians have a moral responsibility to try to ensure that history is not misused and distorted by people for their own ends?
- On what criteria could we decide whether people in the past have a right to privacy in the present?
- Do historians have an ethical obligation not to ignore contradictory evidence?

Conclusion

History is often abused by TOK students as the definitive example of a discipline riddled with 'bias' and uncertainty. But this view is often based on a set of misunderstandings. These include the idea that different perspectives on the past constitute a weakness, that each historian is locked into a set of prejudices that stem from their own background, and a confusion between history as an academic project and the past that it seeks to investigate. It is hoped that this chapter has dispelled some of these matters.

It would be hard to improve on the following heartfelt description of the inspiration for the calling of the historian from George Macaulay Trevelyan. It is hoped that it may inspire not only the hesitant prospective student of history who appeared at the start of this chapter, but also you as the reader of this book.

> 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 [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 [her] all [her] life, that carries [her] each morning, eager as a lover, to the library and the muniment room. It haunts [her] 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 [e247]: wildcatisland.blogspot.com/2009/05/finals-filler-appeal-of-history.html)

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Arts 4.6

Introduction

[The Egyptian painters'] method resembled that of the map-maker rather than that of the painter.

(Gombrich, 1995, p. 61)

Once upon a time a young woman went to visit her cousin in New York City as a gift from her parents when she passed her IB diploma. She wanted to see all the sights and visit the Museum of Modern Art where she knew her beloved Monet painting of water lilies was hanging. So off she went to stand in line and buy a ticket and mount the stairs to the second floor where the lovely Impressionist paintings were shown. But rounding the landing she caught sight of the huge *Les Desmoiselles d'Avignon* and was overtaken by a *coup de foudre* of excitement and admiration beyond what she had ever known. Weak in the knees but catching her breath, she stood awestruck in front of what she thought was surely a masterpiece.

What is going on in this little vignette? What does the painting tell her? What does she have to know to be so receptive? What does she now know about herself? How are knowledge and emotion all mixed up here in this experience? What kind of knowledge is going back and forth? Have you ever come to know anything and had the same kind of thrill in your school subjects or even outside of the classroom?

Think of the three kinds of knowledge mentioned so far in this book. Can you pinpoint in the story above any one of those kinds of knowledge: *knowing how*, *knowing that*, and *map-like* knowledge?

The question above is about how these three types of knowledge – map-like knowledge, propositional knowledge, and procedural knowledge – might apply to a work of art. You probably found that answering this question was far from easy. It is complicated by the fact that it is not clear what is meant by 'artistic knowledge'. Do we mean the knowledge of the artist to be able to create the artwork in the first place? This would seem to be procedural knowledge in most cases; knowing how to paint or compose music is surely a skill that is learned by practice. Or perhaps we mean the knowledge that the audience needs to understand the artwork? It is conceivable that this too is procedural knowledge; that you need to have practice listening to certain

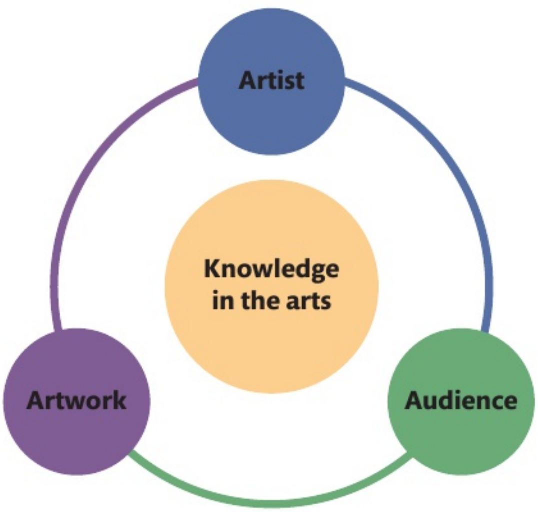


Figure 1 Three aspects of knowledge in the arts

types of music in order to understand it. On the other hand, it is also conceivable that knowing about the background of a visual artist makes it easier to understand their works. In this case propositional knowledge seems most appropriate. The third possibility is that 'artistic knowledge' refers to what the artwork tells us about the world. A novel or a play might teach something about what it is like to be a human being in a complex world. This type of knowledge might be best described as map-like.

These three aspects of artistic knowledge form a thread running through this chapter.

Of the three ways of looking at artistic knowledge, perhaps it is the third way that is the most interesting but also the most controversial; the other two – the artist's knowledge and the knowledge required by the audience to understand the work – appear to be simpler.

In many senses the artist is a bit like an engineer. Artists create something out of nothing, and the artwork is expected to 'work' in some sense. To do this the artist needs to master a set of technical skills such as being able use a paintbrush or a camera, or notate music on paper or a computer. The knowledge of the audience too is not so different, perhaps, from the knowledge you need to read an article in a science journal. A certain amount of background familiarity with the special language of the field is needed, as well as some practice in reading this type of article. But the third type of knowledge, the knowledge that the artwork gives us about the world, is indeed the most puzzling. A skilful audience member can imbue an artwork with meaning; perhaps relating it to an aspect of their own life and experience, or perhaps relating it to an aspect of the wider world.

One worry about the third aspect – the knowledge contained in an artwork – might be the suspicion that it does not carry any meaning at all. What if the arts are just there to thrill and entertain us and that all talk about this type of knowledge is empty? This could be described as a *sceptical* position regarding artistic knowledge. Someone holding this position could still talk about the knowledge of the artist to produce the work and the knowledge (perhaps the background knowledge) that the audience might need to enjoy it, but could deny that the artwork meant anything at all. Undoubtedly there are artworks which fail to be meaningful in this sense. (Can you think of any?) But can something have aesthetic value without being meaningful? These are big questions and discussion of them will take up a large portion of this chapter.

Another issue that needs to be tackled early on is what we mean be the term 'art'. This is not an easy task, but we might take comfort from the reflection that, on the whole, we recognise 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. We don't need to appeal to an abstract definition to recognise something as a work of art.

In addition to the different types of artistic knowledge there are perspectives that can be taken on art in general. Art can be viewed from the perspective of those who think its main job is to imitate nature. Naturalistic painting falls into this category. But art can also be viewed as a means of creating awareness about human issues and perhaps even of changing them. In this category are those who see the purpose of art to be social criticism and as a vehicle for social change.

Within the artistic community there are other perspectives often linked to a particular period in history. Art is notorious for its fair share of 'isms'. *Les Demoiselles* belongs to a category called *cubism* but there are others: impressionism, fauvism, abstract expressionism, minimalism, and so on. Moreover, the meaning of an artwork is often strongly tied to its location in the continuum of art history. There are artworks that refer explicitly to other artworks, styles, or methods and 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.

Moving on to the next part of the knowledge framework, the methods of the arts appear at first sight to be unlike those of the sciences. They seem to rely heavily on the free imagination of the artist unconstrained by facts about the world. Nevertheless, many painters seek to represent the world in some way; novelists and filmmakers describe plausible human situations based on observation and experience of human psychology; choreographers represent human interaction in a highly stylised way; and musicians play on the psychology of acoustic perception in the construction of their works. There are many ways in which the arts connect the material world to the world of human experience. Moreover, each artwork does seem to possess some sort of inner logic; there is a virtual reality created in which certain rules operate that we can play with and manipulate; in this sense the arts might be a sort of laboratory where we can experiment with, and model, real human issues.

Finally, we might expect that the artists bear a responsibility for the role that they play in terms of the methods that they use to create their works and in the knowledge that these works might embody. If the arts do have the power to change society, this power must be wielded responsibly.

Things to think about

- The arts are often thought of in contrast to other things. We contrast the arts and the sciences, art and nature, art and reality, art and morality, art and sport, art and craft, and *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 view of the arts. In your opinion, which of the following descriptions of art and science are true?

Art	Science
Subjective	Objective
Fictional	Real
Uses emotion	Uses reason
Individual	Collective

- Which of the following statements do you agree with and why?

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 with a greater or lesser degree of this distinctive value.

V

The arts or **art:** this is a general term that covers all artistic knowledge and activity

Art form: an individual discipline such as painting, weaving, filmmaking, jazz, dance, or architecture

Artist: the producer of the artwork. It can be a single person or a group of people

Artwork or **work of art:** the product of the 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 closely linked to the arts such as artists, producers, museum directors, gallery owners, critics, art historians, art journalists, and patrons who support the arts

6. Artworks succeed or fail in realising their aims.
7. Artworks can be understood or misunderstood.
8. Artworks may be subjected to analysis.
9. Artworks may be praised or criticised.

Scope

Our first job is to define what we mean by the arts.

Activity 1

With your neighbour, discuss which of the following counts 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 we describe something as art or not?

The painting *Sunflowers* by Vincent van Gogh.
A football match.
A pile of bricks on a building site.
A pile of bricks in the Tate Gallery in London (Carl Andre, 1966).

The Dayak skull.

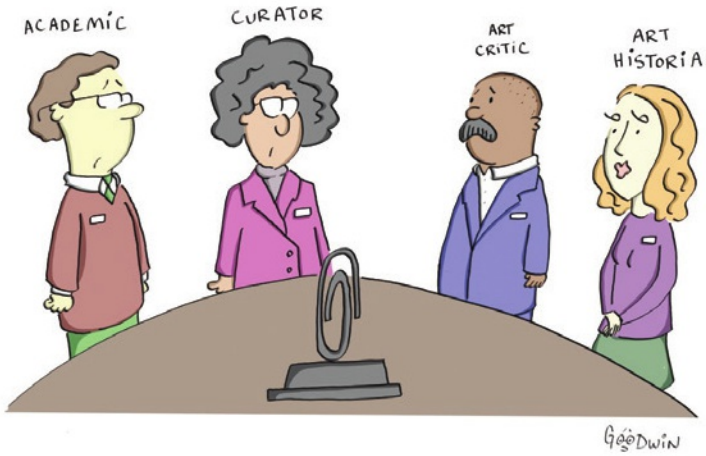
The German expressionist film Metropolis (1927) directed by Fritz Lang (see picture below).

A sunrise.
A piece played by a Gamelan Orchestra.
A Japanese *Noh* play.
A picture painted by a 5-year-old child.

There are three points you might have noticed about the classification exercise in Activity 1.

- Deciding whether something is art or not is different from deciding whether something is good art or not. You might decide that the painting by the five-year-old is art but not necessarily good art.
- Art might require three basic elements: an artist, an artwork, and an audience. So art, like other areas of knowledge, is a human social activity.
- Or, you might decide that a work of art is whatever the artist says it is or means it to be. Alternatively, it might be something that the audience decides is art.

Whether a work of art is good or not might be a *social fact*; that is, a fact that is brought about through human social interaction. Most social facts are created using language in an appropriate setting (see Chapter 2.2 **Knowledge and technology**). But it might not be the artist who decides this. (Perhaps this is a shame from the artist's perspective.) Instead, what is meant by good art and which art pieces qualify might be decided by a particular group, let us call it *the artworld*, that consists of gallery curators, private collectors, art historians, art critics, and some influential artists. This is only one view of value in art called the *institutional* view.



Does the art world decide what is a work of art?

A problem with the institutional view is that it depends on what a particular group of people decide is art at a given time, and not on a feature of the object itself. On this view, anything could be art provided the right people think it is. The philosopher William Kennick (Kennick, 1958) proposed a test for a definition of art. He suggests a scenario where a warehouse is on fire and people have to rescue the artworks in the warehouse according only to a definition. If it is possible to know the difference between the works of art and other things in the warehouse then the definition passes the 'warehouse test'. Unfortunately, the institutional view fails this test. Do you think that institutional view is helpful even if it fails the warehouse test?

Figure 2 The warehouse test for a definition of art

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. Perhaps this is one of those times when you know it when you see it, but you can't put your finger on what the single defining feature is.

Figure 3 Family likeness

On the other hand, there are some who say that art does not even have a family-likeness definition. They are called *anti-essentialists* and insist that there are no essential properties that make something a work of art. This category includes some feminist thinkers who are suspicious of the motives for a search for a definition. Definitions are dangerous, they say, because they cast in stone a set of relationships in which males dominate. Traditionally, a distinction is made between the fine arts and the crafts, for example. Feminists point out that the fine art category is dominated by men, while women dominate the area defined as the crafts. What do you think of this position? Which category is seen by many to be artistically superior?

Things to think about

- Write down the names of ten famous artists. How many of them are women? What do your results mean? What do you understand by Virginia Woolf's comment that 'for much of history Anonymous was a woman'?
- Do you agree with the feminist view that hard and fast definitions of art are dangerous because they perpetuate male dominance?
- 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.
    - X is intended to be an artwork.
    - X is identifiable as an artwork.
    - X falls easily within an established art category.
    - X possesses aesthetic, formal, expressive or representational properties.
    - X has the capacity to communicate complex meanings.
    - The production of X requires skill.
    - The production of X requires creative imagination.
    - X invites the emotional and cognitive response of the audience.

Try this definition out on your favourite works of art (music, literature, film, paintings, 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?

- To what extent might it be true that the arts are the systematic treatment of sense experiences? Music would be the systematic treatment of the sense of hearing – organised sound. The visual arts would be organised vision. What art forms represent the systematic treatments of taste, smell, and touch? Could 'the systematic treatment of sense experiences' also include the sciences?
- Discuss each of the following statements with a classmate. Which statements do you agree with and why?
    - The arts are purely for enjoyment.
    - The purpose of the arts is to make us happy.
    - Knowledge is a type of belief. There is no belief in the arts therefore the arts embody no knowledge.
    - Anyone can appreciate art (dance, music, literature); there is no special knowledge required.
    - The arts are not designed to solve any particular problem.
    - Whether a work of art is good or not is just a matter of opinion.
    - There is no reason in the arts. They act purely at an emotional level.
    - A work of art is just the expression of the emotions of its author.
    - The arts are purely the result of imagination and creativity, they tell us nothing about the world.
    - The arts have no effect on the development of human knowledge.
- Choose a TV show and ask yourself in what sense was the show well crafted? How did it solve the internal problems of providing an unified and varied TV experience? Did it borrow from other art forms such as film, theatre, or literature? Can you identify any deeper knowledge issues that it raised?
- The *Mona Lisa* is the most visited object in the Louvre Museum. Most scholars of art recognise it as being of high aesthetic value. Yet its popularity might not derive from it being of high value, but rather that it is simply famous. Is great art always something appreciated by an elite few or can it have mass appeal?

Knowledge questions

- Do the disciplines in the arts diverge from one another more fundamentally than disciplines within other areas of knowledge?
- Does new knowledge in the arts always build on what is already known?
- How have new technologies changed the nature and scope of the arts as an area of knowledge?
- Are the arts best seen as a system of knowledge, a type of knowledge, or a means of expressing knowledge?
- Is artistic knowledge something that cannot be expressed in any other way?
- Is the relationship between *knowing how* and *knowing that* different in the arts compared to other areas of knowledge? Does art enlarge what it is possible for us to think and know?

Perspectives

We shall consider four perspectives on the arts: their purpose, the role of history in shaping them, the idea of the arts as portraying what is possible, and finally their relationship to the individual knower and their potential to change us.

Purpose of the arts

The first perspective asks what the arts are for. Are they like a map in that we can use them to answer questions or solve problems? If so, what sort of questions do they address? Clearly, they do not answer questions as we ordinarily understand a question wanting an answer, as might be the case with the natural sciences. Think about your favourite art form. Does it solve problems or answer questions? If so what types of problems or questions?

Many students in TOK essays simply assume that the purpose of an artwork is to communicate the emotions of the artist. This is unlikely to be true in most cases if 'emotion' is taken to refer to those transitory feelings we have that come and go. If emotion is taken to mean more generally 'thought', then it becomes a truism that the artwork reflects the thoughts of the maker. What else could it reflect? Think of your favourite novel. Is it about the feelings of the author while writing it? Or is it telling a story that produces thoughts and feelings in the reader? Try to avoid an assumption like this in your TOK essay.

Let's divide the questions that concern the arts into two categories:

- *External questions* are those that concern things outside the art form itself; for example, questions about humankind's relationship with the rest of the cosmos or what it is like to be human.
- *Internal questions* are particular to the art form; for example, how to construct a film that is two hours long in a way that is interesting and compelling or how to paint a picture that grabs the attention of the viewer.

Perhaps an analogy might help. Consider an architect commissioned to design a new airport. They need to answer two types of question. There are the 'external' questions of how to provide a space to house ticket desks, check-in counters, security channels, shops, and gates, for example. But then there are the 'internal' engineering questions to answer (and in this analogy they are literally engineering questions): how to build large vaults without the ceiling falling in; how to make the design light but strong. There are also aesthetic problems to solve: how to make the design both unified and interesting to look at. These aesthetic problems are akin to an engineering problem – how to make the work hang together as an artistic whole. Ultimately the architect might have to combine form and function in an effective manner.

Things to think about

- Consider a public building you know well. How does the architect solve the external and internal problems mentioned above? How are form and function combined?

One set of external questions that artists grapple with has to do with the nature of our relationships with one another. Almost all theatre, film, and novels deal with human relationships under various conditions. Certain types of novel provide a laboratory for exploring what happens when human relationships are put under stress. The French writer Émile Zola's *Thérèse Raquin* is a good example of a novel that deals with questions about the response of human beings to extreme situations.

A reasonable objection at this point might be that the discipline of psychology surely does the same thing and in a more systematic manner. But novelists can answer that they deal with these questions in a distinctive and more vivid manner. The great 19th-century Russian novelist Ivan Turgenev said: 'The writer must be a psychologist, but a secret one; he must sense and know the roots of phenomena, but offer only the phenomena themselves as they blossom or wither.' With the novel, the reader is given a personal view of the characters in the novel and it shows us in a vicarious way how human beings are prone to think, feel, and act. In contrast, psychology gives us general and impersonal laws of human behaviour.

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 idealisation of what happens in real life?

Our relationship with our natural environment is a favoured topic of visual artists. There are many who explore the characteristics of the world that surrounds us – from painted landscapes and seascapes, to sculpture in iron, bronze, plastic, and even concrete. This grew to a climax in the 19th century, with the 'panorama' craze. Special buildings were constructed to house massive canvases representing the outside world on a vast scale. Again, the arts seem to take a different approach to the sciences here. While biology might investigate the organisms present in the ocean and marine engineering might investigate methods for building ships, the Dutch artist Hendrik Willem Mesdag painted his panorama to capture the 'feel' of the beach near The Hague by offering the viewer a 360-degree spectacle – perhaps a 19th-century version of VR.

Figure 4 Visitors viewing the Panorama Mesdag (1881) in Den Haag, Netherlands

Historical perspective

An artwork is always situated at a point in history and a historical perspective might be relevant to understanding the artwork. There are representations of actual historical events, such as Picasso's painting of the bombing of the town of Guernica during the Spanish Civil War, or representations of imagined or mythological history as in Shakespeare's *Macbeth* or *Antony and Cleopatra*. In the hands of a great artist, historical themes can be used to explore and understand present-day features of human life. Shakespeare's play might get the audience thinking about human politics and how little has changed since Julius Ceasar's day. His work might capture something universal about human nature.

Figure 5 Part of the Bayeux tapestry

The Bayeux tapestry (see Figure 5) was produced to record the victory of the Norman King, William the Conqueror, at the Battle of Hastings in 1066 in the south of England. The work is historical in two senses. It certainly is an attempt to represent a historical event. A historian would call it a contemporary record because it was produced shortly after the event. But from our modern point of view it is historical in that it is almost 1000 years old.

Figure 6 John Singleton Copley's painting: Charles I Demanding the Five Members in the House of Commons in 1642

The painting in Figure 6 by John Singleton Copley was produced more than 100 years after the events it portrays. In it, the English King Charles I is demanding the surrender of five impeached members of the House of Commons. Parliament, in a challenge to Charles's authority, refuses to surrender them. This is a significant moment in English history where the will of the king is trumped by that of parliament. It heralds the English Civil War and the eventual execution of Charles 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, when you consider that just two years before Copley portrayed the dramatic clash between Charles and Parliament, the then current King George III had signed a peace treaty 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.

Figure 7 Yoruba man with a bicycle

Historical references can be more subtle than a straight portrayal of events. The work in Figure 7 strikes a dissonance between the material and the subject matter. It is a Nigerian sculpture in traditional materials. Yet, as philosopher Kwame Anthony Appiah notes, 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 critique of the colonial period (Appiah, 1992).

The arts giving a perspective on the possible

The third perspective is that the arts are concerned, not with the world as it is, but with the world as it *could* be. While the sciences generally represent the existing world, the arts have the opportunity of depicting possible worlds. The philosopher Friedrich Nietzsche felt that this made the arts superior to the sciences. While ethics could be thought of as interested in possible worlds (see the final section in this chapter), Nietzsche dismissed moral thinking because it was 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. The power to invent other worlds is used to great effect in genres such as science fiction, where questions of the sort discussed above are set in virtual environments where special rules operate producing a powerful tool for exploring human nature.

Think of your favourite science fiction story, or film, or TV series. What evidence is there that the work, despite appearances to the contrary, actually explores contemporary issues in current society?

Figure 8 *Interstellar*

The ability to portray possible worlds makes art an immensely powerful tool for examining human society and questions of 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 contributing to such a change.

There are many examples of works of art banned by political authorities because of their potential for fomenting dissent. The Soviet composer Dmitri Shostakovich was taken to task for writing music perceived to threaten the stability of the Communist state. His music was strictly monitored by the state censor and his opera *Lady Macbeth of the Mtsensk District* was openly criticised by senior figures in the Communist Party in 1936 for what was thought to be a satirical commentary on contemporary Soviet society. His extraordinary *5th Symphony* that followed was much more cautious and is sometimes subtitled 'a soviet composer's creative response to just 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 the vehicle for bringing about social change, 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 cultural 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 the Hollywood of the 1940s for producing films that gave people the impression they were living in the best of all possible worlds. His view was that popular culture was controlled by forces that had an interest in preserving capitalism. He argued that the arts gave people a false consciousness of their own situation; they felt good after coming out of 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; capitalism would be safe. The reason Adorno gives for the failure of communism after the First World War was that capitalism had grown a culture to protect it from being undermined. A central part of this culture was the arts. Can you think of any contemporary films that seem to reinforce a capitalist message, or celebrate capitalist values?

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 the popular 'culture industry', as he described it. 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* by Alban Berg.

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 was used to reinforce the existing social and political structures and to create precisely the sort of 'false consciousness' that Adorno so abhorred.

Figure 9 An example of Stalinist propaganda against the West

The poster in Figure 9 is a fine example of Stalinist propaganda against the West. It was 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 a 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* by the Socialist Realist composer Aleksandr Mosolov. The piece is for a large symphony orchestra and is a literal rendering of the sounds of an iron foundry. You can listen to the piece using the QR code.

It is four minutes long, but includes the full gamut of industrial noises associated with the making of steel. At the same time, one can still identify melody, rhythm, and harmony. It is recognisably music written in the early modern tradition AND it is art rather than just the incidental noise of steel production. Have you ever wondered what the difference is between music and noise?

The arts and the personal perspective

The final perspective is personal. How do the arts impact on us as individuals? How do they change our minds and feelings? Perhaps one way this happens is through our personal appreciation of beauty.

In his book *Beauty*, the philosopher Roger Scruton stated six popular ideas about beauty.

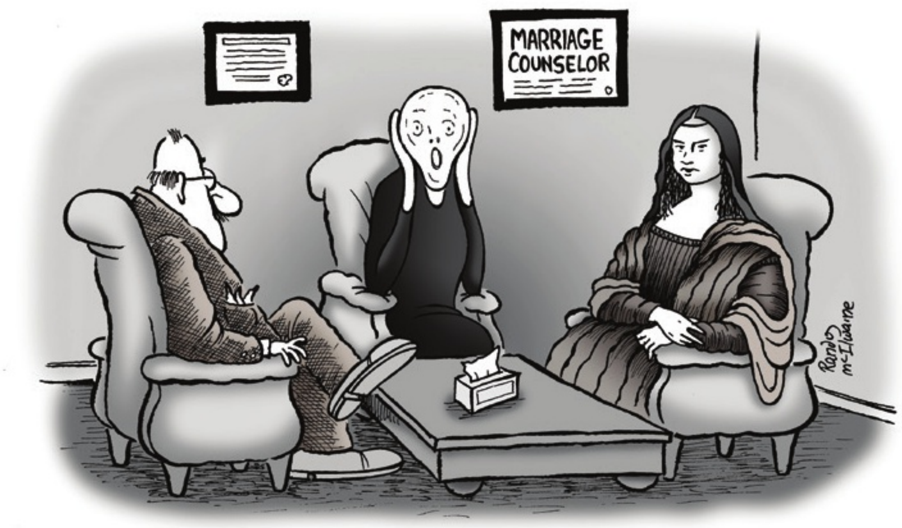
1. Beauty pleases us.
2. One thing can be more beautiful than another.
3. Beauty is a judgement of taste.
4. Judgement of beauty is a judgement about the object not the subject's state of mind.
5. There are no second-hand judgements of beauty.
6. Beauty is a sufficient reason for attending to the object of beauty.

How many of these statements seem correct to you? If all are true, then we are presented with a picture of beauty as something that moves us directly and is pleasurable. It is something that can be compared and that relies on our making a judgement based on taste. The fourth statement suggests that the well-known 'beauty is in the eye of the beholder' is not true and that beauty is actually a feature of the object, not the person perceiving it. The fifth suggests that we cannot be persuaded by others into finding something beautiful; knowledge of beauty seems to be different from other types of knowledge. The last statement suggests that beauty on its own is sufficient to attract our attention – we need no other reason. Indeed there are some thinkers, notably Kant or some 19th-century writers associated with the aesthetic movement, who claimed that if the beautiful object were valuable because it was a means to an end then it was not pure beauty that was being judged but something else, like usefulness or practicality.

One such writer was the art critic Clive Bell, who claimed that a special feature in a work of art made it beautiful: significant form. This produced a particular 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 whether artistic value lay 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. 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 of Scruton's platitudes above. 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, and which people or group or cultures have this sensitivity? If the answer ends up being 'the artworld' then this theory becomes similar to the *institutional view* mentioned earlier. On the other hand, if the answer is 'those who are able to perceive beauty' then the argument is circular: beauty is explained 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.



"He overreacts to everything!"

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 personal circumstances in a propositional way. We can read ourselves in the novel or poem, or find our own thoughts mirrored in a piece of music.

The arts can also help us appreciate the immensity of things outside ourselves. The lofty vaults of Köln Dom or the intricate carvings of Angkor Wat can help forge an almost physical understanding of things much bigger than ourselves and out of our reach. The haunting melody of Messiaen's *Quartet for the End of Time* might lead us towards an understanding of eternity and the horrors of the concentration camp. Chinua Achebe's *Things Fall Apart* helps us understand the perspective of an oppressed people 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 has experienced these things. In this way the personal perspective on the arts can create powerful understanding.

Things to think about

- To what extent do you agree with Adorno and the Frankfurt school that the function of the arts is social criticism? Think of an area where the arts might play this role (for example, climate change, gender issues, social inequality). Identify an artwork to back up your point.
- The ideal of being true to nature seems to apply to the art of earlier times. Rebecca West was dismissive of this idea when she said, 'A copy of the universe is not what is required of art: one of the damned things is enough'. Can you think of any modern art that tries to produce an accurate copy of the world?
- To what extent do you think that popular culture is what Adorno means by the 'culture industry' creating a false consciousness in which the inequality of the world is forgotten and a false feel-good factor installed in its place?
- Should we judge art by its time or ours?
- The great works of music and literature seem to have stood the test of time. Does that make them good art? Is artistic knowledge more value laden than that of other areas of knowledge?
- Is it possible to make critical judgements about art from a culture with which you are not familiar?

Knowledge questions

- Is there such a thing as 'obsolete' knowledge in the arts?
- Can a work of art have meaning of which the artist themselves is unaware?
- How does knowing more about the social, cultural, or historical context of a work of art have an impact on our knowledge of the work itself?
- Can art change the way we interpret the world?
- What are the justifications for, and implications of, claiming that there are absolute standards for 'good art'?
- Who determines what art is valued, and on what criteria?
- Should your judgements about art be given the same weight as those of an expert?
- What role does the history of an art form play in evaluating present work?

Methods and tools

> 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.
>
> (Paul Cezanne)

Solving the engineering problems of the arts

Imagine a painter sitting in front of an empty canvas, a composer sitting in front of a blank manuscript (or more likely these days a blank computer screen), a choreographer in front an expectant dance troupe, a film director contemplating the next film, a novelist facing a blank word document. What decisions do these artists have to make in order to produce an effective work?

Clearly there are technical problems that each must solve that depend on the nature of the art form itself. The painter must make decisions about the style and composition of the painting. Will it be abstract or representational? How large will the canvas be? What conventions will it employ? What colour palette? What type of textures? The composer must think about what instruments to use, how long the piece will be, what melody, harmony, and rhythm will be used in the piece. The novelist must 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 must 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.

There is another group of decisions that must 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 structure or surface features.

But how does the artist make these structural decisions? Are there any general principles that guide the engineering of a work of art?

Activity 2

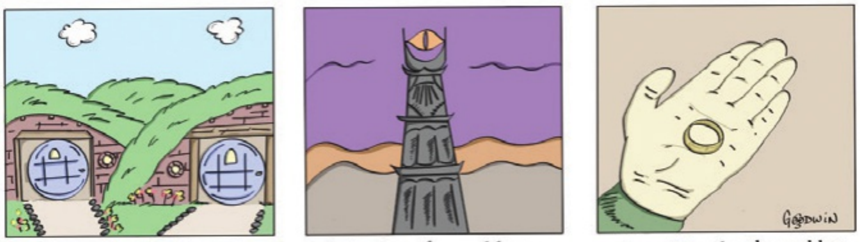
Think back to one of your own artistic projects. How did you reason about the design of the work? What problems were you trying to solve? What difficulties did you encounter? How effective were your solutions? Did they solve the structural problems you identified? How did your work compare to the work 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 they have 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
- attempt to solve the problem.



Set up the virtual world... ...introduce the problem... ...attempt to solve the problem.

We might represent this structure even more abstractly.

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 insisted that the plot should be unified in the sense that everything that happens follows from other things in the plot. He also thought 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. In tragedy, this is usually accompanied 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, roughly speaking, follows approximately the structure above. It is significant in this regard that many courses in script-writing for film take Aristotle's *Poetics* as a starting point.

Activity 3

Try to find an example of a plot for a movie that uses the Aristotelian devices of *peripeteia* and *anagnorisis*.

We might try to look for similar structural devices in other art forms.

In music of the classical period in Western Europe we have the following structure for a piece in sonata form:

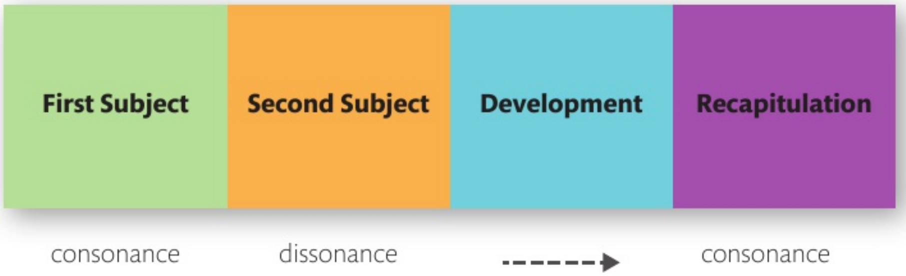


Figure 10 Structure for a piece in sonata form

The *first subject* sets up the language of the work. It introduces us to the theme, which is like the main musical 'character'. The theme is repeated to emphasise its importance. Then a new musical character is introduced that contrasts with the theme, called the *second subject*. This is done to introduce variation. At this point the work has variation but it does not have unity. What the composer must do is to show that the second subject is somehow related to the first. This is done in the third section called the *development*. Here the music starts with the first subject and a musical 'argument' links it to the second subject providing the required unity. Finally, the first subject is repeated (the *recapitulation*) to achieve closure of the work. Non-musicians might be intrigued that music can be used to construct an 'argument'. But well-informed audiences will know what to listen for and will be expecting the various important events in the course of the piece.

Artists in static media such as architects, painters, and sculptors must solve these problems within the static work itself. There are various techniques they can use. Different parts of the painting can have their own shapes or colour schemes, but they can still frame the same scene. Forms can vary through different parts of the building but still be unified by some stylistic element.

Some precisely determine the structure of their work. The painter Piet Mondrian, for example, used mathematical techniques in the composition of the canvas. We saw in Chapter 4.4 **Mathematics** that Mondrian was copying a technique of Greek architects in using the *golden section ratio* as an important structural device. Later architects and composers were also concerned about proportion; some, such as the French impressionist composer Claude Debussy, consciously use the golden ratio as a compositional tool.

On the other hand, there are some artists who allowed random variations to help shape their work. The American painter Jackson Pollock relied on the patterns formed by the paint as it dribbled down the canvas to produce his work. The American composer John Cage used chance as a technique in his compositions, including random ambient sounds in the concert hall.

There are other areas of knowledge that have loaned their methods to the arts. The natural sciences have been influential across much of culture. The painting in Figure 11 is a striking example of how developments in contemporary physics can feed into the visual arts. In his *Special Theory of Relativity* of 1905, Einstein provided a way of thinking about time as being just another dimension that was coupled to the dimensions of space by the invariant speed of light. This meant in a sense that the whole of time, including past and future events, could be conceived as existing eternally. Future events existed but lay beyond us along the time dimension. In his *Nude Descending a Staircase* of 1912, Marcel Duchamps exploits this idea using the conventions of his style. What is remarkable is that every stage of the journey is depicted simultaneously following Einstein's theory.

Figure 11 Marcel Duchamp's *Nude Descending a Staircase (No. 2)* (1912)

Activity 4

How does the artist solve the engineering problem of balancing unity and variation in the following paintings?

The role of convention in the arts

Take a look at the artworks in Figures 12, 13 and 14. What differences do you notice about the way that they portray their subject matter?

Figure 12 Portrait of Hesire c. 2750 BCE

Figure 13 Antonio and Piero del Pollaiuolo's *The Martyrdom of Saint Sebastian* (1475)

Figure 14 *Interior of the Sint-Odulphuskerk in Assendelft* by Pieter Jansz (1649)

The biggest differences lie in the artistic conventions that the works use to produce their meaning (and therefore perhaps to create knowledge). A convention is an accepted way of doing or saying something established through practice. You can spot them because they are something to do with how the artwork generally looks or sounds.

An elaborate set of conventions governs the style of Ancient Egyptian art. Look at the first example. The head is portrayed in profile, but the eye and 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, as EH Gombrich describes in his excellent book *The Story of Art*: '[the Egyptian painters'] method resembled that of the map-maker rather than that of the painter' (Gombrich, 1995. p. 61). He also notes that the purpose of the Egyptian painter was not prettiness but completeness: 'It was the artists' task to preserve everything as clearly and permanently as possible'. This was important because Egyptian artworks played an important role in the afterlife: 'How could a man with his arm "foreshortened" or "cut off" bring or receive the required offerings to the dead?'

Gombrich goes on to say:

> It is not only the knowledge of forms and shapes that the artist embodies in his picture but also his knowledge of their significance… the Egyptian drew the boss bigger than his servants or even his wife. Once we have grasped these rules and conventions, we understand the language of the pictures in which the life of the Egyptians is chronicled.
>
> (Gombrich, 1995. p. 62)

There is a literal sense that Egyptian art used conventions in the same way as a map uses symbols. Art was about depicting significant objects.

More recent art deploys different conventions. The most striking difference between the 15th-century Italian painting (Figure 13) and the 17th-century Flemish work (Figure 14) is the handling of perspective. In the older painting the figures are more or less the same size and the background feels flat. It was not considered important to get perspective right in the 15th century and artistic techniques had therefore not developed for rendering it. The Flemish masters changed the convention and showed how to incorporate perspective leading to a different artistic style. A collection of corresponding artistic styles might be called an *artistic tradition*.

Convention does an important job through establishing expectations. In certain types of Western music, a G7 chord is usually followed by a C chord. The audience expects this and is surprised if the composer follows it, instead, with an A minor chord. This type of surprise is called an 'interrupted cadence' – the term itself giving away the fact that it somehow frustrates our expectations. If we see the sky in a nightscape such as van Gogh's *The Starry Night* we might expect a uniform dark blue patch, not a complex of brushwork spirals. If we see a portrait of a human face in an early 20th-century painting, we expect the eyes and mouth to be arranged in a regular fashion, not in a disjointed fractured mass of angular planes as in Picasso's *Portrait of a Young Girl*. The fulfilling and breaking of expectations produces 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, that we are within our comfort zone, or that we are home somehow. A frustrated expectation is when things do not turn out as convention would suggest. We get an 'uh, that's strange?' feeling – a feeling that we are outside our comfort zone or that we are still far from home. These differences in emotional temperature allow the artist to structure the piece and produce movement: from relaxation to tension to relaxation, say. 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.

Figure 15 Van Gogh's *The Starry Night* frustrates expectations.

Figure 16 Sceptical view of non-verbal communication

Self-reference and parody in the arts

This section ends by considering a common method employed in the arts: referencing other art works. These references help bind the work into the historical tradition. They might be ironic in that they are somehow poking fun at the earlier work – *parody* – or they might be an expression of respect or admiration for it. In either case the meaning of the present work is deepened by incorporating a link to other works.

Figure 17 shows Velázquez's famous 1656 painting *Las Meninas* (the maids of honour). It is an extraordinary painting in that it flouts the usual convention that the viewer is a spectator of the scene portrayed by the picture. In this painting the view is paradoxically the subject of the painting. The roles are reversed. The painter and onlookers are visible in the painting. The ostensible subjects of the painting are the Royal couple who are only visible in the mirror at the back of the room. The work

Figure 17 Diego Velázquez's famous painting *Las Meninas* (1656)

inspired many references in more recent painting. Perhaps the most well known is the series of 58 paintings produced by Picasso in 1957 called *Las Meninas* of which one is reproduced in Figure 18. 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 becomes distorted into a figure from the Inquisition, the ceiling rose becomes a grotesque hook 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.

Figure 18 Painting from Picasso's 1957 *Las Meninas* series

This example is all the more striking because of the stylistic changes in painting that have taken place between the original Velázquez and the Picasso. 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 discussed in Chapter 4.2 **Natural sciences**. We have 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.

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 Glas* by the Swedish author Hjalmar Söderberg is the starting point for a more recent novel by Bengt Ohlsson that is written from the point of view of the antagonist Gregorius (this referencing is called *intertextuality* in literature). 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 bases his *Young Person's Guide to the Orchestra* on a theme of Purcell; Rachmaninov and Saint-Saëns both reference the plainchant *Dies Irae*; Elgar quotes Mendelssohn in his *Enigma Variations*. Most spectacularly, the modern Italian composer Luciano Berio piles 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 *The Kreutzer Sonata*, 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.*

Things to think about

- Does it matter that art refers to other art rather than to the 'real' world? Does that make art more relevant or less relevant to us?
- Write down a list of works in film, literature, and music that contain references to other works. What are the functions of such references in an artwork?
- Can you identify paradigm shifts in music, literature, painting, film, dance, and theatre?
- What are the differences between the use of convention in the arts and the natural sciences?
- Why did Copley portray the historical event of the fall of Charles I rather than the contemporary events of the War of Independence?

Activity 5

This activity can be done in groups of five or so. The aim is to construct and perform a piece of music using everyday items that happen to be lying around the room. While the activity is in progress each person should make a mental note of the challenges they face, the decisions made, and how it felt to be part of the activity. Each group should use a large piece of flipchart paper and felt pens to draw a graphic 'score' of a piece of music. Each group should decide how the various graphical elements should be 'played' using the 'instruments' at their disposal. The groups should then practise their piece. When the time comes for the performance they should perform it in front of the rest of the class. When all the performances are done the voting starts. Depending on how many groups there are, each person has one vote worth 3 points, one vote worth 2 points, and one vote worth 1 point. Individuals are not allowed to vote for their own group. The teacher is to add up the vote tallies. At the end, one group is the winner.

After the voting is over ask yourself the following questions.

- What artistic challenges did your group face in preparing the piece of music?
- How did you solve these challenges?
- How did your group use creativity in the production of the work?
- Why did the winning group win – what features of their work made it popular with the voters?
- Did you need knowledge to produce the piece/appreciate the other pieces?
- If so, what knowledge did you need?
- What kind of knowledge is embodied in the winning piece?

Knowledge questions

- Does convention play a different role in the arts compared to other areas of knowledge?
- Does sense perception perform a radically different role in the arts compared to other areas of knowledge?
- If the language of an art form is non-verbal, does this free it from being limited to propositional knowledge?
- Can some knowledge in the arts only be gained through experience? How does the medium used change the way that knowledge is produced, shared, or understood?
- To what extent are the methods of justification different in the arts compared to other areas of knowledge?

Ethics

The tripartite distinction made in the introduction between the knowledge of the artist, the knowledge of the audience required to appreciate the artwork, and the knowledge carried by the art object itself suggests a similar division of labour in terms of ethical responsibility. The artist bears a responsibility for the methods they use in producing the artwork, as well as a responsibility for the knowledge that they require to execute the work successfully. The audience carries a responsibility in terms of how they react to the artwork and perhaps the knowledge that they should have in order to appreciate it. The third category is less clear. Where does the responsibility rest for the knowledge content of the artwork itself? On the face of it the artist, as the author of the work, bears this responsibility. But as we saw in the case of the natural sciences there are instances where the producer of knowledge cannot be held responsible for the uses to which it is put.

The responsibilities of the artist

There are clear cases illustrating the responsibility of the artist for the methods used to produce the work. There are clear issues with works that involve violence or suffering in their execution. In August 2007 the Costa Rican artist Guillermo Vargas Jiménez (also known as Habacuc) caused controversy when he exhibited an emaciated dog as part of his installation *Exposición No. 1* in the Códice Gallery in Managua, Nicaragua. The exhibit caused outrage when internet memes spread stating that the dog had died of starvation. The director of the gallery replied that the animal was fed regularly and eventually escaped. Vargas intended the exhibit to highlight the hypocrisy of people who complain about a starving dog in a gallery but do nothing about starving dogs on the street. Although the truth of the case is not clear, it highlights a responsibility that the artist carries in the production of the work. Do you think that Vargas was justified in causing the dog to suffer in order that the plight of other dogs is taken seriously?

In 2000, the Trapholt Museum in Kolding, Denmark, displayed *Helena & El Pescador* – a work of the Chilean artist Marco Evaristti consisting of ten food blenders in which goldfish were swimming. There was a notice to the public inviting them to switch on the blenders. One person did so, resulting in the death of two goldfish. The director of the museum, Peter Meyer, was fined for animal cruelty after complaints from the campaign group, Friends of Animals. In appealing against his conviction Meyer stated: 'It is a question of principle. An artist has the right to create works that defy our concept of what is right and what is wrong.' Expert witnesses, including the company that made the blenders, testified that the goldfish would have been killed instantly and would not have experienced prolonged suffering. Meyer was acquitted. Who do you think was responsible for the death of the goldfish? Was it the member of the public who turned on the blender or the artist who exhibited the work? According to expert testimony the goldfish suffered no more (and perhaps less) than they would if they had been caught on a fishing line. Does it make a difference that they suffered in an art museum rather than on the riverbank?

It is tempting to think that ethical issues surrounding the production of art is a phenomenon exclusively associated with modern conceptual art. However, there are historical works that plausibly produced suffering in their making. More recently, in 1852 the pre-Raphaelite painter John Everett Millais painted his work *Ophelia* from a model (Elizabeth Siddal) lying fully clothed in a bathtub of cold water during winter. Stories that she died from the experience are apocryphal. She did, however, contract an illness from the ordeal and Millais ended up paying compensation to her.

Figure 19 John Everett Millais's *Ophelia* (1852)

The cases above are of art that has deliberately inflicted suffering on sentient beings, either as the main point of the work or as a by-product of it. But there are artists who have made the portrayal of human suffering a feature of their work. This category might include photographs taken from disaster areas, such as Kevin Carter's 1994

Pulitzer prize-winning photograph of the starving child and the vulture in Sudan. Much war photography falls into this category, too. It often depicts human suffering, but there are good arguments to suggest that it is important that there is a visual record of human conflict. One such justification could be that human beings should be aware of the full horror of war. Paradoxically many of these photographs have aesthetic qualities and some might describe them as beautiful despite the horrific scenes that they depict.

What about the responsibilities of the audience? Is there a responsible way of viewing and responding to art? Are we responsible to the artist, or to ourselves, or to others? Should the viewers in the Códice gallery have fed or released the dog? Was the gallery visitor who switched on the blender in the Trapholt museum acting responsibly? What of the work itself: does it impose on the audience a responsibility to be taken seriously?

Yoko Ono performed an installation work called *Cut Piece* in the Yamaichi Concert Hall in Kyoto on 20 July 1964. Audience members were invited to cut her clothing as she knelt silently on the stage. The piece was seen as a powerful feminist statement about the objectification of women's bodies. What responsibility did audience members carry in this case?

Figure 20 The 2003 version of Yoko Ono's *Cut Piece*

What responsibilities do we carry when we are viewing work from a culture that is not ours? Are we in a position to make judgements about this work? Figure 21 shows an image produced by the aboriginal people of Australia. These works depict items that have deep spiritual and historical significance. To what extent are we, as an audience, permitted to regard them as 'just' art? The same question is raised even when visiting religious monuments in our own culture. To what extent are we permitted to view the elaborate patterns of the Blue Mosque in Istanbul purely as decoration without appreciating the intimate links with the system of religious knowledge of which it is a part?

Let us turn to the ethical dimension of the work itself. Ask yourself two questions. How many novels have you read that pose an ethical question at their core? What might be the advantage of exploring moral questions in a novel rather than in a philosophical treatise? Since most novels explore the choices involved in how to live life, they are

Figure 21 The Wandjina spirit beings from the Kalumburu in the Kimberley

almost certainly going to be dealing directly or indirectly with ethical questions. Such themes can be found in film, novel, opera, ballet, and the short story. Here a work can invite the audience to experience for themselves the issues facing the protagonists not only in terms of the intellect, but also in terms of the emotions that make the question living (and difficult). In this way the reader or audience member engages directly and emotionally with the issues more easily than with a dry academic work.

Not only can we use works of art to explore ethical questions but, as we have seen, we can be inspired by them to behave well (or badly). One would hope that art that is associated with religion, for example, exhorts us to do good things. Gospel music carries the ethical value of the good deeds that it inspires. How can one fail to be generous to one's fellow human beings after encountering the Requiem of the French composer Gabriel Fauré? But let us not forget that music has been used for millennia to inspire troops in combat and religious music could be used to incite religious conflict, too.

The history of religious ethics runs parallel to the history of religious art. In the past, art provided a direct vector into the minds of a largely illiterate population and was an effective means of maintaining and reinforcing values and teachings. Art went to the 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.

Inuit art often has a quasi-religious function, being used to reinforce Inuit mythology, assist with the telling of history, or for use in religious ceremony and ritual.

Figure 22 Inuit mask

Ethical values in religion also influenced the development of the accompanying art. In Christianity, God forbade 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, nor may any image of a person appear in a mosque. Islamic art is thus characterised by its use of abstract pattern, the extraordinarily ornate inscription of passages from the Qu'ran, and its absence of depictions of human beings. 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.

Figure 23 Calligraphic panel written by Mustafa Râkim

Finally, can we separate the value of the work from the character of the artist? Some of the most sublime music in the Western canon was composed by people who could be described as racist, sexist, and misogynistic. Some of the world's most impressive literature was written by people who behaved appallingly to those around them. Popular culture is not immune from this either. Can you think of excellent art or music produced by someone whose actions could be described as unethical? How would you respond to the legendary TOK question: How can a bad man write a good book? Is that question relevant today?

Figure 24 Hindu Siva mask

Things to think about

- Is there a sense that the arts are above ethical constraints (see the Evaristti example)?
- Is the value of the artwork independent of the ethics of the author? Should paintings by Adolf Hitler be judged purely on their artistic merit?
- The Taliban destroyed fine works of art in the ancient site of Palmyra for ethical/religious reasons. Are any ethical reasons strong enough for destroying a work of beauty?
- A movement was started in 2015 to remove the statue of Cecil Rhodes at Oriel College in the University of Oxford because of Rhodes's involvement in Britain's imperial ambitions on the African continent (see www.bbc.co.uk/news/uk-england-oxfordshire-35435805). Were the protesters right to demand the removal of the statue? What are the differences between this case and the Palmyra example above?
- Adorno said, 'There can be no more poetry after Auschwitz.' What might this mean about the relationship between art and human actions in the world? What are we to make of the fact that those involved in the Final Solution listened to recitals of Schubert and Beethoven when off-duty?
- Can anything of value ever result from art that embodies suffering?
- From an audience point of view, must art hurt before it becomes important or significant?
- Is it acceptable for an artist to shock or upset the audience? Should works of art be accompanied with trigger warnings if they are likely to offend, shock, or upset?
- Is it possible for someone to produce great art when they are happy with how the world is?
- To what extent is refusing to make value judgements about art from a culture we do not know or understand actually a type of cultural colonialism?

Knowledge questions

- In what ways are moral judgements similar to, or different from, aesthetic judgements?
- Do the arts play a role in the development of our personal value systems?
- How important is the study of literature in our individual ethical development?
- Is the production and enjoyment of art subject to ethical constraints?
- On what criteria could it be decided if the state has the right to censor art that is deemed immoral or blasphemous?
- Do the arts have the power to challenge established moral values?
- Are moral and aesthetic judgements more a matter of taste than a matter of truth?
- Can we separate the moral character of the artist from the value of the artwork?

Conclusion

What have we learned in this exploration of the arts as an area of knowledge? We have discussed three types of knowledge associated with the arts: the knowledge and methods of the artist, the knowledge required by the audience, and the knowledge embodied in the work of art itself.

In the first case it is possible to argue that artistic knowledge – in the sense of what knowledge the artist needs to make the artwork – is similar to, or an extension of, other types of knowledge. There is technical engineering-style knowledge required by the artist to produce the work, which could be described in many cases as *know how* or procedural knowledge. The artist must solve problems of unity and diversity in order to make a successful artwork.

The audience needs familiarity with the art form and its conventions. This may also be procedural knowledge. In appreciating art, as in watching sport, audiences need to be aware of the rules of the game to get the most from the experience. In some art forms such as painting and literature, some knowledge of the canon and the historical background of the work helps an audience to understand and appreciate it. This historical knowledge might resemble a more traditional propositional kind of knowledge similar to that of the area of knowledge, history.

Finally, there is a case for proposing that many artworks do give us knowledge about the world and employ map-like techniques to do so. We saw how art can affect us at a personal level. It can change our individual perspectives. Being able to do so in a responsible manner suggests that we need to think carefully about where such responsibilities lie. In any case, that might ultimately be a test for good art: the ability to affect us and change our minds.

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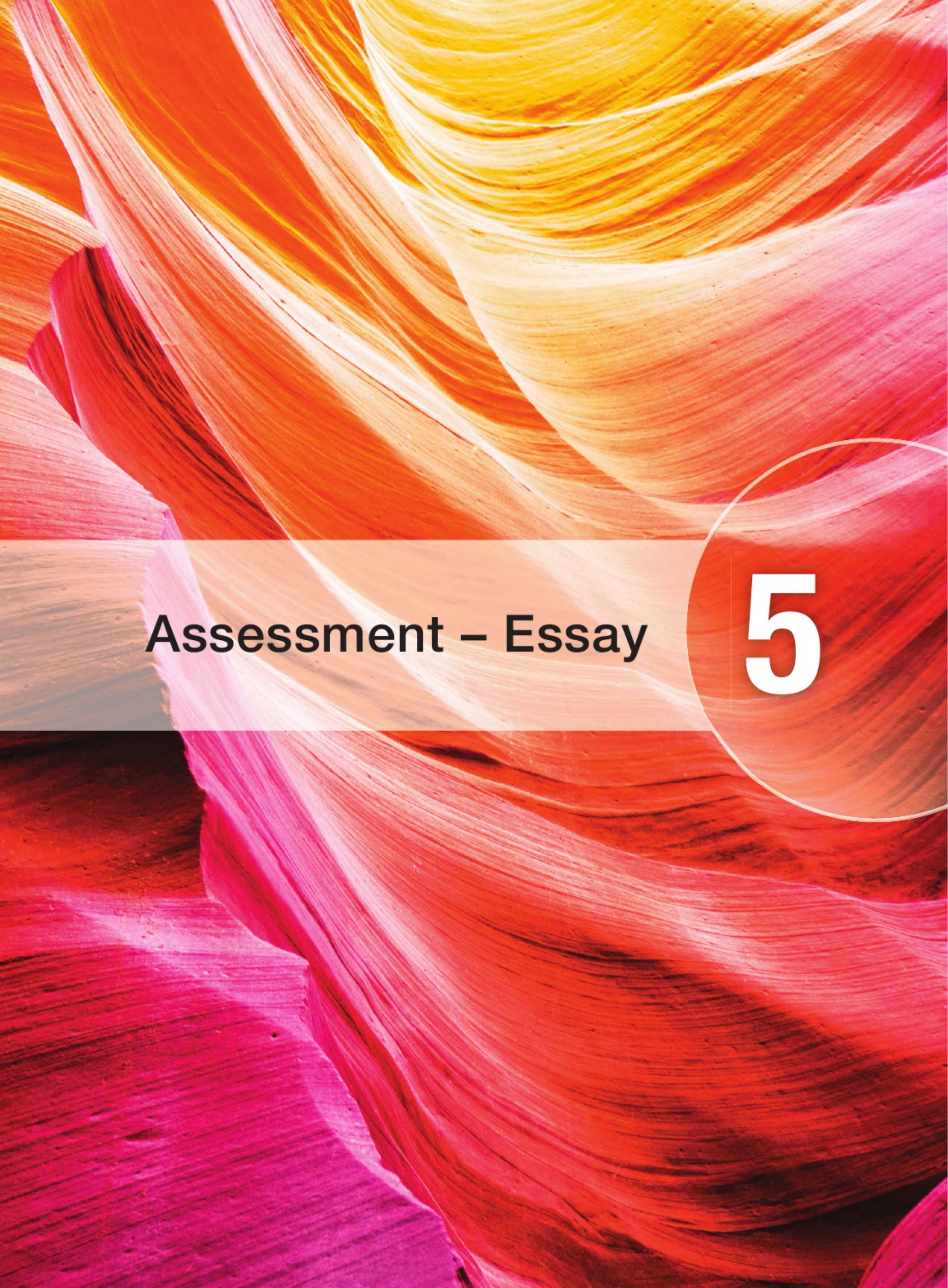

5 Assessment – Essay

Introduction: about the essay task

There is something playful about the TOK essay. It is an exercise in thinking, and thinking itself is playful. When thinking, we try out ideas and compare them; we ask 'what if?' questions and we explore more than one possible way of looking at things. This is what is expected of a TOK essay. In fact, the word 'essay' is linked to the verb *essayer* in French, which means 'to try', suggesting an exploration, trying out ways of thinking and comparing them.

Already, this discussion raises a technical issue. In your exploration you will be trying out different ideas by engaging in multiple lines of thought. But the form of the essay is a single stream of text. So, the art of the essay, or the challenge, is to transform the many facets of thinking – of your exploration – into a linear text. The key to this challenge lies in the structure of the essay. One approach is to make the essay *modular*. This means constructing the essay out of more or less self-contained parts, each of which has a particular function. There is a lot to say about modularity in this chapter.

The other key to essay writing in TOK, and many other TOK activities as well, is a simple rule: concrete – abstract – concrete. Start with a concrete example. Build the example into more general abstract arguments. Then illustrate (and possibly challenge) the conclusions of these arguments with concrete examples. In your TOK discussions, look for concrete examples to get an understanding of an idea or concept. Develop the example into something like a general statement or argument and then explore the implications of the generalisation or argument by considering other examples that maybe do not fit the conclusion so well.

Using these ideas, this chapter will try first to separate the complex process of producing the essay into simpler components. Then it will say something about the sort of essay we might expect to result from this process. There is more than one kind of TOK essay, and there are many ways of responding to a given prescribed title (PT). However, there are certain features that all good TOK essays have in common. There must be:

- logical arguments
- a paragraph showing a clear understanding of the PT and what it demands
- clearly described examples linked to the PT and to areas of knowledge (probably two of them)
- generalisation based on your examples – showing how they are somehow typical of the areas of knowledge you have chosen
- evaluation of the arguments
- a conclusion that answers the question in the PT
- some acknowledgement of the more general implications of the conclusion.

The preparation process and essay structure presented here is intended as a guide to your own thinking. It is not a straitjacket or a template, but rather one way of meeting the challenge above. The authors of this book have been marking students' TOK essays for a long time and one fact that sticks out from this experience is that the same issues keep recurring. So we offer six major pieces of advice in order of importance.

1. Answer the question posed in the PT.
2. Make sense of the PT – tell the reader how you understand its key terms in the context of TOK, **not** what the dictionary says.
3. Use examples to show your understanding of the PT and link these examples to your argument.
4. Generalise these examples. A single example will not be evidence for a general claim on its own.
5. Evaluate the different arguments you make in the essay and tell the reader which one you favour and why.
6. Think about the implications of what you are saying.

The rest of this chapter puts some detail on these points. In doing so, we shall focus on developing the TOK essay and say little about marking it except for a brief section on the assessment instrument and academic integrity. The intention is to offer a practical way in which you can think about the prescribed titles.

Following this introduction, are four sections on developing a TOK essay. The first section is an extended set of practical pointers that cover the development process, from when you first see the titles to a structured brainstorm of a chosen title. The next section offers a detailed description of a simple modular essay form and includes examples of useful language for each module. The next section puts together an essay outline based on the development work already done. The final section discusses the assessment instrument and academic integrity. The conclusion to the chapter includes some more useful language and an example of an essay that might have come out of the whole process.

Practical steps to develop a TOK essay

While you might want to get the essay out of the way as quickly as possible, you should try to resist the temptation to write it in one pass. Writing an essay is best thought of as a process rather than a product. As with preparing food, it is good to have a plan before you begin the actual writing; take some time to get the ingredients together and prepare them. Collect your ideas and see how they fit together; see how they fit the PT and where they conflict.

So where should you start? The TOK essay is an answer to one of six prescribed titles (PT) – these PTs are actually questions, what the IB calls **Knowledge questions**. These are the starting point for the essay and you will need to select one of them. Your teacher will introduce the essay task, most likely through a general class discussion.

In this section we will work through a few practical exercises that can take your thinking further. The author of this chapter has used these exercises with many students, who report that they found the process of building an essay from these beginnings relatively straightforward. Once you have these basic elements the actual writing of the essay is considerably simplified. The difficult part, as with the cooking metaphor, is preparing the ingredients. The exercise here follows the general 'concrete – abstract – concrete' form. You will be asked to come up with concrete examples that help you understand the PT. From the concrete examples you will build a more abstract argument. In the essay, the abstract argument will come to a conclusion that can be applied to other examples. In this unpacking exercise we shall concentrate on the first two stages only: concrete – abstract.

Figure 1 The TOK PT, like some types of furniture, needs to be unpacked to make its structure apparent.

Unpacking the prescribed title

One of the most important parts of the process of producing a TOK essay is what is called 'unpacking the title'. One can think of the title as being like flatpack furniture. When transported from the shop, flatpack furniture is just that: a flat cardboard package. Only when the package is opened and different parts identified and put together does it become a structured three-dimensional object. Similarly, at first sight, the PT appears flat and structureless. It is only when you start to apply it to concrete examples that it comes alive and reveals an interesting structure. With furniture some of the pieces in the package have major structural functions, such as shelves and doors. With each PT published by the IB there are keywords or phrases that play important roles in the question. You will need to identify these keywords or phrases and make sense of them because they will be the link between the abstract PT and your concrete examples. Arguments in which the keywords appear are the backbone of the essay. The unpacking process means identifying these keywords or phrases in the question and then arriving at an understanding of their meaning in the context of the essay and its examples. In many cases the final score of the essay can be predicted from the quality of this unpacking process. Your essay may contain some brilliant analysis, but if it is not explicitly linked to the PT it will not score well. The flip side is that with a good unpacking you are more than half-way to constructing the essay. So, the first job is to identify the keywords in the title. In the box below are examples of PTs with the keywords highlighted.

Keywords and key phrases in TOK PTs

- Given that fields of study of academic disciplines can overlap, are there any problems in adopting interdisciplinary approaches to the production of knowledge?
- When historians and natural scientists say that they have explained something, are they using the word 'explain' in the same way?
- Are there fewer ethical constraints on the pursuit of knowledge in the arts than there are in the human sciences?
- 'We know with confidence only when we know little; with knowledge doubt increases' (adapted from JW von Goethe). To what extent does this statement apply to two areas of knowledge?
- While 'Suspension of disbelief' is an essential feature of theatre, is it essential in other areas of knowledge? Develop your answer with reference to two areas of knowledge.
- To what extent might robust knowledge require both consensus and disagreement? Explore this claim with reference to two areas of knowledge.

Since these keywords are to be understood *in the context* of the TOK essay, it is not helpful to look up the words in a dictionary. Dictionaries tell us about the general use of a word rather than its meaning within the specific TOK context. Instead, we suggest that one good way to arrive at an understanding of these keywords and phrases is by using concrete examples.

Activity 1

1. Pick a title from the set of six PTs above.
2. Select two areas of knowledge (AOKs) to which the title seems to apply.
3. Find an example from each of these AOKs that seems to fit the title.
4. Ask yourself: what is it in the example that corresponds to each of the keywords?
5. Write down any doubts you have when trying to fit the example to the PT. How well does it fit? (These doubts can be expressed as discussion within the essay.)
6. Each example will yield a specific understanding of the keywords (step 5). 'Understanding' here means an idea regarding how the keywords can be interpreted in the example. It might be that the two examples provide slightly different interpretations of the keywords. This is a normal situation in TOK and is something that can itself be discussed in the essay. The next step is to make a poster stating your examples and showing how they relate to the keywords in the PT.

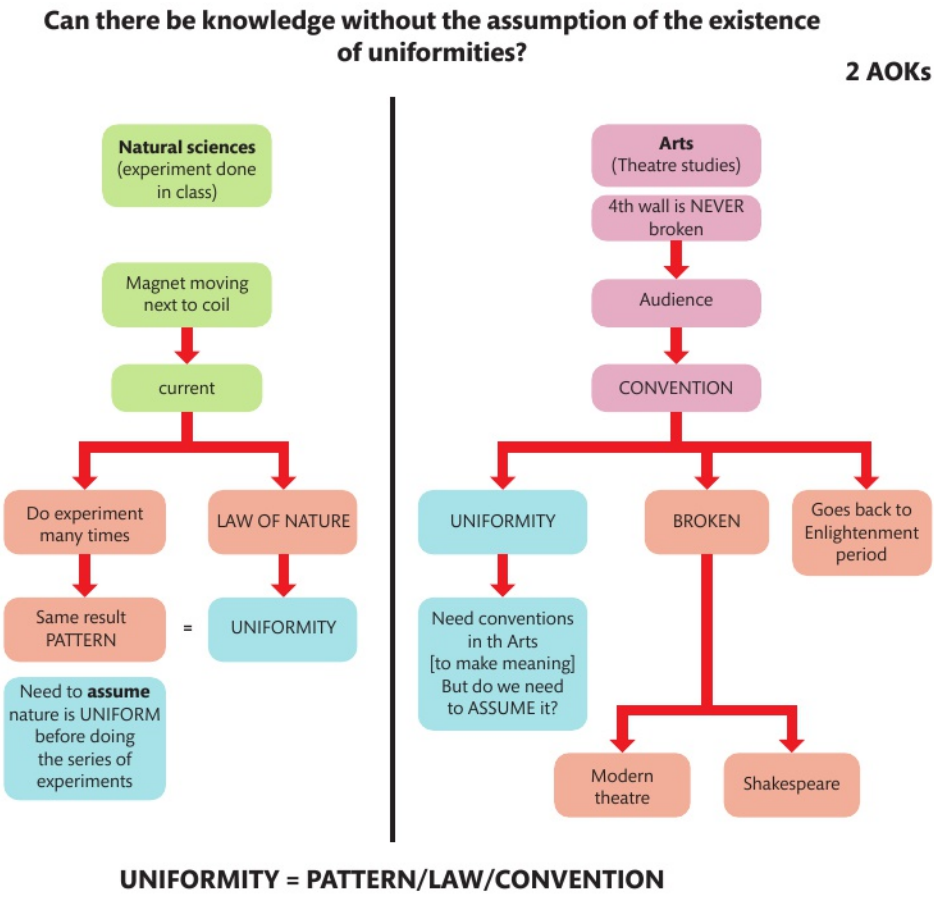

Figure 2 This is the result of an unpacking exercise by a group of TOK teachers at a workshop in Berlin 2019.

This poster is based on the work of a group of TOK teachers at a workshop. They were following the instructions in the exercise above. For the purposes of this chapter we shall treat these teachers as rather good TOK students. Let's go through each of the steps above and see how well they did.

Step 1: Choose a PT

The teachers chose the following title which they wrote at the top of their poster:

> Can there be knowledge without the assumption of the existence of uniformities? Answer this question with reference to two areas of knowledge.

Step 2: Highlight the keywords in the PT

At the top of the poster you can see that the teachers identified three keywords in the title that need unpacking: *assumption*, *existence*, and *uniformities*. Note that they did not highlight *knowledge* as requiring a definition. Generally, in a TOK essay there is no need to define knowledge because the whole essay is, in a sense, a response to the question 'what is knowledge?' There seems little point in trying to summarise 100 hours of TOK in a pat definition. If you feel you have to define knowledge in the introduction why not refer to the map metaphor as a placeholder? This is the idea that knowledge may be like a map giving us information about the landscape without every detail being in place. But you will need to point out that it is just a *metaphor*, which is really not the

Info box

Prescribed titles

TOK **prescribed titles** are carefully worded. Although the words they employ are abstract and need to be interpreted (this is why we are doing the unpacking activity), they are put together in a deliberate way. Be particularly careful with 'if' statements. 'If A then B' does not mean that A is true. Rather it speaks of the consequences if we assume that A is true. The same care should be taken with statements involving the words *all* and *some*.

same thing as a definition. Also, be particularly careful with making such bold claims as knowledge is *justified, true belief*, without understanding its meaning. The advice here is: let the essay itself tell the reader what knowledge is and how it works.

Regarding the wording of the title, it is important that you answer the PT *exactly as it is stated*. There is a danger that by rewording the PT question you change its meaning. Examiners are asked to assess your essay against the original title. If you deviate from this and answer your own version of the question, they might decide that you haven't answered the question as stated – meaning that the essay will not score well.

PTs often make a distinction between producing knowledge and acquiring or using it. You will need to be alert to the differences between these terms. Production of knowledge describes the processes by which we arrive at new knowledge through, for example, scientific experiments, medical trials, new theories in the human sciences, new works of art or literature (or new interpretations of existing works), and new interpretations of history or of mathematics. Acquiring knowledge refers to the way in which we relate to existing knowledge. For example, in a school science class you might encounter a relationship between two concepts or ideas that you previously did not know about, such as between the temperature of a gas and its pressure. This relationship has been known for some time so is not *new* knowledge, but nonetheless it is new to you. This counts as knowledge acquisition rather than knowledge production. How you might use this knowledge to do practical things, such as design a water boiler, raises interesting questions. Is this application of knowledge adding something? Is there new knowledge involved in applying existing knowledge to new situations? The answer is not obvious and makes an interesting TOK topic itself.

In the title we are considering here: *Can there be knowledge without the assumption of the existence of uniformities? Answer this question with reference to two areas of knowledge*, there is no reference to either acquisition or production of knowledge. This means that the student is free to interpret the title either way. Is it about acquisition of knowledge or about producing it in the first place? Or about its use?

Step 3: Find an area of knowledge to which the title seems to apply

The teachers group thought that they could find examples to fit the question from within the natural sciences and the arts. How you choose your areas of knowledge depends a bit on the question as well as on your interests. It is a good idea to use examples with which you are familiar so that you can describe them simply to others. Consider avoiding examples like 'string theory', which require a PhD in mathematical physics to understand and a two-volume book to explain.

Step 4: Find an example for each area of knowledge that seems to fit the title

This is a crucial step and perhaps the most difficult. Remember that the task is to find examples that fit the PT question first using an everyday (non-specialised) understanding of the keywords. The example might not fit perfectly the first time and you might need to refine it a little. Once we have concrete examples we can start working out what the keywords mean *in context*, not in the abstract.

In their discussions, the teachers group talked about scientific experiments and how they had to be repeated before they were accepted. They felt initially that this repetition could be related somehow to the word *uniformities*. If an experiment turned out the

Info box

Justified, true belief

More than two millennia ago, Plato suggested that knowledge is a species of **belief** that is **true**, and **justified**; that is, good reasons can be given for its truth. Epistemologists (philosophers who study knowledge) do not agree on whether it is true or whether the three parts are jointly sufficient. The 'truth' requirement suggests that once something is knowledge it stays knowledge. While this is the case in mathematics (which was Plato's model for all knowledge), it is not the case in the natural or human sciences. Moreover, such a definition gives priority to *knowing that* but demotes *knowing how*. It suggests that the *knowing how* that is possessed by sports people and musicians, and the *knowing how* that allows us to get around in the world is not actually knowledge. Another problem is that the 'truth' requirement sets a high bar for knowledge. It would mean that most of what we take to be knowledge (even things we learn at school like Newton's laws) don't fit the definition. Having said this, Plato's approach might have its uses in certain areas; for example, religion or mathematics, where it might make sense to talk of unchanging truths.

same way every time, then the assumption is that repetition tells us something about nature rather than a freak result due to some experimental error. They then spent some time discussing which experiment to take as their example. Some wanted to use chemistry while others wanted to talk about elementary particle physics. In the end they decided that describing those examples to the non-specialist would take up too much space. They opted for a simpler physics experiment concerning a coil of wire and a magnet. A circuit is made with the coil and an ammeter (a device for measuring current) in parallel. Suppose that it is found that moving the magnet near the coil causes the ammeter to show a deflection. This means that current is flowing through the wire. Moreover, the experiment can be repeated any number of times and the same result observed. The faster the magnet moves, the more current is generated, and as soon as the movement stops the generation of current stops. The teachers argued that the experiment needed to be performed many times and the same result observed before they could conclude that this was a law of nature. So, the experiment rests on the assumption that nature is uniform and that if the same effect is observed every time then this is a feature of nature.

Once the teachers had settled on the physics example, they found it much easier to find an example from the arts. They were convinced that the science example supported a positive answer to the PT, so they were actively looking for an example in the arts that would give them a different point of view on the title, or might support a negative answer. The film and theatre teachers in the group came up with a good example. There is a rule of thumb in certain types of theatre and film that 'the fourth wall is never broken'. If you think of the stage space in a theatre as being roughly box shaped with three walls, a floor, and a ceiling, then the audience view the action through the 'fourth wall'. The fourth wall rule means that the action on stage never acknowledges the existence of the audience. The same idea applies to the camera in a film; the actors do not acknowledge its existence. The existence of the 'fourth wall' is a *convention* – a rule that is accepted by the actors and the audience in order to give meaning to the whole theatre experience. But the teachers pointed out that this rule *was* broken. Not only is there acknowledgement and even interaction with the audience in modern theatre and film, and pantomime in the early 18th century, but it can be argued that the Globe Theatre in London (where many Shakespeare plays were performed in the early 17th century) was actually built in a circular form with a central stage to break the fourth wall. In certain parts of the performance, actors would directly address the spectators and respond to them. In film there are cases where the fourth wall is broken, such as when a character speaks directly to the camera to elicit sympathy from the unseen audience.

The teachers thought that the fourth wall was a uniformity, but they were not sure whether it had to be assumed. It was a convention that is broken in some cases. There was some disagreement about whether a broken convention is still a convention, and if the convention is broken is it still a uniformity. Eventually they decided that a convention is still a uniformity even if it is broken, in the same way that rules are still rules even if they are broken. The teachers realised that this discussion could be brought into the essay.

Step 5. Ask yourself: what is it in the example that corresponds to each of the keywords?

Now that the teachers were armed with examples, they could go back to deciding what the keywords meant. They thought that in the science example you had to assume that nature was uniform, in the sense that it did not matter much where and when you did the experiment with the moving magnet and the coil. Nature was the same and if the experiment delivered the same result every time one could say that this was a real feature of the natural world.

In terms of the arts example, they decided that uniformity meant something like an artistic convention that gave meaning to artistic activity, such as the fourth wall. They argued that the arts need conventions but also that it is important that these conventions are challenged from time to time and new conventions take their place. They said that there is an assumption of uniformity in producing artistic knowledge as well, although the details of the uniformity could be challenged.

Note that the idea of uniformity needs to be interpreted *in context* of the examples discussed. Of course, uniformity will look slightly different in the sciences than in the arts. This is typical of a TOK essay. The important point is that the two interpretations of the key word in the two contexts have something in common. In this case, something like a repeating situation or pattern or rule. Without using a dictionary definition, the teachers arrived at the meaning of the terms in their exploration. What's more, these examples would form the backbone of the essay, as you will see in the next sections.

Step 6. Write down any doubt you have when trying to fit the example. How well does it fit?

This step is important. There are places in the essay where there can be discussions of how to understand a doubtful term, or where there is a set of different arguments to evaluate. In these discussions we involve the reader in our thought processes. This is where the essay is true to its French roots; where we are literally playing with different ideas. Discussing doubts attached to ideas or interpretation is an essential activity in TOK and should be showcased in the essay.

The teacher group doing the task got stuck on a number of points. On the science side of the line they could not decide whether something was still uniform if, for example, suddenly a new result was found and the previous knowledge was abandoned. When this occurred, they called it a *paradigm shift*. In the end, the consensus was that there is still an expectation that nature is uniform, even if we change our mind about the details. On the arts side there was more argument. They could not decide if uniformities like conventions were necessary to appreciate art. What if you did not know anything about the artistic conventions of the indigenous peoples of southern Australia? Can you still appreciate their paintings and other artworks in the National Gallery of Victoria? A TOK essay should be honest about struggles like these and include them.

This unpacking activity not only gives a better understanding of the key terms in the context of examples, but it has also given us two fine examples which provide the backbone for the essay. However, TOK essays cannot present their arguments based purely on two examples. The essay must show that the examples are somehow typical of the area of knowledge they represent.

Argument

We have seen how a comprehensive unpacking of the key terms by using concrete examples provides the basis for further thinking about what to say in the essay. But one more bit of careful thinking is needed to forge the main components of the essay: the arguments. The problem is that the prescribed title is a general question, but examples are specific. So, in order to answer the PT, the examples must be *generalised*. This means that you must show, by using an argument, that your examples are somehow typical of your chosen areas of knowledge. The argument will have to appeal to your thoughts about how these areas of knowledge operate and what it is that they do to ensure that they produce knowledge in contrast to, say, pure speculation.

The question the teachers now needed to address was: what arguments can you give to show that the examples are typical of your AOK? How do your examples relate to other examples in the same areas of knowledge? Are there (counter)examples that do not fit this pattern? Figure 3 is what the teachers came up with.

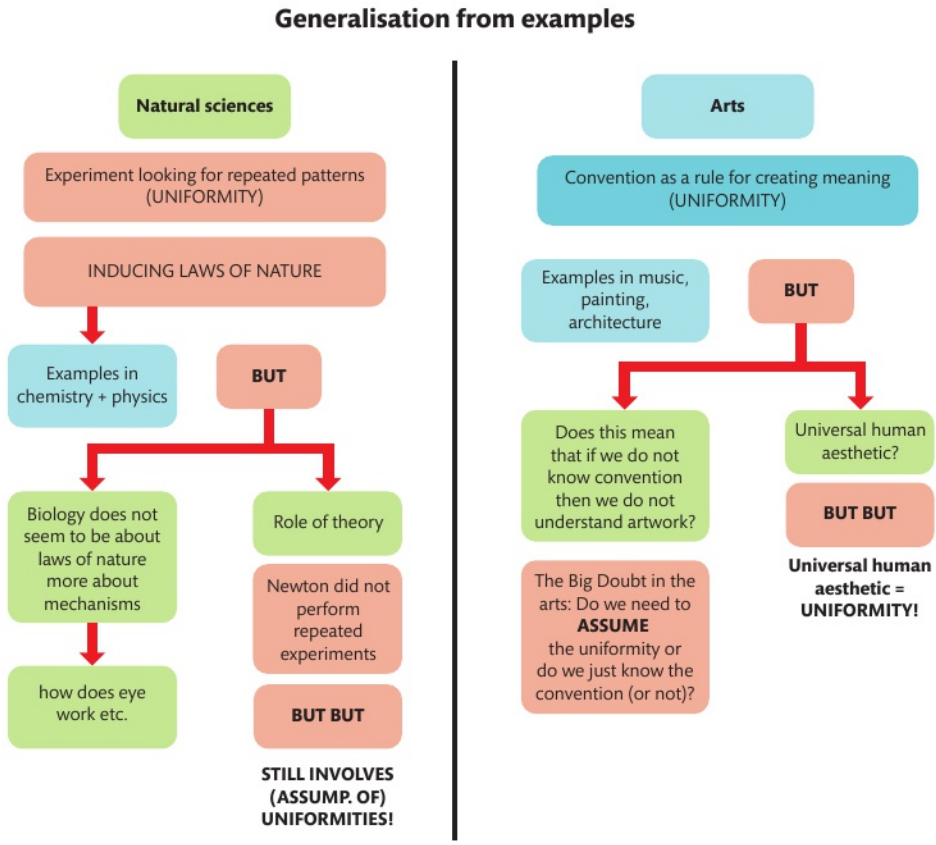

Figure 3 Here is the argument development brainstorm of the teacher group. On the left side is the development of the natural sciences example, and on the right side the development of the arts example.

The teachers decided that looking for repeated patterns based on the assumption that nature is uniform was somewhat typical in the natural sciences. They identified this method of generalising from a collection of individual items (*inductive reasoning*) as being characteristic of a lot of what goes on in physics and chemistry. Something like it happens in astronomy and astrophysics as well, even though we can't literally do experiments with stars and galaxies; it is possible to make repeated observations of them, for example. But there was some argument as to whether biologists need to assume the same uniformities as physicists and chemists, since biologists are not obviously trying to find uniform laws of nature in the same way. There is a sense in which biological organisms are individually unique in a way that hydrogen atoms are not. One teacher suggested that the nature of biology is such that if there are laws, they are either high level (such as those in population genetics) or low level (to do with molecules which are really laws of physics and chemistry). Another suggested that there are uniformities assumed by our systems of classification of organisms: we assume that for something to be a mammal means that it is a different kind of organism from a fish. Perhaps biology is more concerned with particular systems, such as the respiratory system or the visual system; that biology is concerned with identifying mechanisms by which systems make life possible. Another objection stemmed from the fact that a lot of early physics was deductive from a theory rather than inductive. Newton arrived at many of his results by reasoning without doing experiments. At the end of the argument the teachers decided that even in this case an assumption of uniformities is needed. Biologists make assumptions about certain uniformities in nature and Newton assumed that the theory held everywhere – which is a uniformity.

On the arts side, the teachers thought that there were plenty of examples of convention beyond the 'fourth wall' as a type of uniformity giving us artistic knowledge. In order to understand music, we need to know the conventions of harmony and rhythm – we might learn these, like a jazz musician (*knowing how*), by learning how to use them. On the other hand, they might be learned from a harmony book (*knowing that*). It may be difficult to understand music from another tradition where the scales used are different and sound strange. Similarly, there are conventions in architecture and painting in various cultures. Within our own culture, these conventions may allow us to identify different styles, but then an argument broke out about whether someone needed to know a convention in order to understand or appreciate a work of art of any kind. The realisation that because humans have a shared sense of what is beautiful, it was possible to appreciate art without background knowledge, led to the thought that this depended on human nature – itself a uniformity. The question is subtle because it asks about the need to *assume* the existence of uniformities to make knowledge rather than just whether they existed. So the question is whether the uniformity of human nature needs to be assumed to get artistic knowledge off the ground or not? The teachers pondered this for a while and then concluded that if artistic knowledge was knowledge *about* the arts then the situation was similar to the sciences, but if artistic knowledge was making or appreciating art in an aesthetic manner then the answer to the question was not clear. This kind of disagreement is not a setback; it is useful and can be reported in the essay.

It is possible to collaborate with your classmates on an exercise like this, especially if you are practising essay writing based on old questions. However, it is important that the essay you write is your own work so at some point you will need to develop your thoughts on your own. You will need to be able to have discussions like these with yourself. One way of doing this is writing down one side of the argument and then trying to find problems with it.

Structuring the TOK essay

This section makes some suggestions as to what to put where in the essay and what phrases you might want to use to express your ideas. The main purpose of this section is to help you put your ideas across in the clearest way possible. The examiner is not looking for clever language or beautiful prose – in some cases this can obscure the meaning. Rather, they are looking to understand your ideas. You should be aiming to make your ideas crystal clear. This aim has implications for how you structure the essay.

In terms of the large-scale structure, you will need to make your essay modular. This means that it should contain a number of self-contained sections. These are most likely to be paragraphs. It is important that each paragraph deals with a single topic, whether it be analysing an example, making an argument, or evaluating arguments already made in the essay. If a paragraph gets too long, it might need to be split according to sub-topic. Nonetheless each paragraph should remain a self-contained unit.

Figure 4 The internal structure of a paragraph in the TOK essay

You are doubtless familiar from your Group 1 language studies with the words that are used to knit paragraphs together called *transition signals*. A transition signal is a statement at the top of the paragraph that indicates what its main function is. For example, phrases like 'on the other hand' bring in a counterargument or counterexample, while 'The strengths of this argument are…' ushers in an evaluation section. The introductory paragraph helps to bind these modules together by giving the reader a roadmap of the structure of the whole; this enables the reader to create a mental map of the whole essay so that they always know where they are going.

The modular principle also applies to paragraphs themselves. Each paragraph should start with a statement of its purpose and end with some sort of conclusion. It should be possible to understand the main arguments of your essay by reading only the first and last sentence of every paragraph. When you have completed the first draft of your essay, try doing this. If the essay still makes some sense, and you can follow the main argument, then your essay is well structured.

Again, it should be emphasised that the proposals made in this chapter are only suggestions. There is not just one way to write a good TOK essay. While these building blocks are important in a TOK essay, it is conceivable that they appear in a different guise or are ordered differently. The examiner will be open to different kinds of expression.

Overall structure

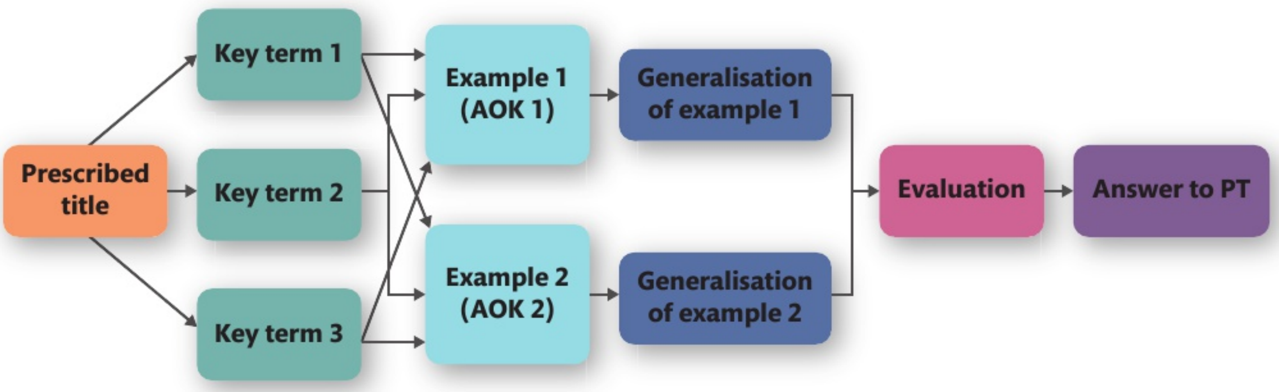

Figure 5 A schematic diagram showing the main components of one kind of TOK essay and their relations. This is a two-dimensional picture which will need to be transformed into a linear form for the essay. There are many ways in which this can be done. The suggestions made in this chapter are just one way.

The diagram in Figure 5 suggests a general flow diagram for the ideas in the essay. This flow diagram involves parallel streams of development. There are two streams here, representing ideas developed from each of the big examples explored in the unpacking exercise. You need more than one argument to evaluate when you get to the evaluation section. The essay plan is a structural problem that you must solve. The essay plan that the teachers group adopted looked something like Figure 6.

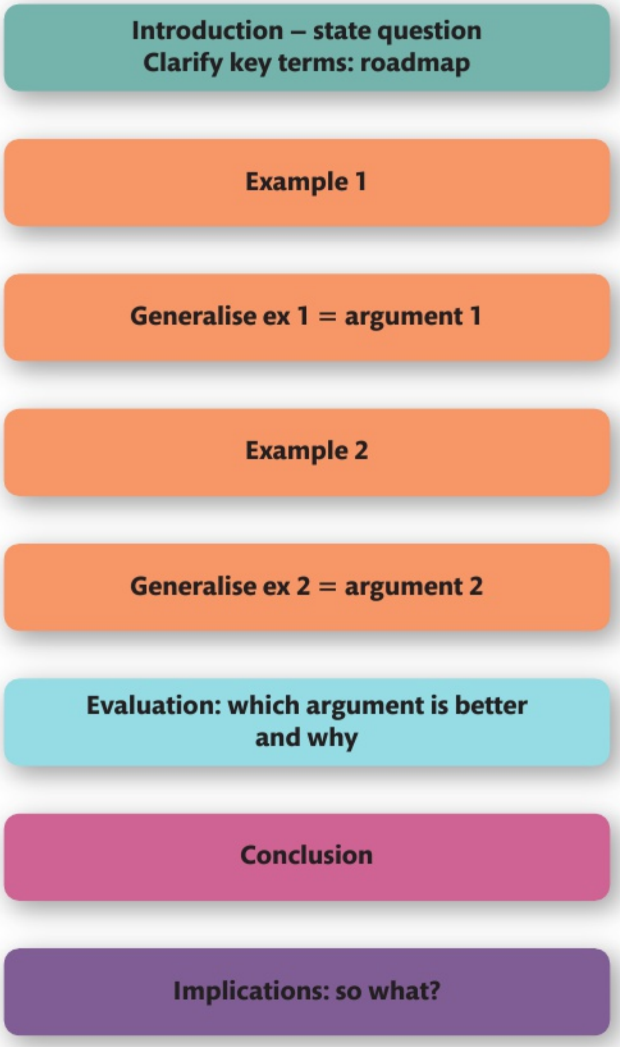

Figure 6 This is one way of making a block diagram for a TOK essay. There are, of course, other ways of organising the essay.

Introduction

At the beginning of the essay the PT should be clearly stated. Don't leave it up to the examiner to decide which question you are answering. Examiners are instructed to award 0 to an essay that does not seem to be connected to any title in the set, so take no chances.

The introduction is the most important paragraph in the whole essay, so it is worth spending some time getting it right. Ideally, the introduction should set out a roadmap of the whole essay, including giving a foretaste of the conclusion and a preview of the main arguments.

It is also a good idea to write the introduction last after the rest of the essay is drafted. The introduction should set up the whole essay so that the reader has a clear idea about which PT the essay addresses, how you understand the keywords in the PT question, how the essay intends to address this question, and, roughly speaking, what conclusions it comes to. This amounts to a short version of the unpacking discussed in the previous section. In Figure 5, three key terms were assumed but it is clear that any PT could involve a different number of key terms.

Language to use in the introduction

This essay will argue that…

I shall eventually answer the question in the following way…

Evidence from X and Y will be considered.

Alternative approaches such as Z might look attractive for reason A.

Upon evaluation, however, it seems that W supports my thesis.

X could mean… or, more personally…

By X I mean…

Y can be understood as…

First example

After the introduction, the main examples can be set out in detail. It is probably a good policy to allocate one paragraph to each example. Not only should the examples be explained in a way that can be understood by the general reader, it is also important that the keywords in the PT question are linked to the examples. This is crucial because the examiner is looking for an explicit link between the question and your treatment of it. If there is no link made in the essay, then there is a danger that the examiner will regard the discussion of the example as irrelevant to the PT. The examiner wants to know what information in the example corresponds to the keywords in the question. More generally, what does the example tell us about the answer to the question? A good strategy here is to start with your best example that supports your best argument.

As the diagram in Figure 7 shows, examples have to be handled carefully. Obviously, it is necessary to describe the example to the reader, but the main job of an example paragraph is to show how the example links to the PT; this is where all the hard work

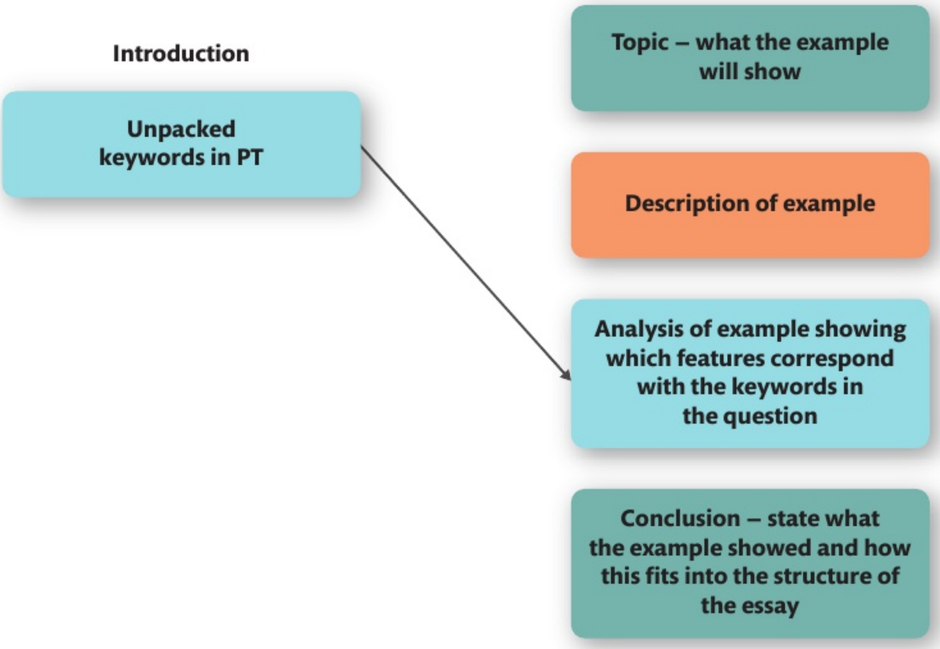

Figure 7 Each example should be linked carefully to the roadmap in the introduction and to the keywords discussed there.

you did earlier in the unpacking pays off. When you link the example to more general ideas, such as the PT, you are *analysing* it. Analysis of examples should be at least half of the text in the paragraph. For this reason, examples should be chosen carefully. It is best to use examples that can be explained to the average reader in relatively simple terms. If most of the paragraph is taken up with description, then there is little space left for analysis. And it is in the analysis that you are doing most of the TOK.

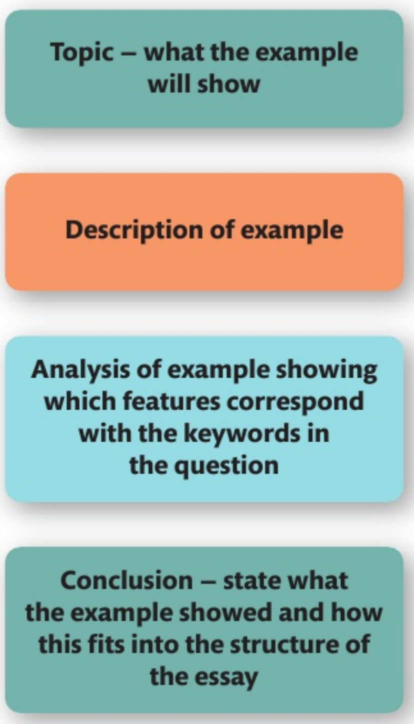

Figure 8 Possible structure of an example paragraph

Analysis and description

There will be both *analysis* and *description* in your TOK essay.

Description: refers to text that presents examples and makes factual statements. It is usually about a specific example in the world. It employs the vocabulary of areas of knowledge and everyday language used to describe how the world is

Analysis: refers to text that links the example to more general ideas – such as the concepts in the PT question. It employs more general TOK vocabulary. It is second order in that it is *about knowledge*

Language that might be used in the discussion of the example

This is an example of…

The example shows that…

In this example we can understand [keyword] to mean…

In the light of this example, my position on this is…

First argument

The PT invites you to address a general statement about a certain aspect of knowledge. But as you know from your TOK course, a single example is weak support for a general statement. One option is to bring in more examples to support your view. But how many is sufficient? Moreover, there is a limit to the number of examples you can fit in a 1,600-word essay. A better solution is to use the examples that are already in the essay and show that they are somehow typical – and therefore cover a whole set of examples. Showing that an example is typical is called *generalising*. The teachers developed the physics example of a coil moving in a magnetic field that produces a current. We could repeat the experiment many times and, if we get the same result, we could tentatively conclude that the effect is always observed. Nonetheless, there is always a chance that the next time we do the experiment it will not work. The teachers needed to show that this situation is typical of the natural sciences – and that we cannot be absolutely certain that what comes out of the experimental process is a good model of the world.

In producing the general argument guided by the example you will need to use special TOK vocabulary. You will need words like *induction, deduction, hypothesis, model, objective, subjective, adequate evidence,* and so on. Your argument will employ slightly more abstract vocabulary than that of the specific example. It is also useful to ensure that the keywords in the PT make an appearance.

Language that might be useful in this section

The example can be generalised in the following way…

These features of the example are typical of this area of knowledge because…

This example makes use of the following methods, which are typical of this area of knowledge…

The example illustrates [*induction, deduction, the correlation-causation distinction*] (other TOK keywords and ideas)

Second example and generalising argument

One example will not be enough for a TOK essay, even if the PT does not explicitly specify two areas of knowledge. It is important that your essay is balanced, and this means that you look at the PT from different (and perhaps conflicting) perspectives. The unpacking task involved finding two contrasting examples that fitted the question.

A contrast could be achieved by taking an example from an area of knowledge that is different in its scope. If your first example is from the natural sciences, then consider taking a second example from the arts or history. Of course, the example must fit the PT and it should be able to show which parts of the example correspond to the keywords in the question.

When you have introduced your second example you should broaden it, as you did with the first example, to cover the typical ways in which knowledge is produced in that area of knowledge.

This second argument should offer something different from the first, and may conflict with it. This leads some teachers and students to talk about this section as a *counterargument*. Indeed, some students like to structure the dialogue between contrasting examples in the form of 'claim' versus 'counterclaim'. There is a danger in this method that the counterargument is not carefully worded and therefore the essay contradicts itself. Remember, the reader has read the first argument and may be convinced by it; now the essay is arguing against it. A good word to use to avoid this problem is *if*. 'If, on the other hand, we take a different starting point then…' Because the second argument takes a different starting point it does not contradict the first. The examiner is looking for evidence of your ability to look at the question from different perspectives.

In practice, it is unlikely that the second argument is just a negation of the first. The second argument should develop from a different example and will probably show a different way of looking at the question, including a different way of interpreting the key terms. Perhaps critical thinking is better demonstrated in a TOK essay by showing that a given argument based on an example supports the question *to a certain degree* but not further, rather than a simple comparison of arguments in favour versus arguments against. Certain examples will fit the question, but others might not. You will need to say where the border is between the two, and why.

Finally, there is some freedom in how to present your examples. You could present the example first and then the argument that flows from it, or you could start with the argument and present the example as an illustration. This is largely a matter of style.

Language that might be useful in this section

Example X suggests… but analysis of example Y leads to a different perspective on the question.

On the other hand…

Against this, it can be argued that…

Alternatively,…

However,…

There are objections to this line of thinking such as…

More extreme cases do not seem to fit this pattern though…

If we understand the key terms in this way, the answer to the question looks a little different.

Evaluation

So far in the essay you have presented two main strands of argument based on two examples. Of course, there may be more, but within the word limit it is likely that there are just two perspectives explored in detail. In this section, your job is to make a judgement between the strands. Which argument is better, more rigorous, more general, or based on more secure premises? You will need to examine the merits and weaknesses of both arguments and decide which is the stronger. This is the part of the essay where the two perspectives you have introduced can be compared and evaluated and where you demonstrate your powers of analysis and judgement.

As we saw with the unpacking, the keywords in the question might have slightly different interpretations in the two examples. You could base your evaluation on which interpretation seems to be the most plausible, or offers the greatest generality (meaning it applies to more examples or more areas of knowledge). But your judgement must be thoroughly supported by an argument. It is not enough to simply pick one of the arguments and state your choice. It is good general advice in the IB diploma programme that the way to do well in any subject is to do three things: evaluate, evaluate, and evaluate.

Useful evaluation phrases

On balance it seems that…

While [counterexample] suggests that [thesis] does not hold universally, we can see that it does hold in [special cases]

The problem with the view that… is that…

Conclusion

Unlike the argument and evaluation sections, the conclusion should be relatively short. In the evaluation section you have settled on the strongest argument and given reasons for your judgement. In the conclusion you present an explicit answer to the PT.

Useful conclusion phrases

In conclusion,…

To respond to the prescribed title…

To conclude,…

Therefore,…

The previous analysis suggests that…

Implications

In the description of an essay achieving the highest mark band, the assessment instrument in the subject guide states: 'the implications of arguments are considered'. The drawing of implications can take place throughout the essay but some teachers suggest that they should have their own short dedicated section at the end. An implication is an answer to the question 'so what?'. You have gone to the trouble of writing a whole TOK essay and, after careful consideration, reached a conclusion that answers the PT. But what does your answer *mean*? It is useful to write a few lines explaining why your conclusion is significant and what insight it brings to other situations. The implications section could also hint at where your essay could have gone if you could have developed it further.

Useful implication phrases

The broader implications are…

This means that…

This conclusion is significant because…

This analysis is relevant to…

These findings raise questions about…

An essay outline

The teacher group brainstormed the unpacking of the prescribed title and have two contrasting examples that fit it. They completed another brainstorm that generalised these examples; that is, they developed arguments that supported an answer to the question. They were then instructed to produce a paragraph-by-paragraph bulleted plan of the essay based on the two brainstorm posters they had drawn. The whole outline should fit on one page.

Essay outline

Without the assumption of the existence of uniformities there can be no knowledge. Discuss with reference to two areas of knowledge.

Introduction

- Uniformity = pattern/law/convention/rule.
- Assumption of uniformity required before knowledge can be produced – a precondition for getting the knowledge production process off the ground.
- Road map of essay: section on natural sciences seems to suggest that PT is correct, section on the arts shows that there are uniformities in art convention/or human aesthetic values possibly – but no obvious requirement that these should be assumed before artistic knowledge is sought.

Natural sciences example

- Magnetic induction experiment.
- Needs to be done many times to be sure that the result is due to nature and not an artefact of the experiment – might also mean triangulation – getting same result through different methods.
- This works if we assume that nature behaves in a uniform way – i.e., there are laws of nature.

Generalise natural sciences example

- Claim that this type of experimental method is true in other fields – i.e., chemistry even in non-experimental fields like astrophysics.
- Biology might be a bit different – seems to be more to do with mechanisms and taxonomy.

- But these are still uniformities and still need to be assumed to get the knowledge process started.

Arts example

- 'Fourth wall' in theatre and film = convention that is needed to make sense of the play/film.
- But: conventions can be broken in the arts – fourth wall broken by Laurel and Hardy and modern playwrights – but that does not mean that there are no conventions, just that they change.

Generalise arts example

- Examples of convention in music and architecture. Convention necessary for meaning?
- Does this mean that only 'those in the know' can appreciate art?
- Perhaps we all have an aesthetic sense that enables us to appreciate beauty of different cultures?
- But if this is the case then it is an example of uniformity of human nature.

Evaluation

- The science examples are convincing and support the PT.
- The arts argument seems to suggest that there are uniformities either in conventions or in human aesthetic capacities BUT does this need to be assumed to have artistic knowledge?

Conclusion

- Science needs to assume uniformities to get started.
- The arts work through uniformities of human nature or artistic conventions but it is not clear that these need to be assumed.

Armed with the outline and the brainstorm posters the teachers were in a position to write the essay. You can see how the teachers' essay turned out at the end of this chapter. You will notice how closely they followed the outline.

Assessment and academic integrity

Assessment

The TOK essay assessment instrument is shown opposite. It is used by your teacher to help produce a predicted grade and by an examiner to grade your essay. After you have uploaded your essay onto the IB website it will be distributed to one of the TOK examiners. The essay is anonymous, so the examiner doesn't know who has written it or from which school it was submitted. The examiner marks the essay and assigns a score out of 10 based on the grid. When the examiner has read the essay, they will look at the descriptions in the columns and will make a judgement as to which description fits your essay best.

While it is not your job to mark TOK essays, it might be useful for you to swap with a friend and offer constructive criticism of one another's essays. You might even want to try marking the essay to gain familiarity with the assessment instrument.

Does the student provide a clear, coherent and critical exploration of the essay title?

Excellent 9-10	Good 7-8	Satisfactory 5-6	Basic 3-4	Rudimentary 1-2	0
The discussion has a sustained focus on the title and is linked effectively to areas of knowledge. Arguments are clear, coherent and effectively supported by specific examples. The implications of arguments are considered. There is clear awareness and evaluation of different points of view.	The discussion is focused on the title and is linked effectively to areas of knowledge. Arguments are clear, coherent and supported by examples. There is awareness and some evaluation of different points of view.	The discussion is focused on the title and is developed with some links to areas of knowledge. Arguments are offered and are supported by examples. There is some awareness of different points of view.	The discussion is connected to the title and makes superficial or limited links to areas of knowledge. The discussion is largely descriptive. Limited arguments are offered but they are unclear and are not supported by effective examples.	The discussion is weakly connected to the title. While there may be links to the areas of knowledge, any relevant points are descriptive or consist only of unsupported assertions.	The discussion does not reach the standard described by the other levels or is not a response to one of the prescribed titles for the correct assessment session.
Insightful Convincing Accomplished Lucid	Pertinent Relevant Analytical Organised	Acceptable Mainstream Adequate Competent	Underdeveloped Basic Superficial Limited	Ineffective Descriptive Incoherent Formless	

Academic integrity

Your ideas belong to you. In fact, ideas drive our modern world. Given that they are so important, the ownership of ideas is protected legally and morally, which allows you to reap their benefit; eventually, even, they can become a source of income. For example, if you create a musical track, others cannot use it or copy it without your permission. Similarly if you produce a text, write a piece of computer code, invent a machine, take a photograph, paint a picture, write a poem, etc., it becomes your property and certain restrictions come into force regarding who can use or copy it.

In commercial publishing the rules are strict. You cannot reproduce any text or picture without the permission of the owner of the copyright unless the material falls under a licence such as the creative commons, which permits sharing. This includes pictures that are available on the internet. The rules for academic writing are slightly more lenient. You may quote the work of others in your TOK essay without asking their permission *but only if you acknowledge the author of the work*. This means that you must use one of the standard citation systems used by academics to reference the work you are quoting. In academia, the Harvard referencing system is the most common, but there are others such as APA, Oxford, IEEE, and MLA that are used in various academic disciplines. Your school probably has a standard referencing system that it uses.

If you do not reference a source that you have drawn on in your essay then, whether it is intentional or not, it counts as plagiarism. Plagiarism is presenting other people's words and ideas as your own and is a type of theft. Not only does it break the law, but it also breaks the moral codes that academics and IB diploma students, along with all IB representatives, live by.

Clearly, the important question is what counts as presenting other people's ideas? Presenting other people's ideas includes quoting directly from their work. If you do this, you must signal the borrowed text by enclosing it in quotation marks ('like this') and the source should be cited according to one of the referencing conventions. This is called a *verbatim quotation*. But you are also presenting other people's ideas even when you paraphrase or reword them. Here you do not need the quotation marks, but you still need to reference the source properly.

Basic general knowledge about the world does not need to be referenced. For example, 'Paris is the capital of France' is not knowledge that has been produced by a particular person or organisation so it can be used without a reference. However, if your essay relies on factual knowledge that you know through another source (such as a textbook/internet/encyclopedia) then you must provide the source. A good rule is: if in doubt cite it.

If you are found guilty of plagiarism you risk your whole IB diploma, so it is worth getting it right.

Conclusion

The most important process in the production of the TOK essay is the unpacking of the title. This means finding examples that fit the PT question (whether agreeing with it or not). Through this process you can work towards an understanding of the key terms in the PT that make sense linked to your chosen examples. Once these examples are in place and you are happy with them, you can try to generalise from them by producing arguments for why they are typical somehow of the AOK you have selected. In the course of this generalisation, you might encounter questions or doubts. These doubts often make good discussion points in the essay and should be seen in a positive light. By choosing examples that are contrasting in the first place, your arguments that generalise them will also provide different perspectives on the PT. These perspectives need to be brought together in a central evaluation that provides the basis for the conclusions in the essay.

Finally, do not forget the original meaning of the essay – that it is a playful exercise in thinking. Use the word *if* to set up different possible scenarios to explore.

Below you will find the essay written by one of the teachers and a list of helpful phrases to use in your essay.

Useful words and phrases for the essay

The author of this chapter has learned that sometimes students make over-generalised claims or black-and-white statements in the essay because they do not have a vocabulary that can express shades of grey. This may also prevent them making conditional statements and control degrees of probability in their essay such as *certain*, *likely*, or *unlikely*. Having access to this vocabulary allows students to control their essay in a more refined way. Here is a list of phrases that you might find useful in the essay.

Language that might be useful for the essay

Degrees of probability

Probably, possibly, it is likely that…, it is unlikely that…, it is possible that…, perhaps, in all probability, presumably, it could be argued that…, impossible

Logical structure

If… then…, and, or, it is not the case that…, from… we can infer that…, from… it can be deduced that…, therefore, so, consequently, it follows that, for this reason, subsequently, only if, if and only if, because, equivalent to, implies, does not imply

Other logical language

Contradiction, tautology, consistent, inconsistent, logical truth, self-contradiction, oxymoron, analytic statement, analytic truth, necessary condition, sufficient condition, we are forced to conclude that…

Causality

Cause, effect, A causes B, A produces B, B results from A, necessary condition, sufficient condition, because

Quantifiers

Some, many, all, none

Generalising

In general, as a rule, often, mostly, on the whole, generally speaking

Comparison

In comparison, by way of comparison, similarly, likewise, at the same time, in a similar way

Adding another point

Also, in addition, further, furthermore, and, moreover, besides, again,… not to mention that…

Adding a contrast

On the other hand, in contrast, yet, nevertheless, in spite of this…, instead, but, however

Making a claim

It is true that…, apparently, obviously, as a matter of fact, naturally, of course, certainly, in fact, it can be asserted that…, it seems reasonable to hold that…

Introducing an example

For example, for instance, by way of example, an example of this is…

Signalling order of points

First, second, third, secondly, thirdly, last, lastly, finally, initially, later, soon, immediately, this time, previously, eventually, subsequently

A TOK essay written by a TOK teacher

Without the assumption of the existence of uniformities there can be no knowledge. Discuss with reference to two areas of knowledge.

Taking a cue from the ancient Greeks, this essay will understand a uniformity as something that is constant and unchanging like a law of nature, a law of human nature or indeed a principle in mathematics. One of the remarkable achievements of the Golden Age (500–300 BCE) was the realisation that the universe contains regularities that make it understandable to human beings. In this essay, I shall argue that the quotation in the title is broadly correct – that underlying our methods of producing knowledge there is an assumption that the target of our investigation is subject to some unchanging laws, patterns or regularities. This is clear in the natural sciences, but I argue that it holds even in the arts – that artistic knowledge is based on a set of uniform expectations specific to a particular artform or genre. Of course, there are differences between the two areas. While the uniformities assumed in the sciences are descriptive, they are assumed to be true of the universe we are seeking to understand, those in the arts are prescriptive – they regulate our artistic behaviour. By developing and generalising examples in these areas I shall explore the role of such assumptions and conclude that they are necessary to get the production of knowledge off the ground; without them there can be no knowledge. Finally, I argue that the assumption of uniformities in general is different from assuming that a particular uniformity exists for all time. We find that both the sciences and the arts update their understanding of uniformities over time. So, the quote in the PT is broadly correct if uniformities are understood as being rules, laws, and regularities in general.

The natural sciences are largely constructed from repeated experiment and observation. In Physics Higher Level we did an experiment in which a coil attached to an ammeter was moved between the poles of a magnet. Every time we moved the coil the ammeter showed a deflection. This effect was robust. It did not matter who was performing the experiment, or where or when it was performed, the results would be the same: there was a correlation between the speed at which we moved the coil and the amount of deflection. It felt that the more we did the experiment and got the same results the more confidently we could predict the outcome. But as we shall see, these intuitions only operate because we assume that there are lawlike uniformities in the world. We assume that if only we can find the factors that are significant for a given phenomenon, then repeating these conditions will repeat the phenomenon. Indeed, we assume more than this, we assume that there are a set of conditions that are both necessary and sufficient for the phenomenon – that these conditions are sufficient to cause it and that without them the phenomenon just doesn't happen. These are strong assumptions underlying scientific experiment.

How well does this analysis generalise to other areas in the sciences? The assumption of uniformities in nature was necessary for repeated experiments to lead to confidence in the result of our induction coil example. In fact, we shall see that the assumption of uniformities is necessary to justify the method called 'induction' in other experiments too. Many experiments in physics and chemistry operate in the same way. A set of variables thought to be relevant to the phenomenon are controlled and the experiment repeated. Perhaps one of the variables is changed. Assuming that nature behaves according to unchanging laws we infer that there is a connection between these variables and the phenomenon we want to explain. This is true even for fields like astrophysics where there is less scope for performing experiments. Here the universe helpfully provides the laboratory. There are many examples of, say, binary star systems in our galaxy that we can observe. By looking at large numbers of them and assuming that they behave according to some uniform laws of nature we can, again tentatively, infer these laws of nature. The description of laws of nature constitutes one type of scientific knowledge.

Biology appears to be a bit different in relation to law inferring laws of nature. While some biological knowledge fits the 'law of nature' pattern, such as the laws of natural selection or the statistical laws that govern mathematical population genetics, a lot of biology concerns more specific mechanisms that produce a given phenomenon in a given type of organism that resists the pattern. Biological explanation is often about the activities of small parts that together produce the behaviour of a larger whole. Nonetheless, even here there is some sort of generalisation based on individual cases. Individual organisms are taken to be models for more general kinds like species. Understanding the physiology of a particular rat can yield knowledge about rats in general if we assume an underlying regularity. Individual specimens may be different in certain ways, but the assumption is that there are deeper uniformities – without this assumption we cannot produce biological knowledge.

In both the fields of physics and biology there is a further fact supporting our confidence in the result of a repeated experiment. It is not just that we observe correlations between relevant factors and the phenomenon to be explained but we can also go some of the way towards explaining these regularities in terms of a general theory. In the physics example we have a theory of electro-magnetism that tells us that the rate at which the coil cuts the magnetic field lines is related to the current induced in the coil. The theory is a deeper sort of uniformity in nature. Science is motivated to look for these deeper theories because it assumes that they exist.

So far, the analysis suggests that the statement in the question is correct. But does it apply to other, non-scientific, areas of knowledge? In the remainder of the essay I shall examine examples in the area of the arts.

In theatre there is a general rule that the players should not acknowledge that they are part of a play and are being watched by an audience. This is known in the trade as the 'fourth wall'. It is a convention in the sense that it is a generally agreed rule that governs the production of the performance. It is understood by players and audience alike and is a crucial ingredient to understanding the theatre show. The assumption of the fourth wall is a uniform feature of certain Western theatre traditions.

More generally, conventions in the arts are uniformities assumed to give the subsequent artwork meaning. In jazz music there are conventions operating at all levels from, at the lowest level, the sequence of chords played, and their attendant scales, to the turn-taking involved in soloing. It is conventional for the audience to applaud solos mid-song and the jazz audience knows this. The chord sequences create meaning because they are accompanied by expectations by the players and the audience and these expectations can be manipulated to produce tension and relaxation and define the emotional response to the work.

But unlike science, in the arts these uniformities can be broken. The fourth wall did not exist in Shakespeare's Globe Theatre (Tribble, 2005), Brecht broke it in his epic theatre tradition, and in film Stan Laurel breaks it by talking direct to camera (Bhaskar, 2009). In jazz, John Coltrane soloed over the 'wrong' scale in *Love Supreme* and Miles Davis did not respect the turn-taking uniformity in his solos late in his career. In short, artists have seen convention as being something that can be broken for strong artistic effect.

The fact that artistic conventions can be broken might weaken their claim to be uniformities. But when a particular convention is broken, it is invariably replaced by another. It is not the case that there are no uniformities at all – the only doubt is how 'uniform' artistic convention really is. That these uniformities are assumed is implicit in the nature of artistic convention. They are assumed both by the producers and the consumers of the artwork in the production of meaning.

The same is true of the sciences. It is necessary to assume uniformities in nature to ground scientific investigation, but this does not imply that our knowledge of these uniformities stays constant. We must distinguish uniformities in nature and uniformities in our knowledge of nature. The latter might actually change over time. Just like artistic convention, scientific regularities and laws *do* change over time. In contrast to the arts though, this change is not driven by the whim of an individual scientist. Neither is it to do with an uncooperative universe that stubbornly changes its rules of operation from time to time. Human scientific knowledge is never static and is always subject to modification in the light of new experimental data and theoretical advancement. Underlying scientific knowledge is the assumption of uniformity of nature despite changes in our understanding of these uniformities or the methods used to detect them and the language used to describe them.

To conclude, by understanding uniformities to be regularities in the universe in the case of the sciences and conventions in the arts, we find that it is necessary to assume them to produce knowledge in these areas. Without this assumption, there can be no knowledge. It is conceivable that these arguments could be modified to apply to other areas of knowledge although we have no space to examine the details. This conclusion highlights the importance of being aware of the assumptions underlying our methods of producing knowledge.

[1594 words]

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