Chapter 2

The scientific approach to research

SUPERVISOR'S VIEW: EMERITUS PROFESSOR WILLIAM W. ROZEBOOM

The Enigma of Hypothesis Testing: Although it is generically a sound principle of hypothesis appraisal that verifying some previously uncertain consequence *c* inferred from a hypothesis *h* increases *h*'s credibility, the hypothetico-deductive (HD) model of scientific inference standardly proclaimed in introductory science texts (you'll see it later in this very chapter) is operationally helpful to roughly the same degree as would-be driver training that never mentions traffic signals. The HD training slogan's counterpart neglect is failure to recognise, much less suppress, two potential confirmation corruptions, *hypothesis inflation* and *consequence dilution*: if hypothesis *h* entails consequence *c* (abbreviate this as $h \rightarrow c$) while *a* and *d* are additional propositions such that *a*&*h* is not logically false nor *c-or-d* logically true (that is, ignoring trivialising extremes), then also $a\&h \rightarrow c$ [h-inflation] and $h \rightarrow$ *c-or-d* [c-dilution]. These seem to allow HD confirmation to make dubious conjectures plausible by appending them to some theory generating a strong track record of successful predictions, and to diminish prediction failures of theories we love by disjunctive cushioning of their more dubious implications. And though common sense surely shields us from inferences so egregiously perverse, we still want some metatheory clarifying how such arguments go wrong and some concern for whether subtle versions of these may not sometimes degrade our real-life reasoning.

Hypothesis inflation is as common as food mold and often not merely benign but operationally unavoidable. Almost always in scientific research, and scarcely less frequently in everyday life, our hypothesis-based deductive predictions take the form 'If *h*, then *c* always occurs in circumstances *a*', or more briefly, 'If *h*, then *c*-wherever-*a*'. (Inference this ideally determinate is in practice usually softened to probabilistic import. But problems of strict-entailment rationality don't vanish from probabilistic inference; they just get murkier there.)

When empirical research on prospect *h* finds or experimentally contrives an instantiation *i* of observable condition *a*, whether *i* also manifests *c* is a test of inflated hypothesis *a(i)&h* which, however, focuses its confirmational impact just on *h* since *a*(*i*) retains its truth presumption. But an *h* with non-trivial real-life implications can almost always be analysed as a conjunction of constituent propositions; and *h*'s confirmation as a whole by HD consequence verification seldom if ever confirms all conjunctive constituents of *h* equally. Indeed, it may even disconfirm some.

An important admonition for science praxis follows immediately from this: **Never interpret results of a hypothesis test holistically**. For your research to advance our understanding of the topic addressed by hypothesis *h*, it is nearly worthless for us to learn simply that your test of *h* has confirmed/disconfirmed this by verifying/refuting *h*'s data implication *d*. Unless *h* is trivially simple, it is logically a conjunction of many propositions, not all of which are needed for *h* to entail your declared prediction. Those which are not inflate a more austere portion *h** of *h* sufficient to imply *d*, and have no manifest claim to any of the belief change warranted by our learning whether *d*. So far as you are able you should try to identify components of *h* that can be expunged from *h* without impairing the deflated *h**'s import for your study's results. It does not, however, follow that whenever *h* is logically equivalent to *g*&*h** with *h** alone sufficient to predict your experiment's *d*-outcome, our *g*-credence should be indifferent to that result. If *g* has explanatory import for *h**, confirmation of *h** by your *d*-finding should also pass some confirmation back to *g*. And if we suspect that *d* may be over-determined, i.e. has multiple sources perhaps including *g* that can bring about *d* even absent *h**, our current belief repertoire may approve an adjustment of our *g*-credence in light of your *d*-finding independent of how that affects our *h**-belief. It is impractical for a research report to attempt updating the credibilities of all propositions to which its results are relevant, but it's important to appreciate that its *h* is generally a conflation of many ideas and needs separate appraisals of its most salient parts.

Consequence dilution, on the other hand, seems to be more a metatheoretic curiosity than an operational threat insomuch as commonsense should scorn reasoning this manifestly perverse even though disjunctive predictions such as parameter intervals aren't always objectionable. But we still want some understanding of how diluting a HD test's prediction corrupts that, and the provisional account I would proffer were more space available here challenges us to clarify our notions of 'because'. You would appreciate that explication more, however, were you to develop it on your own. Although it's far too early in your career for you to fly solo on that, you might give it a try to test your potential at concept analysis – not expecting to reach an articulate conclusion but to see if philosophy-of-science puzzles turn you on.

VIEW FROM THE TRENCHES: DR JAN WIESEKE

When I started my Ph.D. I was struggling with the practical and scientific requirements of my work. I felt that my thesis had to make both a scientific as well as a practical impact. At that point of time I found this tightrope walk to be a key challenge for me. Now, looking back after completing the thesis, I still think that this point is of crucial importance. My feeling is that talking to practitioners and their main problems significantly helps to develop exciting research. The quest for a researcher is then to abstract from the concrete problem to a generalisable phenomenon. But it is difficult early on to fully understand even what the ideal of generalisability means.

If there is one other thing that I found to be helpful in this challenge I would say multidisciplinarity. If you are stuck entirely within a single discipline you can sometimes miss out on key aspects of scientific methods and philosophies, depending on the development of your discipline. In my case I had a detailed background in psychology, doing my Masters in this area. During my Ph.D. in the business/marketing field this background was of immense help. With the knowledge about psychological methods, philosophies, theories and current research topics, it was much easier to develop research questions and to find research gaps in the marketing area. Moreover, due to my earlier studies I also had a broader equipment of methodological approaches in my mind, compared to other Ph.D. students with no interdisciplinary background. Crucially, it also helped me to more clearly understand key scientific concepts, which weren't as clearly explicated in the marketing literature I was reading for my Ph.D. That said, it is important to realise the extra-effort that is necessary to delve into two disciplines. Nevertheless, from my experience this effort has had a large and long-term pay off. Therefore the best suggestion that I can give is to gain interdisciplinary insights as early as possible within the Ph.D.-time.

The word 'science' means many different things to different people. To some it conjures up images of white-coated people in high-tech laboratories performing experiments with Bunsen burners or particle accelerators. To others the image of a wizened, white-bearded man (often suspiciously like Albert Einstein) writing formulae on a blackboard dominates. I'll be discussing some of these stereotypes later in this chapter. However, even though the 'sociology' of science will prove important throughout this book, in the main I want here to talk about science in terms of the *philosophy and methods* of science, not the type of people who *conduct* science. Again though, stereotypes dominate many people's thinking on this issue. To a large part of the population, real science is solely concerned with what could be called the *natural* world – rocks, atoms, chemicals, forces, flora and fauna, and the like. Others, often those who, like me, work in the area, consider the *social* world to be part of the concern of science. But even among social researchers there is contradiction over what science is. Some see 'science' as an honorific term for a discipline to work towards, others as an irrelevant label held over from the past – a 'cringe' towards the so-called real sciences which betrays a lack of confidence. I will also talk about some of these issues in the coming chapters.

I prefer to think of science in a rather less judgemental way. The term 'science' certainly implies some rather important things about the characteristics of a field, which will be considered in the following sections. However, to call one discipline a 'science' does not mean it is *better* than another. Science in one sense is simply a label which one can put on a field or discipline to distinguish it from another type – such as an art, or practice. Of course, it's important to label disciplines, as it implies certain characteristics about what one can and can't do, the type of knowledge one can gain from the discipline, and how it should be used. Even so, this does not imply that one type of knowledge is always better than another – although in certain circumstances this may be the case. Nevertheless, just as 'red' is not inherently better than 'blue', science is not inherently better than art, for example. However, science is also a term which can be applied to a specific *method* for generating knowledge, which has developed from the work of many eminent philosophers – some of whom will be introduced in this chapter. The aims of the following chapter are thus twofold. Firstly, I want to give you the knowledge of what science *means* and what the scientific method *is*. This involves in part a brief but fascinating journey through the lives and work of some very interesting people over the past 2,500 years. Secondly, at the end of this chapter I would like you to be able to think of science in a non-judgemental way, and begin to be able to determine *for yourself* whether you want to be a 'social scientist' or not.

But in order to answer this question, you need to have come to terms with the following key concepts that are covered here:

- How notions of science developed throughout the history of philosophy.
- Different ideas about what science and scientific knowledge are.
- The scientific method as a way of conducting research.
- The implications of such a viewpoint for *social* scientists.

Why is it Important to Know This Stuff?

Firstly, you should also understand that the concepts I am about to mention in this little box apply equally to the next chapter, but let's not complicate things right now – I'll do a very good job of that later on. Anyway, if you recall Figure 1.4 in the previous chapter, you know, the link between theory and reality, you can see where philosophy of science fits in. It's concerned with exactly how we can link theoretical ideas to the reality of our world, but also about the nature of that reality, and how much we can ever know about it. Figure 2.1 expresses the position of philosophy in this little model of research. Philosophy is often thought of as dry, boring, and irrelevant – rather like research methods themselves, or music theory in fact (you know, notes, scales, time signatures, keys, melodies, all that stuff). 'Why is this relevant?' I hear you ask. Well, most of us listen to music – and I listen to, write, and play *a lot* of music. So when I'm not thinking about research, I'm thinking about music (well, almost always anyway). Now it's perfectly possible to write a great song without *knowing* the first thing about music theory, and which melody fits with which key and all that – I can name hundreds of them (unfortunately none written by me). But those songs are great by *luck*, or instinct if you would rather call it that. That doesn't make the song less great, but it does make it rather more difficult to consistently keep writing great songs – since you don't know *why* they worked. Just that it 'felt' right at the time.

Philosophy of science is like the music theory of research – it tells you what knowledge itself should be, which questions you can ask about the world, which methods are appropriate to collect data to answer those questions, and even what answers you can logically give to your questions. You can do great research without knowing a jot of philosophy, but again it will be by luck, instinct, or by simply slavishly following a model laid down earlier – say, by your supervisor. The former means you are not likely to do consistently good research, and the latter means you are doomed to simply repeat that which has gone before and never create anything original (I can name a few musicians who take the same approach!)

So it's important to have a grasp of the philosophy of science in general. It's also important, however, to have a good grounding in the 'scientific' approach to research – which with most of this chapter is specifically concerned. This approach was the backbone to many of the great discoveries of natural science, and also underpins the social scientific methodology. The approach discussed in this chapter forms the bedrock of social science, so it's a really important starting point for you. While (as Chapter 3 will explore) criticisms have appeared, one needs a grounding in the traditional scientific approach in order to criticise it – if that's what you want to do. Without this grounding, any criticisms are uninformed, or just copies of those made by others. So whoever you are, and whatever you want to do, the content of this chapter is vital to your research education.

Furthermore, the story of the philosophy of science is full of weird characters with strange ideas – it's the great soap opera of Western history (and I am just going to present the 'clean' version)! Finally, my stated goal of this book is for you to leave it being able to think for yourself, and if you want to think for yourself, you should concern yourself with the thoughts of great thinkers in the past. You might just find it interesting.

Oh yeah, I make some pretty good jokes in here too, if I do say so myself!

To begin, we will together travel back over two thousand years to Ancient Greece (if it helps, you can imagine swirling colours and whooshing sounds to enhance the illusion)!

Philosophy and the roots of science

Although the specific details of this are subject to some debate, it is generally accepted that the first true philosophers were the Milesians, who lived in Miletus, a city on the coast of what is now Turkey in the 6th century BC, which sounds nice. Unlike many other humans at that point it would seem that they had quite a lot of spare time, since they began to ask the question 'what is reality made of?' If you go back to the first chapter, it is easy to see that this is a fundamental question concerning the philosophy of science! In fact, it is often surprising for non-philosophers to discover that questions of the philosophy of science seem to be those which have exercised the minds of many of what we consider the 'great' philosophers. Moving back to the Milesians, the reason which we consider them to be the first true

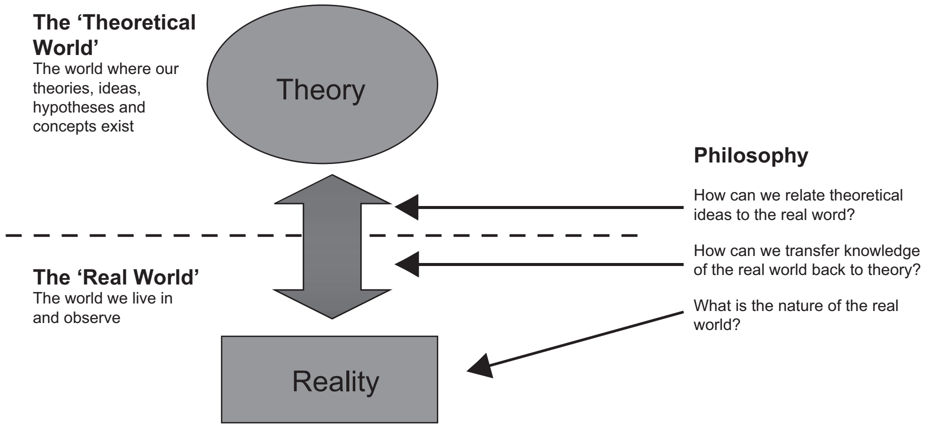

Figure 2.1 Philosophy's place in the research model

philosophers is that they were unwilling to rely on supernatural (e.g. religious) explanations for phenomena. In other words, they did not want to 'explain away' anything they didn't understand by appealing to an all-powerful God or Gods. Pythagoras (571–496 BC), who lived in Greece, was also concerned with the nature of reality. You may remember him from your geometry and mathematics classes. He had some strange beliefs (such as eating beans was sinful), but he also believed that truth should not be accepted but instead *proved*. Of course, considering as he did that the only truth is mathematics, makes this doctrine somewhat easier. Fortunately for today's students, most supervisors have given up on his rather harsh method of dealing with student debate – he once drowned one of his students for revealing the existence of irrational numbers (such as Pi) to the world. Heraclitus (*circa* 500 BC) believed that one can never trust the knowledge from our senses. Instead, true knowledge comes from reason, not observation. These and many other 'pre-Socratic' philosophers contributed much to early philosophy of science, even though most of the specifics of their ideas have since been disproved. This is an important illustration of *scientific progress*. New ideas inevitably build on those prior to them, either extending or debunking them with additional knowledge. We are all but one small link in the vast and constantly growing chain of knowledge.

Socrates (470–399 BC) is generally considered to be the 'father' of Western philosophy. One of his primary contributions was to move philosophy away from questions of reality, and towards questions of *morality*, which do not really concern us here. However, his fundamental doctrine is a compelling one to all good researchers: **question everything**. He is credited with inventing Socratic Dialogue, which essentially involves a constant questioning of ideas, which he believed should ultimately lead to the truth. He must have been a rather exasperating dinner party guest, and perhaps this was why he was eventually condemned to death by his erstwhile allies. Many of those who followed Socrates, such as Plato (427–347 BC), have much importance to philosophy in general, but Aristotle (384–322 BC) is particularly relevant to our purposes. Crucially, Aristotle appears to have first articulated the concepts of deduction and induction, which you've already come across in Chapter 1. This led to the idea of *generalisation* (see IDE 2.1), and the ability to predict events from theory. Aristotle also thought long and hard about causality, and why things behave as they do. Ultimately though, he talked himself into something of a corner, tracing all events back to one single cause or 'prime mover' – which is uncomfortably close to a supernatural explanation.

IDE 2.1: Generalisation

Generalisation is a key concept in research, and you'll be spending much more time learning about it in later chapters. Generalisation is in essence the idea that we can apply our specific results to a wider context than just the one that we studied. Aristotle's thinking about induction paved the way for generalisation in a number of ways. Induction, as you should remember, is the idea that we can theorise from the observations we make. So if Aristotle observed a number of fish swimming in the river, he is able to make an educated assumption from this data that all fish can swim. This concept gives science the ability to predict rather than simply report what is happening. But as we shall see in Chapter 3, not all social researchers think that this is a good thing

It is at around this point that history begins to intrude on our tale. In fact, one of Aristotle's pupils, Alexander the Great (356–323 BC, you may have heard of him) swept all before him across the Mediterranean and Asia Minor. Eventually the Roman Empire supplanted Alexander to become the major force across Europe. Within this period little concerns us, and philosophy was mainly concerned with politics and morals.

Another major event also occurs around this time, which you may have already guessed – Christianity. Once the Church was established as the major power within Europe, it held a monopoly on all types of thought. Philosophy became concerned with religious questions, i.e. *Theology*. Questions of science were subservient to questions regarding the nature of God, Evil, or suchlike. Explanations of phenomena also required consideration of the role of God. One can imagine that the Milesians would not have been best pleased.

Renaissance, enlightenment and empiricism

The period of Church domination of Western thought is often termed 'The Dark Ages', and not without reason. In fact, it is not until the 14th century that European philosophers began to ask questions about the nature of science again. In fact, the great philosophical works and ideas we've already discussed were only kept alive in the Islamic world, by the Abbasid Caliphs (rulers of what is now approximately Iran, Iraq, Saudi Arabia, Egypt, and surrounding countries). The Abbasids played a major role in transmitting the thoughts of the classical philosophers to the Christian West, and as such contributed significantly to the eventual Enlightenment.

According to some schools of thought, it was the rediscovery and translation into Latin of the Islamic collections of the work of the classical philosophers which kick-started the Renaissance in Catholic Italy, and particularly 13th century Florence. The Renaissance was an explosion of artistic and scientific endeavour, while in Protestant countries the Reformation was also associated with an increase in scientific thinking. Great scientists such as Galileo (1564–1642) employed experimentation, induction and observation to make fundamental discoveries (although this did not impress the Catholic Church overly). At the same time Francis Bacon (1561–1626) began to elucidate the idea of physical causes, and laws of nature which can be discovered by scientific methods. But the man commonly accepted as the originator of modern philosophy is René Descartes (1596–1650). Descartes was profoundly sceptical of the evidence provided by his senses, and looked to determine a method to discover accurate scientific knowledge. Ultimately, it is arguable whether he ever did, but he did come up with a rather nice catchphrase; 'cogito, ergo sum', *I think, therefore I am*. Descartes' belief that observed data were inferior and untrustworthy compared with pure reason (termed **rationalism**) kick-started one of the key debates of modern philosophy of science, which I will come to next.

At the same time, the Enlightenment was raging throughout Europe, bringing in a new era of belief in the primacy of science and reason over superstition and dogma. One of the major contributions to philosophy of science made at this time was that of John Locke (1632–1704), one of the founders of **empiricism**. Empiricism holds that the only knowledge we have can come from our observations, and that humans have no innate ideas which are not from experience (see IDE 2.2). One can see that this is almost diametrically opposed to Descartes' position, and the debate between rationalism and empiricism as the foundation of knowledge has continued in various forms ever since.

IDE 2.2: Rationalism and Empiricism

The debate between rationalism and empiricism is possibly the key one in modern philosophy of science, and it can be argued that it has still not been satisfactorily resolved. Descartes considered reason to be more trustworthy than observation, because he was of the opinion that our senses could be easily fooled. In fact, the only things he considered to definitely exist were thoughts – because even doubting them was a kind of thought. This is where the famous 'cogito' comes from. The only thing Descartes was sure of was that he was thinking. This idea naturally leads to the contention that our reasoning must be of a greater value than mere empirical observation – since we know that our senses can be fooled.

In contrast, Locke's empiricism considered that rationalism was subservient to empirical observation. He argued that at birth the human mind was a blank slate (or as he put it a *tabula rasa*), and that therefore in order to reason about the world we first had to observe it. From this idea, it is easy to get to the stage where one can consider empirical data to be of primary importance over mental reasoning. More specifically, the 'blank slate' idea implies that all your reasoning must in some way depend on empirical observations, since you had no capacity to reason before observation. Combining the two positions of empiricism and rationalism has since occupied the minds of many eminent philosophers.

David Hume (1711–1776) was an empiricist, but he also discredited the contention that inductive reasoning can be a source of true knowledge, and this assertion is a key component of the modern scientific method. Specifically, Hume argued that scientific findings based on observation are not 'proved', but are merely conjecture. No matter how many times you observe something, it only takes a single contradictory observation to disprove your idea. Hume also believed that causality was only human belief based on prior experiences. It would pay to remember these ideas, since I shall return to both in some more detail later in this chapter – so don't worry if you haven't quite got a handle on them yet.

Immanuel Kant (1724–1804) was heavily influenced by Hume, and he will also appear (somewhat controversially) in the next chapter. Kant can be thought of as something of a mid-point between rationalism and empiricism. He considered that observations must be constituted by the mind to create knowledge, and that the mind does contain some inherent knowledge with which to categorise our observations.

Georg Hegel (1770–1831) is also important to the philosophy of science. Hegel proposed that ideas evolve towards a better representation of reality through a *dialectic* process. An idea is a *thesis*, which automatically creates an *antithesis* (its opposite). A struggle between these ideas naturally occurs until a *synthesis,* or more truthful idea, is achieved. This process is fundamental to conceptualisations of science. Hegel believed that eventually through the dialectic process we could achieve true knowledge.

Betrand Russell (1872–1970) also operated within the empiricist framework, at least in his early years. He considered that in order to understand anything, we must break it down into its component parts (philosophers term this **analysis**). He also argued that direct experience was the only route to certainty, and anything else must be created through logical construction from its component parts (i.e. **synthesis**). However, it was at around this time that *scientists* rather than philosophers began to make their presence felt in debates regarding the philosophy of science.

The Vienna Circle, logical positivism, logical empiricism and the scientific method

The Vienna Circle were not philosophers of science, but instead were practising scientists. In fact, they generally considered all philosophy to be rubbish and concerned with irrelevant, unsolvable 'pseudo-debates' (you may think the same about now). The primary members of the Vienna Circle were Moritz Schlick (1882–1936), Otto Neurath (1882–1945) and Rudolf Carnap (1891–1970), although others were involved as well. They believed that the only true knowledge was through science, with philosophy relegated to an activity which clarifies concepts and clears up confusions. They are generally associated with a philosophy of science termed **logical positivism**. In many ways, logical positivism can be seen as an evolution of empiricism. To the logical positivists, ideas were only meaningful if they were *verifiable*, or could be empirically tested. Further, knowledge of anything not *directly observable* was considered impossible. They also believed that the more abstract theories and propositions of social sciences could be reduced to those of more fundamental sciences such as physics – termed *reductionism*. True logical positivism is generally seen as having died out by the 1960s, although tragically for Schlick this happened much earlier. In direct contrast to Pythagoras, Schlick was killed by one of his students – something I am sure my own students dream of sometimes.

While positivism, in one form or another, has been argued as the 'standard view' of Western philosophy of science in the 20th century, its reliance on pure empiricism means that it is not really the foundation of modern science that it is often mistaken for. In fact, another member of the Vienna Circle – Herbert Feigl (1902–1988), who was a student of Schlick – began as a positivist, but eventually became the first to move beyond positivism when he developed and promulgated a **logical empiricist** philosophy of science, which can also be described in general terms as a **realist** position. Feigl became the first of the positivists to settle in the US when he moved to Iowa in 1931, having spent time at Harvard in 1930. In fact, in 1931 he published a paper with Albert Blumberg in the *Journal of Philosophy* which is generally credited with introducing logical positivism to America. Feigl was appointed Professor at the University of Minnesota in 1940, and in 1953 he established the Minnesota Centre for Philosophy of Science, which was probably the first such institution in the world. This Centre became a hotbed of philosophical development and discourse, and many of the contributors to 20th century philosophy of science which are mentioned in this book have passed through it, including Bill Rozeboom and Paul Meehl.

Feigl differentiated his logical empiricist position from logical positivism primarily by his disagreement with the idea that theoretical terms or concepts are solely defined by their empirical observations, or are just 'useful fictions'. Instead, Feigl argued that such terms (e.g. 'motivation', 'electron', 'force', etc.) are almost never defined by their observations (this may be most simply understood as their being 'unobservable'), yet still refer to entities which are 'real'. Thus, in contrast to positivism, realism holds that while many things scientists are interested in, such as internal human processes, cannot be directly observed, one can usefully measure them and study them in the context of theoretical explanations.

In a more general sense, the positivist claim that all knowledge must rely on empirical observation has also been discredited. Observations are instead *theory-laden*.

Observers are not passive receptors of data, but instead interpret it using concepts from, for example, language, culture, or our previous expectations. But, this is not the same as saying that a single reality does not exist (I'll deal with that idea in the next chapter), just that our empirical observations of this reality may be more or less representative due to their theory-laden nature. Similarly, realists have also criticised positivism for not being concerned with causality, only with association. Since only association can truly be observed, positivists contend that causality is an irrelevant concept. However, realists argue that scientific discovery must attempt to uncover the complexity of causal relations, or *why* an association is observed. It is realism, rather than positivism, which should probably be considered as the 'received view' of Western science in the 20th century and especially social science. In fact, even most natural sciences, such as modern physics, can also be argued as fundamentally realist due to their reliance on unobservables (e.g. subatomic particles). Nevertheless, there are of course alternative viewpoints one could take regarding the philosophy of science, many of which fundamentally oppose realism. While a coherent alternative to realism is presented in the next chapter, Alternative View 2.2 presents some additional discussion of this issue.

Alternative View 2.1: Positivism or Realism?

The term 'positivism' is often used to refer to what could be termed the 'standard view' of Western science, by both its supporters and opponents. So much so in fact that the true meaning of positivism seems to have been obscured. However, true positivism itself depends on a number of assertions which have been criticised and ultimately discredited. In particular, positivist conceptions of science only consider things to exist if they are directly observable. And any proposition which cannot be directly empirically tested is nonsense. Positivists called this *verifiability*. This rules out consideration of many theories and concepts which have become fundamental to modern social sciences such as psychology. For example, one cannot directly observe a student's motivation to attend class, only the result (actual attendance). However, motivation as an unobservable construct (which will be discussed more fully in Chapter 6) is a vital part of psychological theory, as are many other 'unobservables'. Even modern physical sciences depend on unobservable particles and forces for their explanations of the universe (read Hawking's *A Brief History of Time* if you want to know more). Positivist philosophy of science must consider any of these things to not actually exist. Nevertheless, few psychologists would consider motivation to not actually exist, nor a physicist consider a quark to be non-existent. Furthermore, causality is a huge problem to positivism. Strictly speaking, one can never observe one thing causing another, only their superficial correlation (try thinking about what you *really* observe when you see two snooker or pool balls collide, for example). But questions of one thing causing another are fundamental to the goals of most modern science. Ultimately, verifiability as a principle is untenable for modern science – since so much modern science is conceptual and not directly testable. For example, Einstein's theory of relativity was not testable from its inception, and even now not all of its empirical consequences are observable (e.g. gravitational waves).

Realist philosophies (or what Feigl introduced with his logical empiricism) share positivism's belief in an objective world which we can observe and measure. However, realist philosophy also contends that there are some things beyond our ability to confirm their existence directly, but yet still have independent existence. In other words, just because we can't see something, doesn't mean it does not exist.

Furthermore, realist philosophies accept the fact that there may be error in observing the objective world. The implications of accepting realism over positivism are manifold for the scientist. Essentially, we are now allowed to postulate abstract, unobservable entities in our theories. These entities can be related to empirically observable effects, and then if we do observe those effects, we can consider our abstract entities to actually 'exist'. So if I hypothesise some effects of motivation (e.g. class attendance) which I can observe, then my observation of high attendance will imply that motivation exists. As already mentioned in the main text, realism can be seen to place theory at the centre of scientific study. Causality is now possible in our theories as well, since the impossibility of directly observing anything more than correlation is irrelevant.

Another criticism of positivism was its contention that observation could 'prove' theory. Instead, Karl Popper (1902–1994) argued along similar lines to Hume before him, that we should never rely on empirical observation to prove our theories. In fact, this is such a compelling idea to most modern social scientists that it is difficult to conceive of anything else. Popper suggested that true scientists should look to *falsify* their theories with observations that contradict them. In this way, theories can never be proved, but only provisionally accepted in lieu of contradictory observations. It is this idea which can be argued to be at the heart of modern scientific methods, and we will see it in many concepts throughout this book, such as hypothesis testing.

The issues discussed above are all evident in the description of the **scientific method** which will be presented later. However, it should not be ignored that the very concept of a single scientific method has been heavily criticised by philosophers such as Paul Feyerabend (1924–1994), who considered that science can never be directed by a single set of procedures and rules. This will be discussed later in Alternative View 2.3, but in essence Feyerabend argued that progress is really made by radical scientists who actually *break* established rules, and that there is nothing which suggests that scientific knowledge is any better than any other. Thomas Kuhn's (1922–1996) theory of scientific progress is similarly concerned with the importance of radical change – or *paradigm shifts* – rather than the incremental progress science is often thought of as making. Interestingly, if you look at the history of scientific progress, you will see that Feyerabend and Kuhn may have had a point. In fact, many of the truly great discoveries have been made by radicals such as Copernicus, Galileo, Darwin, Einstein and Hawking. They and others like them were mavericks, who faced scorn, ridicule and even imprisonment or death for their discoveries, only later to have them become part of established knowledge (sometimes posthumously which is rather unfortunate). I will try to deal with some of these issues, particularly those concerning a single method, later. But first it would seem appropriate to try to cover some key questions which I asked myself as a doctoral student, and continue to ask today.

Alternative View 2.2: Anti-realism and Pragmatism

It should not be of any great surprise that the *anti-realist* position would deny the real existence of theoretical concepts. There have been many different 'flavours' of anti-realist philosophies of science in the 20th century, but here I will focus on **pragmatism**, which is both interesting in a general sense, and has some specific resonance for the researcher in applied social science disciplines. Pragmatism can be considered to have developed in the US in the late 19th century, with the work of Charles Sanders Peirce, William James, and John Dewey. Peirce in particular was a brilliant polymath and fascinating individual. Pragmatism acknowledges an external reality, but considers theoretical concepts to simply be fictions which help solve particular problems. In fact pragmatism's key tenet is that meaning and truth are only defined in relation to how useful they are in action. This is not quite the same as the common mischaracterisation that 'anything which works is true'. Further, pragmatists tend not to believe that truth is absolute and objective, but that it is co-created by us and the reality we are working within. In other words, only when a theory proves useful does it become true. So, theory and practice are not independent, they are inextricably interlinked. A large number of key thinkers in the latter half of the 20th century have been influenced by pragmatism's concepts, including Donald Davidson (who will appear in Chapter 15).

Echoes of the pragmatic view can be found in many of the other theories discussed in this chapter and the rest of the book. It is also something which will likely chime with those among you who study organisational and managerial topics, and particularly those who may have come from a commercial research background. However, pragmatism is not an 'anything goes' philosophy, it is still concerned with theory and reality. It is not a licence to avoid engaging with wider theories or rigorous methodologies.

What is 'science', and who are 'scientists'?

It is at this point I am reminded of a situation when I had been to a rather good party, and (somewhat the worse for wear) was having a few quiet drinks back at the hotel with Ian Lings, Ian's mum and a number of other colleagues from our faculty at the time. While Ian's mum is a wonderful woman, she made something of a *faux pas* when she asked whether any of us ever dreamed of being '*real* scientists' like a close friend of ours, who is a geneticist, 'and discovering important things which help people'. While it is fair to say we were quite insulted by this, and let her know in various loud, drunken and offensive ways (actually, mainly me to be fair since I was as usual the loudest, drunkest, and most offensive), I should really thank her since it did begin the thought processes from which much of the content of this chapter resulted. It should not be news to you that I consider myself to be a 'scientist'. However, at no point in my career as an academic have I ever worn a white lab coat (at work anyway, what I do in private is my own business). Nor have I so far conducted an experiment in a laboratory, dissected anything, or blown anything up in the course of my work. Ian, however, did begin a Ph.D. in chemistry many years ago. Does this make Ian more of a scientist than me, since he at least has a degree in 'real science'? It should by now be quite clear to you that I think not (Ian's mum probably still does though).

So what then is a scientist? Does one wake up in the morning and all of a sudden realise that he or she is a scientist? Does it give me a warm glow as I sit down at my desk for another day of 'doing science'? Not really, to be honest. However, I still have not answered the question of what a scientist is. If you sense I am beating around the bush a little, you are very perceptive. It's because I am rather nervous about the answer since it seems too simple, and I fear you may ask for your money back. *Scientists are people who do science!* Nothing more and nothing less. Of course, this begs the question: what then, is science?

Science and social science

The question of what science is does not exist purely for the interest of philosophers with too much spare time (like the Milesians), or authors who need to fill a few pages (like me). It is a question of great importance to what my non-academic friends refer to as 'the real world' (as in 'why don't you get a job in …'). For example, at the end of the 20th century, debate raged in many American states as to whether theories of 'creationism' were equally scientific to those of evolution by natural selection. The answer to this question had major implications on how these subjects were taught in schools. The question even came to court in one American state. This case actually resulted in the judge, one William R. Overton, giving a set of criteria as to what makes a 'scientific theory', which seems as good a place as any to start at with a description of science. Judge Overton considered five features to be central to a scientific theory (see Bird, 1998 for some more details and an in-depth discussion).

1. It must be guided by natural law.
2. It has to be explanatory by reference to natural law.
3. It is testable against the empirical world.
4. Its conclusions are tentative (i.e. not necessarily the final word).
5. It is falsifiable.

You may have already come across some of these terms, and some you may not have. Beginning with the idea of 'natural law', this refers to the idea that there are underlying uniformities and general relationships between phenomena which explain the behaviour of things. Most of us can quote a number of scientific laws, or are at least aware of concepts such as 'the laws of physics' – even if it is only from old Star-Trek reruns. The first two criteria essentially mean that claims can be considered scientific if they refer to natural laws, or to facts which rely on natural laws. If not, then any claim is purely conjecture, or opinion. The third criteria means that any claims you make must be testable – i.e. detailed enough to have consequences which can be observed in some way, thus evidence for a claim can be found. Furthermore, no matter how much evidence we have found for our scientific theory, we must always be open to the idea that it may be wrong, and that new evidence may disprove it. Science is full of theories which appeared to be completely correct, only for new evidence to show them completely false (do any of you still think the Earth is flat or that the Sun revolves around the Earth?) Finally, theories should be stated in such a way that we *can* find evidence against them. Thus, scientific claims are never final, and always open to amendment if additional evidence is found.

One can look at what have been called the 'natural sciences', such as physics and chemistry, and quite clearly see that their theories and claims fulfil the above criteria. But what about the social sciences, such as psychology, sociology, economics, management, and my own field, marketing? Claims by most of the social sciences quite easily fulfil the final three of Judge Overton's criteria, but what about the criteria relating to 'natural laws'? Have the social sciences really come up with any genuine laws yet? The law of supply and demand? The expectancy theory of motivation? Are these truly laws? In fact, social sciences such as marketing have sometimes had their scientific status questioned due to the lack of discovery of universal laws (e.g. Buzzell, 1963).

However, if we consider the concept of natural laws in some more detail we find that the question of whether a social science has actually *found* any laws is not really a key issue. In fact, we need to separate the *outcome* of science from the characteristics of science. A natural law is there to be *discovered* not created by science. Thus, the discovery of such laws is the outcome of scientific research. The fact that underlying uniformities and relationships among phenomena are expected to exist in the subject matter of concern for any social science is surely more important than whether or not they have actually yet been discovered. Most of us would argue that social sciences such as marketing and sociology are indeed likely to have underlying regularities and relationships which are there to be conceptualised and subsequently discovered – even if we haven't yet to discovered them. Furthermore, most social sciences are far younger than the natural sciences such as chemistry and physics. Why then should we expect, for example, organisational psychology to have a fully formed set of universal laws for say, motivation? Did physics have such a set of laws 100 years after its inception (if one could pinpoint this time of inception of course)?

The previous discussion also has some implications for organisationally oriented social sciences (such as strategy, marketing, or organisational behaviour) which are not quite as relevant to the natural sciences. In particular, as mentioned in Chapter 1, it is important to distinguish between **normative** and **positive** aspects of fields such as strategy and marketing. This is in some ways analogous to the common debate over science and practice. Normative aspects of a discipline focus on what a manager (for example) *should* do, such as how a firm should plan its long-term strategy, or implement an incentive scheme. By contrast, positive aspects are concerned with 'attempting to describe, explain, predict and understand' the phenomena a discipline is concerned with (Hunt, 1991, p. 10). It is vitally important to avoid confusion between these two approaches to knowledge, especially in the social and organisational science disciplines. Specifically, it is the *positive* aspects of the various organisational study fields that define them as scientific, i.e. the seeking of knowledge to describe, explain, predict and understand organisational and management processes. This is the difference between, for example, marketing science, and the practice of marketing itself. To take another example, the practice of medicine depends on sciences such as biology, physics and chemistry (sometimes, the mix of sciences related to subjects like medicine is called 'life sciences'). The practice of marketing in companies is based around theories and knowledge gained from (among others) *marketing science*. This is one of the reasons I get so angry when people refer to me as a 'marketer' (well to be honest I get angry about a *lot* of things). As I once said 'do you call someone who studies insects an insect?' Of course not, they are called entomologists. I suspect that because the business and management oriented sciences relate so strongly to practical and observable phenomena, the positive, scientific study of these phenomena gets confused with the normative, practical application of scientific knowledge. Clearly understanding the distinction helps in illuminating exactly what it is that social scientists do.

So, you now have an appreciation of what science means in terms of the characteristics of a given discipline. But 'science' is also a term for what people *do*, as well as a type of knowledge. What makes a method of generating knowledge 'scientific', or indeed what makes a type of knowledge 'scientific'? I discuss these issues and others in the next section, which introduces the **scientific method**.

Scientific knowledge and the scientific method

The term 'knowledge' is one which has – like many others introduced in this book so far – caused considerable controversy throughout history. Just what is knowledge? Are there different types of knowledge? Is one type of knowledge different from another? Must knowledge be the 'truth' even? These are interesting questions, and ones which can receive contrasting answers, depending on your viewpoint. Some of these alternative viewpoints will be considered briefly here, and covered in more depth in subsequent chapters. However, I am primarily concerned here with the idea of **scientific knowledge** and its characteristics. It seems plausible to imagine that the basic output of science is knowledge, but when pushed, most laypeople (indeed most scientists) struggle to define exactly what this knowledge actually consists of. One helpful way of looking at this is to consider that this scientific knowledge, the output of science, consists essentially of a body of *declarative sentences or statements* about the world around us, that have some credibility or plausibility which allows us to trust them to some extent. Without evidence of this credibility, you could characterise a statement as simply a ‘knowledge claim’. Therefore, we of course wish to provide some evidence which will drive us to either believe or disbelieve these claims.

But the question then becomes one of how exactly do we provide evidence which can assure one of the credibility of these so-called ‘scientific’ statements, or knowledge claims. In other words, what makes knowledge scientific in nature? While I would not claim to offer any particularly new insight to this debate, it seems to me that the ‘scientific-ness’ of a particular knowledge claim depends on a few things. Firstly, a given claim should have been confronted with empirical data which could reveal flaws or weaknesses. Yet, this is not always possible for knowledge which claims scientific status. For example, many of the most cutting-edge physical theories, and the knowledge claims which result from them, appear untestable with our current technological abilities, such as claims regarding the nature of black holes in space. Nevertheless, these knowledge claims *are* testable in principle in the future, in the same way that many of Einstein’s theories have become testable as technology advanced in the 20th century. Another criterion for scientific knowledge also seems pertinent, that it should explain the relevant phenomena better than any credible rival explanations. Thus, scientific knowledge must be able to survive the occurrence of any data which becomes available. While we cannot, for example, directly observe what goes on inside black holes yet (and maybe we never will) theories regarding the process must be able to explain any relevant occurrences better than other credible theories for them to be regarded as scientific knowledge. Thus, at no point should ‘faith’ be required to accept scientific knowledge. Any method for generating scientific knowledge should therefore take into account the necessity of confronting knowledge claims with empirical information in an attempt to reveal its weakness.

Furthermore, scientific endeavour should not just be about gathering facts and observations about the world. Science should instead be concerned with creating **theory**. In other words, we should try to develop explanations of what happens in the world, not just observe what is happening. This of course is in direct contrast to empiricist (and by association positivist) standpoints. In my opinion, observation without explanation is not particularly useful. Furthermore, theory gives us reason to expect certain observations. In fact, the agreement between theoretically based expectation and actual empirical observation is one of the cornerstones of the scientific method. From this it can also be seen that science proceeds in a generally incremental fashion. Theories give us reason to expect some things, and combined with creative thinking and observation can suggest new angles on problems. Scientific research can then suggest solutions to these problems which then extend and add to the theory, and the cycle begins again.

Alternative View 2.3: Controversies in Method and Progress

In this chapter I will soon explain what has been termed by many authors the 'scientific method'. However, a radical alternative – most famously and compellingly asserted by Paul Feyerabend in his book *Against Method* – is that there can be no single 'scientific' method. His basic thesis is that for every possible candidate for the 'scientific method', there has been a situation where scientific knowledge has advanced by going *against* its principles. In fact, he argues that the only possible universal principle of the scientific method is 'anything goes' (Feyerabend, 1993, p. 28). While many philosophers of science consider acceptance of this view as a death-knell to traditional notions of science, it is not necessarily so. Specifically, it can be argued that no one method has a monopoly on knowledge; in fact, methods themselves are the products of science and are constantly being improved. Furthermore, one can take Feyerabend's famous example of Voodoo witchdoctors – which he (to his credit) was known to frequent as demonstration of his commitment to the pluralistic standpoint. If such a witchdoctor has developed a reliable method for diagnosing illness, should this not be considered 'knowledge'? Whether or not the witchdoctor attributes his success to metaphysical sources (when it may in fact be due to a physiological reason) is surely immaterial. However, orthodox advocates of the single scientific method would reject this knowledge outright. In fact, one can imagine that much knowledge has in the past been lost or ignored because of such strict adherence to the principles of 'science'.

Related to this is Kuhn's thesis of scientific revolutions. While the traditional view is that scientific progress is made in incremental fashion, Kuhn in his famous book *The Structure of Scientific Revolutions* argued that science also progressed in occasional 'revolutions' where existing ideas and methods were rejected and new ones took their place. Kuhn termed this revolution process a *paradigm shift*, where paradigm refers to a set of ideas, theories and methods used in a science. Both Kuhn and Feyerabend considered that theories and ideas from one paradigm were *incommensurable* with those from another – i.e. one cannot judge the utility of theories and findings from one paradigm from the standpoint of another (see Chapter 15 for some more information). Again then, we move into a situation where 'anything goes' – and one cannot judge work from outside one's paradigm. There is no viewpoint which is independent of all paradigms, and thus no way of comparing knowledge from one paradigm against another. It seems that a full acceptance of this is similar to claims made by postmodernists, that one can never judge the 'quality' of such research by referring to existing scientific standards (see Chapter 3). However, it can also be argued that arguments such as this ultimately lead to nihilism and the irrelevance of the very idea of knowledge itself.

While as Alternative View 2.3 shows, some have argued against the idea of a single scientific method, claims for a 'multiplicity' of scientific methods can be argued as somewhat flawed. Firstly, it is vital to separate the *techniques* used in a given scientific discipline from the *methodology* of the discipline. Techniques are the tools used to conduct scientific research. It is clear that social sciences such as psychology, organisational behaviour and marketing, use considerably different tools from natural sciences such as physics or chemistry. For example, the natural sciences often employ equipment such as Bunsen burners, particle accelerators, radio telescopes and other items. In the social sciences we rely more commonly on questionnaires, measurement scales, content analysis and the like. Nevertheless, these differences have no bearing on whether or not a discipline can be considered a science or not. As Hunt (1991, p. 20) points out 'the scientific method is not restricted to certain kinds of hardware … or to techniques of gathering data … or to techniques of measuring phenomena … or, most certainly, to techniques of analyzing data'. Of course different sciences use different techniques – take astrophysics and biology for example.

The methodology of science is the manner in which a science accepts or rejects the truth of the knowledge created by the techniques it uses. In other words, it is concerned with *justification* of knowledge, not its *discovery*. While we have seen above that different sciences use different methods to discover knowledge, are there multiple ways in which to justify the knowledge created by a science? I will deal with alternative perspectives to some of these issues in the next chapter, however, many scholars have thoroughly discredited the notion that there are multiple ways to assess the truth of knowledge claims. Thus, the single scientific method is concerned with finding evidence to support claims, by using them to generate implications which are testable (such as hypotheses). These implications can then be checked by any investigator and evidence to support the knowledge claim is thus generated. How the knowledge claims are discovered is immaterial to how evidence is generated to support, corroborate and validate them. To take the witchdoctor example in Alternative View 2.3, whether the witchdoctor simply stumbled upon a reliable diagnostic method is immaterial to his *knowledge claim*, but it is the characteristics of the search for justification and explanation of that knowledge claim which makes such knowledge ultimately *scientific*. So, to go right back to the beginning of this discussion, a 'declarative statement' claiming some knowledge is only considered scientific knowledge if it has been subjected to some rigorous search for evidence and justification. It is this method of justification that will be the focus of the remainder of this chapter.

The scientific method

You should recall the previous section, where I argued that the intended output of science was in the first instance a set of declarative sentences about the world, which have a high credibility. However, the plausibility of these statements must somehow be assessed in order for us to rate their credibility. I touched on some of these issues above, but here we will cover the **scientific method** in more depth. The scientific method can be thought of in basic terms as *a set of techniques about collecting and interpreting evidence which are generally considered* *likely to illuminate differences in the plausibility of these declarative statements*, which recommends activities which help to drive us to either believe or disbelieve a given statement. In other words, the scientific method is how we find evidence to either accept (for the moment) or reject our knowledge claims.

The 'scientific method' is really quite a vague term – furthermore it can sometimes raise criticism from those who conduct research within other frameworks that it implies that their type of research is not 'scientific' and thus less useful. Although I would tend to agree with the former (if it doesn't use the scientific method, then by definition it can't be scientific), I would not like to imply that other types of research are less useful, and in this I make some small concession to Feyerabend's arguments. Thus I will avoid the use of the term 'scientific method' from now on, and call it the **hypothetico-deductive** method. This also has the advantage of sounding very clever and impressive, which can sometimes prove very useful in academic circles (some may say that I have built my whole career on it so far). The hypothetico-deductive method was articulated by Karl Popper, who I have discussed earlier, and rests on a very famous problem in philosophy of science which you are about to realise that you didn't bother to remember, even after I told you to. Now, go back to the brief discussion of David Hume and his ideas on observation as a way of proving scientific ideas. Karl Popper built on this idea and provided a very nice example which almost all of us who teach research methods have surely borrowed at one time or another. Specifically, Popper described the situation where you propose that all swans are white (a *hypothesis*). If you count all the white swans you can find, not finding any black ones, does this prove your hypothesis? The answer of course is no, because there is no way of knowing whether the very next swan you see may be black! This emphasises the tentative nature of scientific conclusions as I mentioned above – we can never prove our claims, merely find support for them until conflicting evidence comes along. The hypothetico-deductive approach systemises the search for conflicting (or *falsifying*) information.

Figure 2.2 graphically represents the hypothetico-deductive approach. One of course must first come up with some kind of research question, and define what it is that you are interested in, in a general sense (step 1). Following this is step 2, a search for ideas about that question, perhaps through a literature review or exploratory research, or an examination of prior experience in the area. Here the scientist should begin to think about the important concepts of variables which are relevant, and how they are interrelated with each other. Even more importantly, are there key issues that previous work has missed out? Many of the strategies and methods involved in this section are detailed in Chapter 4. Subsequent to a general search for ideas is step 3, a more formal process of hypothesis development. Hypotheses must be testable, and you should also make them clear and simple. For example, a hypothesis out of one of my own pieces of work (Pankhania *et al.,* 2007) is:

H_2: *The UK Indian ethnic minority will place different levels of importance on the features offered in a product than the UK Caucasian majority.*

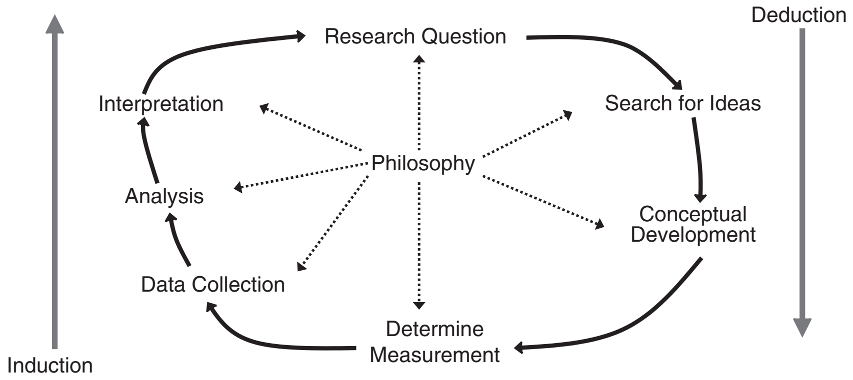

Figure 2.2 The hypothetico-deductive method

Remember, a hypothesis is simply something you expect to see in the data – it has no theoretical content. Hypotheses are just statements, which are *based* on theory, usually presented above the hypothesis. For example, for the hypothesis above, I spent half a page arguing why we should expect to see that in the data. Have a look at the paper if you want to get a feel for this (reference it in your own work too – that should help my citation scores!). Ian will discuss many of these issues in Chapter 5.

Following the theoretical development of concepts, hypotheses and models, we need to determine how to *measure* our variables (step 4). This is the subject in parts of Chapters 6 and 7. Suffice it to say here that measurement is a critical and underdeveloped part of social science, when compared with other methodological subjects, and these chapters may just be one of the most important things you ever read (other than *The Hitchhiker's Guide to the Galaxy* of course). After deciding how to measure our concepts, also called *operationalising* them, we need to collect data on those measurements (step 5). This subject has received massive attention from social scientists, and I cover much of this in Chapters 8, 9 and 11. Of course, once we have the data, we need to analyse it (step 6), which is the subject of Chapters 10, and 12–14. This subject holds more fear for students than any other – especially the quantitative side of it. But really, it's the easiest of all the stages! It's far harder to come to terms with the philosophy of science, design a good study, and collect good data than it is to analyse it. And honestly I'm not just saying it because I know how to do it – my own supervisor will relate to you many hilarious stories of my analysis incompetence at the beginning of my own dissertation work, and my colleagues can tell you of some after its completion! A far harder task is the final one (step 7), that of interpreting your analysis and drawing some conclusions. Here you must decide whether your hypotheses have been supported (remember, *never* proven) or not, and bring your work back to the original theory. Importantly, you should never forget that even if your hypotheses are not supported, this is still interesting news if you have conducted your study with solid methods. You need to relate your findings back to what is already known – and discuss why it is that you think you did not support your hypothesis. I'll be discussing interpretation at length throughout the rest of the book. Remember, the raw numbers mean nothing by themselves, it is *you* the researcher that gives them meaning for the reader.

The scientific method and the social sciences

As you should already be aware, the hypothetico-deductive method was developed in the context of the natural sciences, i.e. physics and the like. However, this book is concerned with social science, not natural science. It is not in question that the social world is different from the natural world – the real question is whether those differences necessitate a different way of investigating the social world. This chapter is aimed at explaining the viewpoint that we do not necessarily need to employ a different method to investigate social phenomena. However, Chapter 3 will present a viewpoint based around the idea that we do need a different way of exploring the social world.

The idea that the approaches and methods of the natural sciences are equally applicable to investigating the social world is termed *naturalism*, or more specifically scientific naturalism. Naturalist viewpoints range from the extreme that all things are reducible to physical properties (*reductionism* – if you recall the logical positivists), to a more gentle viewpoint which simply considers that the social world arises from the physical world, and thus natural science methods can be used to investigate the social world. It can be seen then that underpinning the philosophies of empiricism, positivism and realism within the social sciences is the idea of naturalism. However, it is important to realise that this does not mean that specific natural science techniques must be used, only that the general methodology (i.e. the search for explanation and generalisation, and the hypothetico-deductive method) is appropriate to both natural and social science. For example, Hunt's (1991) quote above specifically referred to the idea that different sciences necessarily use different specific techniques.

There have been numerous objections to the naturalist viewpoint which have been aired throughout the 20th century, by philosophers and social scientists. Chapter 3 will discuss many of these objections, and advance an alternative viewpoint as a contrast to that discussed herein. However, while I may not be so quick these days to nail my flag to the naturalist mast (I like to maintain my mystery nowadays) I was most definitely a committed naturalist (no, *not* a naturist) when I was doing my Ph.D. The next section will discuss some specifics of scientific projects.

Typical examples of 'scientific' dissertations

Of course, I can point to my own dissertation as a typical exemplar of a 'scientific' (or realist) approach to the dissertation, based on the naturalist viewpoint. In essence, it was an attempt to determine how sales managers resolved problems caused by their salespeople, and whether different problem resolution methods led to more positive sales force outcomes than others. Thus, the aim was to first uncover consistent factors generally used by sales managers, then to measure them (and their potential consequences), and then to analyse the relationships evident in the data. In order to do this, multiple methods were employed, beginning with literature reviewing, then qualitative exploratory research with sales force members, and then quantitative surveying of many more sales organisations. Thus, it can be seen that at no point can we define the scientific status of a project by its choice of methods (as was discussed above). I used both qualitative and quantitative methods to explore the research area. However, I utilised the hypothetico-deductive method as a guide to my study, and my aims and assumptions were consistent with a scientific realist approach. In other words, I believed that there was an underlying reality to be discovered, which contained regular and consistent patterns which could ultimately be generalised. Furthermore, I also believed that I could measure unobservable factors like motivation and satisfaction in a systematic and reliable way (which makes the research realist *not* positivist).

Other examples of scientific dissertations I have seen or been involved with in some way are an investigation into the effects of salesperson stereotypes on consumers' information processing, a cross-cultural study of factors impacting on sales force unethical behaviour, a study of the effects of internal marketing on firm performance, and an examination of the interpersonal factors influencing business-to-business relationship quality. Many of these projects were quantitative in nature; however almost all contained some qualitative work, and some were entirely qualitative. Nevertheless, they all fundamentally had as their base the belief that the world could ultimately be objectively measured and the knowledge gained through this research could reflect 'reality'. However, as you shall see in the next chapter, the realist position is by no means the only one available to the organisational researcher, and neither is the hypothetico-deductive the only method of enquiry into organisational phenomena.

Interestingly, from my perspective, I can't really pinpoint a particular time where I made a decision to be a 'realist', or 'naturalist'. In fact, I suspect this is the same for most researchers at the beginning of their careers. By the time you get to the stage of doing a Ph.D. for example, you normally have some solid ideas about how you feel the world works, which can be influenced by all kinds of things, such as your colleagues. I'll address this in some more depth at the end of the next chapter, but I think it's enough to say now that in order to make an informed decision, you need to have a good picture of both sides of the debate about what science is. For most novice researchers such as myself at the time, this is a considerable weakness. I certainly had no real idea of what a non-realist position on science would be, I was just drawn to the ideas collected under the realist heading – even though I didn't really know what this was. Certainly, if you cover the material in this and the next chapter well, you'll have far more information available to you to classify where you stand than I did.

Summary

This chapter is kind of 'twinned' with the next, so now is not the time to offer any final points. Nevertheless, some key points to take from this chapter are:

- The nature of science is a question that has exercised the minds of the great philosophers for thousands of years, and is still a matter of debate.
- Science is done by *people* not machines, and as it is subject to the vagaries of human behaviour and interaction, it's a sociological process as much as anything else.
- An understanding of the development of the philosophy of science over the last 2,500 years is important because it allows a student to place their own efforts into context, and to define their standpoint on research. An *interest* in the area is even better!
- The nature of scientific knowledge is not just a question for dusty academics in their ivory towers. It affects all of us in everyday life – and especially dissertation students!
- What a discipline has *actually discovered* so far does not define it as science. Instead, it is the *possible existence* of, for example, natural laws (i.e. regularities and general relationships between phenomena) which should define a discipline as scientific.
- It is important not to confuse the positive and normative aspects of organisational science. It is the positive aspects (seeking to explain and understand phenomena) which should be considered areas of scientific study, not necessarily the normative application of such knowledge.
- Scientific knowledge should in principle be testable, and also look to create theory which builds on existing theory – not just discover isolated facts.
- The techniques used to *discover* knowledge do not define that knowledge as scientific. Instead it is the logic of *justification* of those knowledge claims which is the distinction between the scientific and non-scientific methods.
- Finally, there has been considerable controversy regarding the scientific method and the incremental progress of science. However, one can usefully systemise the *hypothetico-deductive* method as a logic of discovery and justification of scientific knowledge.

Further reading

- *Sophie's World* by Jostein Gaarder: This is probably the single best book about philosophy that a beginning researcher can read, which justifies its best-seller status (16 million copies and counting). It's interesting, easy to follow and, more importantly, fun. Read it, even if you do nothing else I ever suggest.
- *Foundations of Marketing Theory* and *Controversy in Marketing Theory* by Shelby D. Hunt: Professor Hunt is probably the pre-eminent philosopher of science within my field (marketing). His thoughts have influenced so much of my own, particularly about the nature of science. I recommend reading these two books to get a great picture of a committed realist coming to terms with the nature of social science and his field of study.
- *Popper* by Brian Magee: Popper again has been a major influence on my thinking, and he is the architect of the modern scientific method. This little book is a great introduction to his thoughts on philosophy of science, but there are doubtless many others to choose

from – including more in-depth discussions of the key ideas introduced in this book. Popper also did a lot of work on political philosophy, and some is included here, but I thought that stuff was a bit boring.

- *Realism, Rationalism, and Scientific Method* by Paul Feyerabend: A true original and iconoclast. Whether or not you agree with Feyerabend's thoughts, it's worth trying to get a handle on him just to understand how fearless a thinker he was, and how committed to following through his ideas. A model of a true intellectual we can all aspire to in my opinion. That said, reading his work in the original is somewhat difficult.
- *Philosophy of Science* by Alexander Bird: This book is a great introduction to the philosophy of science. It can get a bit hard going, but that's the nature of the subject after all. This book also contains a much fuller discussion of the nature of science controversy, including all the details of the Judge William Overton court case I briefly touched upon earlier in this chapter.
- *A Historical Introduction to the Philosophy of Science* by John Losee: This book is again a fantastic introduction to the philosophy of science, and is quite easy to read for the beginner. I wish I had found this book *before* writing this chapter!

EXERCISES

1. Create a timeline of the development of thought regarding the nature of science and scientific knowledge from the Milesians to Feyerabend and Kuhn. Note the major developments discussed in this chapter on the line.
2. Now, go beyond the material given in this chapter and fill in any extra ideas and philosophers you feel are also important. Try to justify why their contributions are important.
3. Finally, place at the appropriate points on the timeline important discoveries and theories such as those made by Copernicus, Galileo, Newton and Einstein (and others you feel are important). Can you make any link between the prevailing opinion on scientific knowledge at the time, and the nature of the discovery?
4. Write down a set of typical 'scientific' study topics related to your own research area. What are the factors that make them scientific? What would be the best way to study these topics?
5. Is your supervisor (or potential supervisor) likely to be an advocate of the scientific approach or not? Write 500 words justifying why or why not. One good starting point might be to look at their previous work (e.g. journal articles).
6. Go to the gym. It is not good for you to read books all day!