Chapter 1

What is Behavioural Science?

LEARNING OBJECTIVES

When you have read this chapter you should be able to explain:

• the alternative pathways to arriving at knowledge and their associated limitations;
• how the scientific method attempts to overcome the difficulties involved in knowing what is true;
• what the main characteristics of the scientific approach are; and
• how the scientific approach is applied to the study of human behaviour.

INTRODUCTION

At the start of the third millennium it is a generally accepted fact that all the matter in the universe, including our own bodies, is made up of 105 basic elements such as carbon, nitrogen and oxygen. Within the human body as in all living things the elements form molecules which are built up into different kinds of cells. There are many different kinds of cells corresponding to the different kinds of tissue in the body such as skin, bone and brain tissue. It is accepted that the brain is a very complex organ comprising billions of cells known as neurones intricately linked up together in a complex network. It is this organ that physically controls our behaviour – everything from our breathing to our personalities, learning and memories. In the chapters that follow we will explore the factors that influence the brain so as to produce the individual pattern of behaviour that we witness in each person.
Our current understanding of matter in general, the human brain and human behaviour was not shared by the majority of people throughout history. Learned scholars proposed what became widely accepted views of human behaviour that to us now seem ridiculous. Aristotle (384-322 BC), a Greek scholar who influenced the whole of western philosophy, believed that the function of the brain was only to cool down the blood. The heart was the seat of the human soul and responsible for human behaviour. We still talk about people being soft-hearted or hard-hearted, though we know that the heart has nothing to do with how people behave.

Another great Greek scholar, Hippocrates (c.460-370 BC), explained that human personality was a function of the makeup of one's body. He, together with other learned men of his time, believed that the body was made up of four substances: blood; bile; black bile; and phlegm. The substances, or as they were known, were understood to exist in differing proportions in different people. The one that dominated, according to Hippocrates, dictated one's personality type. Those high on blood were held to be hopeful, optimistic types, those high on phlegm, slow and apathetic. A predominance of bile produced an ill-tempered individual and a high level of black bile resulted in depression and fearfulness. This view of the human body and its effect on human personality endured right up to the seventeenth century.

The issue of interest to us in this chapter is how did we eventually come to discover that such ideas were totally in error? How have we come to know what we now know? What makes the information expressed in this textbook any different to the views of Aristotle and Hippocrates, doubtless men of far greater intellect in their day than the present author? The answer lies within an understanding of science.

To most people 'science' is a thoroughly familiar word. It is impossible to progress through the school system without significant exposure to subjects that are all part of this concept called 'science'. Physics, chemistry and biology will immediately come to mind. Indeed, you may well have been left with the impression that science is a kind of collective term to describe the study of those three subjects because that is what 'science'
in school largely deals with. This, however, is not an accurate picture. The term ‘science’ does not refer to the subject matter being studied at all. It refers instead to the way it is studied or investigated, to the way knowledge about any particular subject is obtained.

Physics, chemistry and biology are just three areas to which a common method called ‘science’ is applied to uncover knowledge. In physics, for example, this method is used to discover how the universe was created and what laws govern the matter of which it consists. In biology it is used to explain the makeup and functioning of living organisms. This same method can be used to explore almost any topic of interest, from UFOs to how economies function. Of more direct interest to us here, it can be used to explore human nature and human behaviour.

Behavioural science is the use of the scientific method to understand human behaviour. To appreciate what this means it is necessary to understand what the scientific method involves and how it works. Firstly, however, you will need to grasp what problem the scientific method is designed to overcome. Put simply, it is the problem that has faced humankind from its primeval origins on the plains of Africa: how to know what is true from what is false; and how to know, for example, whether Hippocrates’ theory of personality is correct.

**SOURCES OF KNOWLEDGE**

If you think for a moment about how you ‘know’ anything is true, you will find that you rely on a limited number of sources of information.

Sources of information can be described as falling under the following three headings:

**Personal experience channelled through your five senses** – e.g. you can see that a person is behaving angrily or that the sun is shining.

**Reputable reports or authoritative sources** – reports by others, whom you trust, that something is true, e.g. your doctor tells you that you have an inflamed appendix, your lecturer tells you that personality is partly inherited through the genes or you read in the newspaper that five people died in a fire in Dublin.
Logical thought – putting together information you already have in a new way to arrive at a fresh piece of knowledge. For example, if you accept that personality is partly a product of genetic inheritance and that identical twins have exactly the same genes while fraternal twins share on average only 50 per cent of their genes, it should logically follow that identical twins can be expected to have more similar personalities than fraternal twins (see Chapter 6 for a discussion of this example).

If you discount divine, magical or supernatural inspiration (see Box 1.1 below), these are the only three routes to finding out what is true about any topic. You experience it yourself, you are told it by someone else or you can work it out from information you already have.

**BOX 1.1**

**DIVINE, MAGICAL OR SUPERNATURAL INSPIRATION**

For most of human history in all parts of the world divine or magical inspiration was an unquestioned route to knowledge. It was assumed that certain chosen individuals, variously called shamens, druids, oracles or religious teachers, had direct links with the supernatural where it was assumed true knowledge resided. Ordinary folk depended on them not just for knowledge of the afterlife but for information on everyday material issues. When will the rains come? What causes thunder and lightning? When is a good time to wage war? How will my illness be cured? Those were the kinds of questions which could only be answered by such special members of the community, by those who could tap into a great fount of knowledge beyond normal human access.

What is the status today of this historically well-trodden path to ‘knowledge’? Do so many people read their horoscopes or seek the advice of fortune-tellers about their futures just to poke fun at those quaint relics of our pre-scientific, superstitious past? Not so. A straw poll among your friends or classmates will doubtless reveal that there is a widespread lingering conviction that ‘mystics’ may know more than the ordinary mortal.
From a scientific standpoint should we dismiss all claims to magical or supernatural insight as nonsense and the work of crackpots and charlatans? It is tempting to do so and in the vast majority of cases we would be right. A true application of the scientific method, however, demands that we keep an open mind but subject such claims to rigorous scrutiny.

Even a superficial scrutiny will reveal the hollowness of most supernatural ‘insights’. However, it is not beyond the bounds of possibility that certain humans possess unusual and as yet unexplained powers. Whether any individual does or does not possess a peculiar route to knowledge is amenable to being tested. Even if such powers are demonstrated and have no explanation known to science, it does not follow that we must accept them as supernatural. Just as dogs can detect smells and sights entirely outside the scope of the human senses, it may be the case that some individuals have special sensory capacities, which in time may be fully understood.

Indeed, evidence from the field of cognitive psychology (see Chapter 3) suggests that we all have abilities of which we are largely unconscious. In the past it has often been suggested that powers of intuition (knowing things without any obvious source of knowledge) in individuals have some kind of supernatural basis. Psychologists now suspect that intuition may be due to the fact that much of our information processing is unconscious. They have even been able to demonstrate experimentally that people can act on visual information presented for such a brief period that they have no awareness of having seen anything (see Claxton, 1998, for a brief review of relevant research).

What once seemed supernatural may, with adequate scientific scrutiny, be shown to be natural enough, though none the less fascinating for that.

THE PROBLEM OF RELIABLE KNOWLEDGE

Each of the three approaches to discovering accurate information described above has its own in-built flaws or problems. Let's consider each in turn:
Personal experience – There are a number of reasons why one’s own experience is a limited and unreliable route to knowledge. Firstly, our system for processing information is highly selective in what it brings to our notice. We are much more likely, for example, to notice things that stand out in some way. Changes in lighting or colour, movement and unusual shapes capture our attention (see Folk, Remington and Wright, 1994). Conversely, we are likely to remain unaware of a great many other sights and sounds, which were available to be seen and heard, simply because we cannot process a great deal of information at the one time. A further problem with information detected through the senses is that we build up an understanding of what we have seen, heard etc., that is significantly based on our existing knowledge, needs and expectations (e.g. Hastorf and Cantrill, 1954). Hastorf and Cantril asked students from two schools to watch a video of a football match between their school teams and to record the number of fouls committed by members of each team. Both groups of students detected more fouls committed by the opposing side. Their partisanship dictated what they actually noticed. The processes of selection and organisation inherent in our perception system will be discussed in more detail in Chapter 3.

Then there is the problem of memory. Any knowledge that we obtain through our senses is necessarily a memory of what we have experienced. Memory, as we all know when studying for exams, deteriorates over time. You may have witnessed five raiders entering a bank but months later, when asked in court for the number, you may have forgotten and say there were four or six. Court cases frequently reveal serious mistakes and misidentifications in eyewitness reports (see: Wells, 1993; Cutler and Penrod, 1995). Part of the eyewitness accuracy problem has to do with the selective and constructive way humans initially perceive information, as discussed in the last paragraph. The problem also derives from the way in which memory operates. Researchers have demonstrated that our memories are affected by later information. Memories from different occasions may become conflated or suggestions after the event may take on the dimensions of actual memories (see: Loftus, 1979; Loftus and Hoffman, 1989).

A further problem with personal experience is that it confines one to a limited sample of events that may be unrepresentative. If I were to visit
Paris on three occasions and each time it was raining heavily, I might come away with the conviction that it has a particularly wet climate – which would be wrong. If one’s total knowledge of Limerick City was derived from either the feature film or the novel, *Angela’s Ashes* (McCourt, 1996), imagine how inaccurate a picture of contemporary Limerick would result.

In many areas where each of us has personal experience, our sample of the total picture is very limited. The laws of probability, therefore, dictate that we are likely to be presented with an unrepresentative impression. Finally, to add to all those basic flaws, just discussed, there is the following obvious limitation of gaining information through one’s senses: it limits you to knowledge that you have had the opportunity to witness. The whole of history and much of the world would remain unknown if we had to rely for knowledge solely on our experience.

**Reputable reports or authoritative sources** – Throughout history most people have relied mainly on this source of knowledge, whether the reports of what was true came from one’s parents, from wise elders, from religious leaders, from journalists or from scientists. The big problem concerns how to know if a source is trustworthy – that it knows and is willing to tell you what the truth is. Generally, leaps of faith were made in regard to authoritative sources. Religious leaders or those supposed to have supernatural powers were heavily relied on for knowledge. When the Christian Church taught that the earth was flat and at the centre of the universe, it was taken to be the truth. People accepted that the church was an authoritative source. Now we know that all this was wrong, as was a great deal of what was said by authoritative sources in the past (see Box 1.2 below for a discussion on the relationship between science and religion). Yet we still rely heavily on authoritative sources. If I have a headache, I may take a paracetamol or an aspirin tablet. Its manufacturers advertise that it will relieve pain and cause no harm in the process. How am I to know that this latter claim is true, that paracetamol or aspirin are indeed harmless substances to take?

I may suspect that watching a lot of violent TV causes a child to act more violently in the playground. But how am I to know for sure? Who can I trust to tell me and how did he/she establish the truth in the first
place? This is where science comes in. Science is a method (or more properly a collection of methods) developed and refined over time to solve the problem of how we can decide whom to trust. How it works will be described in simple terms later in this chapter.

Logical thought – In classical Greece this was thought to be a superior pathway to knowledge, somehow purer and less tainted than personal experience. Yet, quite obviously it is dogged by the problems of the other two approaches. To work anything out logically one must begin with some information from which to draw inferences. Anything worked out logically from available information will only be true if the information on which it is based is true. That clearly brings us back to the problems associated with personal experience and reputable reports.

BOX 1.2

ARE RELIGION AND SCIENCE COMPATIBLE?
In the US the ancient battle lines between science and religion are drawn up once again. Perhaps they have never been stood down in some parts. In 1632 in Italy the issue was whether or not the earth lay at the centre of the universe. Following careful astronomical observation, Galileo published the view that it was not. He was forced by the Inquisition to retract. The Church held that his views were heretical. In 1999, in Kansas, the issue was whether life evolved over millions of years or was created in six days as stated in Genesis. The Kansas Board of Education, under pressure from religious fundamentalists, did not go so far as to ban the teaching of Darwin’s Theory of Evolution but did declare it not to be examinable information in schools in the state. Kansas is the latest of several states to curtail in some way the teaching of evolution as an explanation for life on earth.

If Darwin, as most scientists hold, was correct, does it follow that the Bible was wrong on this most fundamental of all issues? If humans evolved from lower organisms, where is the need for God and why should anyone pay any attention to the Bible? Most devout Christians do not take the Bible literally. They see it as more of a
parable. The Genesis story is a simple timeless way of putting across
the general idea that there is a Divine author of all reality. How the
material world unfolds and to what plan is unknowable to mortals.
The key teachings of the Bible do not concern explanations for
material reality, which is the province of science, but rather matters
of morality or right and wrong, areas that are not the direct concern
of scientific exploration.

Does it follow then that science can tell us nothing about moral-
ity, about what actions are right or wrong? Not entirely. While
science cannot decide the basis on which we declare an action to be
right or wrong, once the criteria for the morality of an act is agreed
on religious or philosophical grounds, it can tell us whether the action
meets those criteria. A widely accepted criterion (though by no
means the only one) for defining any given action as ‘right’ or ‘wrong’
is whether it harms or injures those affected by the action. The sci-
entific method can easily be harnessed in this context. Take, for
example, the controversy over human cloning. Behavioural, medical
and biological scientists can attempt to predict the consequences for
the health, life expectancy and quality of life of the product of a
human cloning in a given set of circumstances. If it were to be shown
that a human clone might reasonably expect to suffer serious adverse
psychological consequences – say through feeling himself or herself to
be a ‘freak’ – then the morality of human cloning could be questioned
on a scientific basis.

A further problem is that not everyone is terribly good at using logic. It is
quite common for individuals to draw conclusions from information that
do not stand the test of logic. Prejudices are a good example of this. Racist
individuals when faced even with lots of real live members of the disliked
race, who evidently are quite nice persons, commonly do not revise their
view of the race (see Kunda and Oleson, 1997). They simply, without any
particular evidence, assume that the cases they have met are unrepresen-
tative. Another example of where people commonly fail in their use of
logic is to assume that the first or the most obvious conclusion drawn from
the available information must be the truth. Whether a conclusion is obvious to any individual is to a large extent based on assumptions applied to that situation, assumptions that may or may not be true.

A striking study carried out by Rosenhan (1973) revealed the extent to which normal assumptions can lead even highly trained professionals into serious error. Rosenhan and a number of colleagues showed up at psychiatric hospitals complaining of hearing voices. They were all admitted and in the main diagnosed as having schizophrenia. After admission they made no further effort to seem in any way abnormal. Yet staff saw ample evidence of abnormal behaviour. As part of their research into how psychiatric patients are treated they all kept diaries. This was interpreted as abnormal behaviour. Simply, it never occurred to the staff that ordinary psychiatric patients would keep detailed diaries for some useful purpose. This was, therefore, further evidence of abnormality fitting in with the diagnosis already made.

All of us are severely limited in what we can find out through personal experience (and even then our perception and memory of what we experience is highly unreliable). We are also frequently limited in our logical powers. As a result, we constantly rely on others to give us the knowledge to make all kinds of important decisions. We need to have some way of knowing when to trust a source. That is the intended contribution of science.

HOW SCIENCE WORKS

In simple terms, science is a collection of methods and approaches designed to establish with as much confidence as possible what is true about any subject. It relies heavily on rigorous cross-checking of work. The saying that 'two heads are better than one' is true, only much more so, of science. In science, it is 'many heads are better than one'. In the practice of science there are a variety of detailed procedures for investigating any question. They are called 'research designs'. The most powerful of these is called the 'experiment'. Research designs and experiments will be discussed in more detail in Chapter 2. The objective of the precise procedures or research designs is to make it clear to all how the scientist came to the conclusions he or she arrived at after investigating a subject.
Even then, the work of one scientist is never trusted. It must be carefully analysed and even repeated or ‘replicated’ by others to see if there are any flaws in the methods and to see if the same results emerge again.

While science has roots in western civilisation dating back over 2000 years, it is only in the last few centuries that it has taken on anything like its current status as a route to knowledge. A brief overview of the development of science is given in Box 1.3 below.

Let’s look now in some more detail at what makes science work – what its essential characteristics are. Remember, it is a method that can be applied to almost any subject. On this course we are concerned with its application to human behaviour.

THE CHARACTERISTICS OF SCIENCE

Specialisation – There is simply so great a volume of information that no scientist, no human, could be expert in anything other than a very narrow field. If scientists did not specialise, no progress would be made, as they would spend all their time trying to gain a grasp on existing knowledge and would have no time to explore anything new. Nowadays, different areas of scientific enquiry are highly specialised because of this. A scientist who specialises in biology will normally specialise in some very precise area within that field such as the study of a particular species of fresh-water snail or a particular type of bacterium. A psychologist will not study human behaviour in general but will specialise in an area like human memory or the behaviour of humans in small groups.

A large and widespread community of experts – If every scientist deals with only a narrow area of study, it is essential that there are lots of scientists to study related areas so that a bigger picture can be built up. It is essential also that there are sufficient experts in individual areas to cross-check and replicate each other’s work. This greatly helps to prevent errors from going unnoticed. It also prevents fraud. Unfortunately, both individual scientists and institutions have in the past attempted to mislead the public about important matters. Would you trust a pharmaceutical company to tell you about the risks and side effects of a drug, if there were no way of checking the truth of what they said?
You can probably appreciate now why a large number of experts in each area is desirable – but why widespread? This is to ensure that under all circumstances there are experts in each field who are free to tell the truth. Imagine if all the experts on the study of intelligence were resident in Nazi Germany during the 1930s. They would not have been free to publish any research which disagreed with the government’s view that certain races such as Jews and Slavs were intellectually inferior. If all the experts were in Germany there would have been no one of scientific standing to say that this was rubbish.

It is easy to imagine a similar situation if all the world experts in a field, say nuclear energy, were employed by the same employer or even industry – the nuclear power industry. The public would be right to feel sceptical about what they said about the safety of nuclear power. The important thing is that scientists who are free from pressure should always exist, so that they can publish what they believe to be the truth. Even the most honest scientist may be a bit reticent in criticising the work of a friend or work colleague. Those who are far apart and with no personal relationships are likely to be less inhibited in speaking out. In this way, where criticism is merited, it will emerge.

A communication system – You will have noticed that a ‘community’ of experts was referred to above. A community is only a community if there is some facility for communication among the members. We normally think of communities as living closely together and meeting each other regularly. However communication need not be face to face. It can be over the telephone, through the internet, etc. The most important vehicle for communication among scientists is through publications. Having carried out their research, scientists have available to them specialist journals in which to publish the details of their work and findings. These journals are available to other experts in the field world-wide, who can then examine, criticise or replicate the work, publishing their views and findings in turn. Scientists also communicate through conferences where they meet and discuss their work in detail and, of course, through the internet, on the telephone, face-to-face and so on. Clearly, if scientists were not able to communicate easily with each other they would be greatly hampered by not being able to avail of the insights and discoveries made by others.
In addition, it would not be possible for scientists to critically appraise each other's work. Errors and downright attempts to mislead would go undetected. Science as we know it would come to a halt.

**Conventions of scientific behaviour** – Conventions are unwritten rules. All scientists develop an understanding of what it is to behave in a scientific way. It is not all that easy to explain in a complete sense what this involves, but the list of conventions which follow make up the principal features of scientific behaviour. Taken together, they add up to a recipe for ensuring that whatever is studied is examined in a highly systematic way, that the findings and how they are arrived at are clear to those who have expertise in that area and that it is possible for others to check if the findings and conclusions are correct.

**CONVENTIONS OF SCIENTIFIC BEHAVIOUR**

**Systematic observation and measurement of variables** – Ordinary individuals who are interested in human behaviour may pay more attention than average to what they can see or hear other people doing as they go about their day to day business. In this way they may build up impressions of how others behave. If they happen to work in a shop they might notice that shoppers tend to take the first few steps inside the door quite quickly without looking around them and then slow down and begin to examine the goods on display. This may suggest that it is better not to display goods too close to the door. We all make observations like these. Scientists cannot depend on this kind of random observation. They need to establish if such observations hold true generally or only under certain conditions.

Scientists also need to quantify any effects – how many steps are taken quickly before the shopper slows down? To establish the facts in this kind of detail requires a systematic approach to observing whatever variables are of interest. **Variables**, incidentally, are simply any characteristics that vary or change from person to person, time to time or place to place. Behavioural scientists observe a great many human variables like personality, motivation, intelligence, behaviour in particular situations and so on. Any characteristic of humans that never varies – if such exists – is hardly of interest to study.
‘Systematic observation’ means the observation of variables of interest under precisely defined and perhaps even controlled circumstances. Following the shopping behaviour example mentioned above, before a behavioural scientist could draw conclusions that shoppers take a number of steps inside the shop door before they slow down, the conclusion would have to be based on, say, video evidence of a great many shoppers in a wide variety of shops. Simple casual observation in one or two settings would not be enough. One or two persons’ impressions are not sufficient.

BOX 1.3

THE HISTORY OF SCIENCE

The origins of science can be traced back to classical Greece during the 5th and 6th centuries BC. The teachings of philosophers such as Thales, Empedocles, Pythagoras, Zeno, Hippocrates and the more famous Plato and Aristotle from this era form the logical foundations of scientific thought. Their contribution was mainly to break with the tradition of invoking magical and mythological causes to explain natural effects and to look to nature itself for understanding; an approach essential to the development of science.

After the decline of the Grecian civilisation, the impetus towards modern science offered by the classical philosophers stalled almost entirely for a whole millennium. For the most part European civilisation, such as it was, reverted to a religion- and superstition-dominated view of the world, frequently hostile towards any reflection on natural causes and effects.

The 12th and 13th centuries saw a rebirth in learning and interest in scientific issues. This was in part due to contact with the Islamic world, which had kept alive some residue of classical insights, and partly due to the development of urban centres with well-off, literate upper-classes. In the 13th century universities were founded throughout Europe. Scientific thinking was still, however, very seriously confused with religious and superstitious concepts. Learned men thought of all understanding as emanating from God and all events as having an ultimately divine or demonic origin.
The break with a religion-dominated world view took place in the 17th century during what became known as the Scientific Revolution. The key development was the conviction that science should be based on the search for natural causes and consequences and not on an exploration of the Divine Will. An English scholar, John Locke (1632-1704), initiated a widely popular philosophical system known as empiricism, which emphasised observation and experience as the route to knowledge. This was the essential intellectual underpinning of science as a method. Among the notable scientific figures from this period were Galileo (1564-1642) in Italy, Francis Bacon (1561-1626), an English philosopher and statesman, and, most notable of all, Isaac Newton, English mathematician, astronomer and physicist (1643-1727).

The ideas of Locke and the discoveries of Newton were seized on by a group of French writers known as the Philosophes, the best known of whom were Voltaire (1694-1778) and Diderot (1713-1784). They popularised throughout Europe the idea that knowledge was to be obtained through observation and critical rational thought and rejected all religious and superstitious explanations for reality. This movement became known as the Enlightenment and was particularly important for the development of a scientific approach towards human behaviour in all its forms.

Though not without setbacks, the scientific approach gradually took on prestige and received a great deal of state and royal patronage throughout Europe. Societies to bring scientists together, to aid the advancement of science and to disseminate its discoveries were founded, firstly in Britain and France and later in other countries. This marked the first recognition of science as a collective endeavour, a key feature of its modern success. Previously and indeed in the main up to the 19th century, science tended to be practised in isolation by well-off amateurs of great ability. Growth in the body of existing knowledge necessitated an increased specialisation on the part of practitioners which in turn required a system to co-ordinate their efforts.

In the 19th century there was a growing democratisation and urbanisation of society throughout Europe, trends that favoured
scientific exploration. The practice of science became more specialised and professionalised with the growth of a sophisticated university system and a well-developed network of journals and other publications facilitating communication among scientists. Charles Darwin (1809-1882) moved biology to the forefront of research with the publication of his theory of evolution in 1859. The application of the scientific approach to human behaviour followed in the late decades of the 19th century. The history of scientific psychology, for example, is usually traced back to the establishment by Wilhelm Wundt in 1879 of a laboratory at the University of Leipzig in Germany for the experimental study of human behaviour.

In the 20th century the main changes were not in the nature of scientific enquiry but in its scale and in its status. In simple terms, the amount of money devoted to science, the number of professional scientists and the number and variety of institutions involved in scientific research grew enormously. The US, particularly after the influx of scientists in the 1930s and 1940s from Nazi Germany, became more and more important. Today, on account of its size and resources, it dominates in many fields of scientific enquiry, not least in the behavioural sciences.

The challenge facing science in the 21st century is how to decide what questions science should seek to answer and how to harness its power for the wellbeing of humanity as a whole. Developments in fields such as nuclear physics, and, more recently, biochemistry and genetics, have raised the spectre of science unleashing forces that may ultimately destroy our planet. The pressing questions are no longer about how to investigate but what to investigate and what to do with what we discover, questions that science alone can not answer. In many respects we are back once more to philosophy, from which science originally originated, to help us answer those most difficult but truly essential questions.

Measurement of variables involves their quantification. It is not enough for scientists to use vague terms like ‘often’ or ‘a lot’ or ‘seldom’. They
need to be quite precise and develop methods of measuring variables. In behavioural science this may be something as simple as a count of particular behaviours in a certain time period. A measure of the outward signs of stress shown by a public speaker might be drawn from a careful count of hand and body movements during the speech. Measurements may also be highly complex, such as intelligence and personality tests that are based on extensive research.

Use of research designs – Research designs are detailed plans for investigating and answering questions. A scientist does not launch into a piece of research. First a detailed plan is drawn up as to how best – given the available resources – to answer the question at hand. There are a number of standard designs commonly used by scientists such as experiments and surveys. These will be dealt with in greater detail in Chapter 2. For now it is enough to remember that a research design is a detailed plan of how the research is to be carried out.

Use of statistics – This refers to a branch of mathematics which is essential to research. All scientists need to summarise and make sense of their findings. Don’t forget that they will typically be measuring variables of one kind or another so they will end up with figures that need to be understood. Let’s say we were curious to find out if the typical IQ of males and females differ in this college. Because the overall IQ of males and females in the general population does not differ, we would expect to find no difference in the college population. Let’s say we measured the IQ of every student using a standard test and listed the IQ of all the males down one column and of the females down another; we would be left with two long lists to compare. Before we decided that there is no difference between males and females we would have to summarise the figures in some way to help compare them. The obvious thing to do is to get the ‘mean’ or ‘average’ of each – to add up each column of figures and divide by the number of figures in the column. A mean or average is a simple statistic – a simple formula or calculation that helps us to summarise and understand numerical information.

There are a great many other such formulas or procedures. Among the decisions statistics can help with are: (1) deciding if two groups differ on
some variable – more than you would expect by chance; and (2) deciding if variables are correlated – as one increases does the other increase or fall?

One very important contribution of statistics is in deciding whether the findings made in a particular piece of research are likely to happen by chance. If we return again to the IQ example mentioned above, it would be very time consuming and expensive to measure the IQ of every student in the college. Normally what scientists will do in such circumstances is take a random sample of the overall group of interest. This overall group they refer to as the ‘population’ of interest.

Clearly, the bigger a random sample is, the more likely it is to be representative of the population from which it is drawn. A random sample of three males and three females might happen to include one or two very unusual cases – say individuals with unusually high or low IQs. This could be very misleading. However if the sample were to be 100 males and 100 females, then the average of each should be more like the average of the overall population of students. Having chosen a sample and carried out the measurements, statistics can tell us if the findings are likely to have occurred by chance. Say, with the 100 randomly sampled male students and 100 randomly sampled female students, we found an average IQ difference of ten points between the sexes. Our statistics would almost certainly tell us that this difference is too big to be a chance outcome, whereas with an IQ difference of two points, we might be told that this difference is likely to occur by chance and we should put no faith in it.

Recording of methods and findings – Science thrives on a lack of trust. Nothing is taken for granted. When a piece of research is carried out and results produced, it must subsequently be possible for other scientists to know precisely how the work was done. They must know how the sample was obtained, how the variables were measured and so on. Ideally it should be possible for one researcher in a distant part of the world to read the research report of another and do the exact same piece of research with no detail changed except for the sample studied. Sometimes it may be possible to use the exact same sample.

Of course, if this is possible, it is also possible to find any errors or omissions in the original piece of research. If I read a piece of research which just said that ‘a random sample of 100 students at a particular college
was used’ I would not be satisfied, because I would need to be told how it was ensured that the sample was really random (i.e. every student at the college had the same chance of ending up in the sample) and not biased in some way. Let’s say the research report also stated the following: ‘a random sample of 100 students was obtained by asking for volunteers in the college canteen’. I would immediately detect a flaw in the research design. Students who volunteer may be unusual in some way – perhaps more outgoing or more interested in research, maybe even more intelligent than average. Furthermore, those who use the canteen may not be representative of the student population as a whole. Perhaps students who live away from home are more likely to visit the canteen. Only if the researcher records all the details of how the research is carried out is it possible to spot flaws like this. There is a duty on scientists to record in great detail every aspect of their research work.

**Publishing methods and findings** – It is not enough to record what was done, it is essential that it be published. In a world where every scientist had only the best interests of science at heart, every discovery would be published in full detail immediately. In that way others could use whatever breakthrough was made to further advance their work and to advance the overall knowledge of the subject. However, unfortunately, this is not always possible. Scientists have to concern themselves with funding for their research. A drug like Viagra, the world-wide selling drug launched by Pfizer in Ireland in 1998 for the cure of male sexual impotence, might have been developed long ago if the scientists working on it could have shared their knowledge with other experts elsewhere at every stage of its development. However, if this were done no organisation or corporation could ever patent and make a large profit from such a discovery. They would then have no motivation to invest the very large sums of money necessary to carry out the development. When we take account of the fact that in 1998 alone Pfizer’s Annual Report shows that it spent $2,594 million on research and development, one gets a sense of the money they need to recoup.

Scientists themselves also have a motivation to keep work secret. They wish to have the honour and the status of making some great discovery. Every scientist dreams of being a Pasteur, a Marie Curie or an
Albert Einstein. If they share too much too early, someone else may have the honour of making the big breakthrough. That was essentially the fate of Alfred Russel Wallace (1823-1913), who had arrived at the theory of evolution at the same time and perhaps before Charles Darwin. Uninterested in fame, he passed on his findings to Darwin. Darwin became a household name after he published his famous book, *On the Origin of Species by Means of Natural Selection* (Darwin, 1859) and Wallace faded into obscurity.

Nevertheless, if scientists did not regularly share their work by publishing it in a detailed form, the progress of knowledge would be seriously hindered. Teams of individuals would be doing the exact same work in different parts of the world. Far better to know about each other’s work so as not to waste time reinventing the wheel. At the end of the day, all important findings and how they were found must be published so their accuracy can be established. It is more a matter of when to publish rather than whether.

**Critical evaluation and replication** – As suggested above, science thrives on scepticism. It is the duty of those who practice it to always retain a questioning mind. Every flaw must be rooted out, every error uncovered. In this way, the process is almost the opposite of normal human relations. If in our daily lives, we spent our energies finding fault with the work of others we would have no friends and nobody would work with us. Yet this is exactly what scientists must do. They do it in the pages of scientific journals – very publicly. Naturally, egos get bruised and feelings hurt, but that is far better than mistakes going undetected. In a thousand different ways in our daily lives, we rely on this critical eye which experts cast on each other’s work. We rely on it to know that the food we eat is safe, the air we breath is unpolluted, the medicines we take do their job, the houses we live in will not fall down and so on. One person can easily err or even seek to cover up or mislead. Hundreds or thousands of experts are not so likely to miss something important. Small groups who work together might be too loyal to each other to engage in very public criticism. Through publications the opportunity is given to experts world-wide to critically evaluate research. In this way personal loyalties, collusion and the like should not be a problem.
Having said all that, nothing human is perfect. Scientists have, in the past, fallen below acceptable standards of critical analysis. Sometimes the views of renowned experts are taken as gospel when they are in error (see Box 1.4 below) and the views of unknown scientists dismissed when they are correct. The latter is especially true when something very unusual or unexpected is being suggested. In 1982 a young medical researcher from Australia called Barry Marshall proposed just such an unexpected idea. He provided convincing evidence that, contrary to long prevailing medical wisdom, stomach ulcers were not primarily caused by stress and poor diet but by infection with a bacterium called *H. pylori* (Reville, 1998). He and another scientist called Robin Warren had isolated the bacterium from the stomach tissue of ulcer victims. Marshall had then deliberately infected himself with the bacteria, which caused him acute stomach inflammation, nausea and vomiting. At this point he cured himself completely with antibiotic drugs. Soon it became clear that even long term chronic ulcer sufferers could be cured in the same way. Despite this major discovery, several years later there remained a great many doctors around the world who continued to treat ulcers in the old, less successful, way. So radical was the shift in thinking required that it took many medical practitioners a long time to be convinced, despite the scientific evidence.

While critical evaluation is essential to science, replication is just as important. No discovery is taken to be ‘for real’ until the research has been replicated a number of times. This means doing the research again and again to see if the same findings are obtained. In 1989 two scientists at the University of Utah, Stanley Pons and Martin Fleischmann, caused a major stir when they claimed in a highly publicised press conference to have successfully carried out a process known as ‘cold fusion’ (Close, 1991). Fusion involves the joining together of atoms – which if it were carried out would release enormous amounts of energy without any radiation. This would represent a safe and infinite source of power for the world, a tremendously exciting prospect. It is the opposite of fission – the splitting of atoms – from which nuclear energy now comes. Physicists had always believed that fusion could only happen if the temperature was enormously high – something like the heat at the core of a nuclear explosion. The difficulty lies in controlling such heat. No practical method has been found.
Pons and Fleischmann claimed to have demonstrated fusion in an ordinary test tube at ordinary temperatures. Enormous international publicity followed. Immediately, teams of excited, if somewhat incredulous, scientists around the world set out to replicate their experiment. It was at this point that the wheels began to come off the ‘cold fusion’ wagon. Scientists at some of the best equipped research institutions in the world, such as the Harwell laboratories in Britain, failed entirely to show any evidence of the remarkable effects described by Pons and Fleischmann. The findings could not be replicated with any degree of reliability. Gradually the whole episode faded from popular consciousness. There are still scientists who claim to demonstrate evidence of cold fusion but their claims are hotly contested by other experts as based on misinterpretation of data or sloppy research design (Kestenbaum, 1997).

In one way the cold fusion affair represents the normal process of science. A piece of research is carried out and a discovery claimed. The methods and findings are made known to the broader scientific community. Other scientists critically evaluate and attempt to replicate the research. If the research approach is sound and findings are reliably replicable, credence is lent to the original discovery. If faults are found in the research or others fail to replicate the results, doubt is cast on the value of the ‘discovery’. Where the cold fusion affair differs from the norm is that the cart was put before the horse. The international publicity preceded the process of critical evaluation and replication. In the words of one scientific commentator, writing in New Scientist:

‘The general public assumes that when researchers claim to have made a major discovery it has been thoroughly and carefully researched. Parts of the test-tube fusion episode failed sadly on this score.’

(Close, 1991)

The principal area in which it failed was that Pons and Fleischmann held a press conference to announce their discovery before the critical evaluation and replication phase. This caused the international press to treat their announcement as if it were already a fact and not an unreplicated experimental finding in one laboratory. It was really a case of the press
and public failing to understand how science works. But why had Pons and Fleischmann taken such a risk in going public before their findings had been checked in the normal way? The answer lies in what they had to gain. By going public when they did, if their discovery had indeed been real, they would have guaranteed that their names would have been ever after synonymous with one of the most important scientific breakthroughs of all time – a means of harnessing a safe, cheap and limitless energy supply.

We should never forget that scientists are just as human as everyone else.

**SCIENTIFIC PROOF**

Research is at the core of all the sciences, including behavioural science. It is through research that information regarded as true or reliable is discovered. This is not to say that scientists are never wrong in what they say. They frequently are. There is an argument in science (Popper, 1986) that research can only prove something to be untrue or false: it can never fully prove something to be true. This is particularly so of general rules or laws about anything. It may be a generally accepted rule that all objects – big and small – in the universe are drawn towards each other by the force of gravity. It would only take a single observation of one object not being pulled by the force of gravity to disprove this law. No matter how long a general fact like this is taken to be true and no matter how many observations have shown it to be so, there may yet be some case waiting to be found which disproves the rule.

Only an infinite amount of observations can prove in an absolute sense the truth of any general statement. Since this is not possible, it can be said that no absolute proof of truth exists. (It is of interest that recently astronomers have had reason to doubt the truth of our understanding of gravity – observations of distant objects in the universe strongly suggest that gravity may also push apart as well as pull together objects, at least under certain circumstances.) Proof, in practice, amounts to a sufficient body of research findings leading to the scientific community being convinced beyond reasonable doubt that a particular theory is indeed true. Of course, even when the weight of evidence is very great there may still
be dissenters who remain for some reason unconvinced. There are still a small number of scientists largely associated with religious fundamentalism in the US who regard the core propositions of Darwin’s theory of evolution as unproven despite a wealth of supporting evidence, which has put the matter beyond doubt for the majority. In the words of Isaac Asimov:

‘… no reputable biologist feels any doubt about the validity of the evolutionary concept.’

(Asimov, 1987, p. 713)

BOX 1.4

THE CASE OF CYRIL BURT

On 24 October 1976 the Sunday Times in Britain published a dramatic article by a writer called Oliver Gillie entitled ‘Crucial Data Faked by Eminent Psychologist’. The psychologist in question, Sir Cyril Burt, who died at the ripe old age of 88 in 1971, had indeed been eminent. He was widely regarded as one of the leading British psychologists, if not the leading British psychologist, in the first half of the 20th century. His work demonstrating the inheritability of personality and intelligence was most influential and his findings were little questioned during his lifetime. How could such a pillar of academic pre-eminence and respectability be exposed as a fraud? What exactly had Oliver Gillie to report?

The first academic to openly question the honesty of Burt’s work was Leon Kamin, an American psychologist. He brought attention to the fact that during Burt’s retirement he had published two important articles, in 1955 and 1966, reporting what were highly improbable research findings when the two articles were looked at together (Kamin, 1974). Both articles reported studies he carried out (or said he carried out) on the relationship between the IQs of identical twins raised together and raised apart. The importance of such studies is that, since identical twins have identical genes, differences in their IQs cannot be due to inheritance but must be due to some aspect of their life experiences. If identical twins, who are raised apart (adopted
by different foster parents shortly after their births), still maintain
very high similarities in their IQs – as you would expect if IQ were an
inheritable characteristic – then it shows that life experience does
not have much influence on IQ and it is mainly down to inheritance
through the genes. This is precisely the finding that Burt claimed
from his two separate studies.

The odd thing that Kamin noted about his two studies is that Burt
did not simply report similar findings for each but reported mathematically and precisely the same findings. In one article he reported
findings from a study of 83 identical twins raised together and 21 pairs
raised apart. In the second article he reported results of a study on 95
identical twins raised together and 53 raised apart. In each of the two
studies the correlation (correlation refers to a statistical summary of
relationship between a number of pairs of figures – in this case twins’
IQ scores) for twins raised together was .944 and for those raised apart
was .771. The chances of getting identical findings such as this in two
separate studies with two separate groups of twin pairs is virtually nil.
Similar findings would be fine but exactly the same down to the third
place of the decimal in each case is simply not credible. Kamin
concluded that the figures must have been made up.

After Kamin had published his sensational claim the floodgates
opened and many psychologists came forward to cast doubt on the
scientific honesty of Burt’s work. Obvious flaws in his methods and
his analysis were pointed out. Efforts to discover the origin of his sam-
ples of identical twins proved fruitless. Even research assistants that
were supposed to have worked with him seemed never to have exist-
ed or at least could not be traced. In different articles Burt had made
contradictory claims about how many identical twins brought up in
separate homes he had been able to find and about how
common a phenomenon this is (Butler and Petrulis, 1999).

What Kamin had originally brought to the attention of the aca-
demic community, Gillie brought to the attention of the public at large.
The most respected of scientists had been unmasked as breaching the
cardinal rule of good science. He had invented research to bear out
his assumptions. He believed that intelligence was largely a geneti-
cally inherited human characteristic and in the absence of adequate
scientific proof he had set to inventing some. Why or how exactly Burt came to do this remains a mystery. In his defence he was getting old at the time and perhaps his faculties were deteriorating. Nobody will ever know for sure. A much more pressing question, however, is why the flaws in his publications, evident after his death, were not highlighted by psychologists while he was alive. Why had there been a widespread failure of the expected standards of critical evaluation by his peers? William Reville in his Science Today feature in the Irish Times on 27 November 1995 offered a disturbing answer to this question. ‘In science,’ he asserts, ‘if you are deemed to be an eminent researcher and your publications confirm existing popular theories, your work is accepted relatively uncritically’. This is a worrying possibility. For the protection of us all, science must not fall prey to this all too human error.

An ironic footnote to this saga is that Burt’s conclusions about the inheritability of IQ and personality have since been strongly supported by actual research – see Chapters 5 and 6.

THE BEHAVIOURAL SCIENCES

The main challenge in answering the question posed by the title of this chapter lay in understanding the concept of science. Now that this issue has been addressed in some detail the reader may be able to fully understand if we say that behavioural science is the application of the scientific approach to the understanding of human behaviour in all its forms.

In keeping with the general scientific trend of specialisation there is not one but several contributory behavioural sciences, the principle ones being psychology and sociology. The focus of psychology is on individual human behaviour and characteristics such as personality and intelligence. Sociology focuses on the behaviour of aggregates, groups or collections of individuals such as the urban working class, the population of late 20th century Ireland or the workers in a particular organisation. Other behavioural sciences include: anthropology (the study of technologically primitive societies); and linguistics (the study of language development). Economics is also taken to be a behavioural science in that it involves the
study of human behaviour in albeit a limited but crucial sphere of existence – that of production and consumption of material goods and services.

The behavioural sciences throw up a number of challenges to scientists, which, though shared to some degree with other areas of research, are particularly acute when carrying out research on human behaviour.

The first obvious issue is the thorny one of ethics, and the question of what actions are acceptable to carry out on humans for the purposes of research. There is general agreement that any actions likely to result in pain, stress or harm of any kind to the research participants have to be engaged in with great caution. A general rule of thumb is that any research involving any appreciable risk of enduring harm to participants cannot be justified. Another generally accepted rule is that where temporary pain or discomfort may result the participants should be aware of this and should not be under pressure at any point to continue against their wills. Adults, who for any reason may have a problem understanding or making decisions about what they are getting involved in, and, of course, children, require special protection.

The great problem thrown up by these ethical considerations is that it is in identifying the causes of long term harm to humans that behavioural sciences such as psychology and sociology can make one of their more valuable contributions to humanity. Does a lack of stimulation in early childhood result in a lowered intellect? Does regular exposure to violence on TV cause children to behave more aggressively? Does stress in the workplace result in diminished productivity? As we will see in Chapter 2, the only certain way to answer such questions involves carrying out experiments where these potentially harmful conditions are imposed on selected individuals. It is an ethical problem that prevents behavioural scientists from carrying out the precise pieces of research which would lead to the most valuable and convincing results. The ingenuity of behavioural scientists is particularly challenged to find alternative safer ways to answer research questions. It may also strike the reader when considering some of the research examples described in this text that some researchers have sailed very close to the wind in ethical terms in their desire to answer important questions.

Another major problem in the behavioural sciences is that human behaviour and responses to the environment are not only a function of being
human but are also impacted upon a great deal by environmental circumstances. The last three chapters of this book deal specifically with external circumstances: the groups, organisations and societies to which one belongs. Inevitably, the way we respond to the world is influenced by the way we were raised by our families which in turn reflects the culture of our own society. The problem this presents is that findings in one society may not hold true in another. The response of Irish workers, for example, may be very different to that of, say, Japanese or Brazilian workers to a particular style of management. This issue of cultural differences is raised at different points throughout this text. Indeed, significant cultural differences involving norms of behaviour and response to circumstances may exist within the one society. Rural people may differ in important ways from urban dwellers, women from men, old from young and middle class from working class, travellers from members of the settled community. All of this makes generalisations more problematic. The only solution is replication of research with differing samples of participants to establish if the findings hold true. This is another compelling reason for a large and widespread community of scientists.

Perhaps the most crucial difference between the behavioural and all other sciences is the fact that the subject matter of the former possesses insight and intelligence. Humans are not simply objects acted upon by outside forces but act in accordance with their own understanding of external events. Knowing why individuals behave as they do from their own standpoint, therefore, becomes as important as knowing the external circumstances that influence their behaviour. This leads many behavioural scientists to focus more on exploring through communication the personal perspectives of their subjects than on the measurement of objective behaviour. This contrast in approach will be discussed in Chapter 6 when the exploration of human personality is discussed. It is the contrast that lies between quantitative research approaches and qualitative research, which is discussed in Chapter 2. The challenge facing behavioural scientists is to rely as little as possible on subjective interpretation when exploring human behaviour and yet not leave the personal perspective or phenomenology of the individual, which is at the heart of the human state, off limits to research scrutiny.

In Chapter 2 the challenges involved in research methodology will be explored in greater detail.
SUMMARY

One of the great challenges that has always faced humankind is how to distinguish what is true from what is false or what is established from what is just a theory.

The challenge arises from the flaws inherent in the limited routes to knowledge, which we all possess. We must discover what we know through our own experience, through logical deduction or from the reports of others in whom we place our trust. Our own experience is hampered by the fact that it can allow us to gain information of events only when we are personally present. Even then it has been amply demonstrated that the way in which humans process and remember information results in a great deal of error. Logical thought suffers from twin deficiencies. On the one hand, the conclusions reached can not be correct unless the premises from which they have been drawn are correct, simply moving the problem back a stage. On the other hand, the use of logical thought is an intellectual skill at which by no means everyone is proficient. As regards accepting the reports of others, the immediate problem presenting is how to decide whom to believe. What is to stop the source from lying or being in error?

In reality we are largely dependent on this latter source, the word of others, for most important information about the world. The function of science is to furnish us with a means by which we can place our confidence in certain sources of information knowing that the information has been arrived at in a manner that minimises the possibility of error. Behavioural science is the application of the scientific approach to gaining knowledge about human behaviour.

Science consists of a series of methods involving agreed conventions as to how information is to be established and rigorously cross-checked by many experts. Science may be described as having the following characteristics: specialisation by individuals in relatively narrow areas of study, the existence of a large and widespread community of individuals studying each area, a system of world-wide communication among scientists and a common adherence to a set of principles of scientific behaviour. Specialisation is necessary to ensure the development of expertise in a world where the amount of established knowledge is enormous.
A large and widespread community of experts with a world-wide communication system ensures complementary and cumulative work. It also ensures the existence of experts willing and in a position to criticise and identify the flaws in the work of others. Operating within a framework of behavioural conventions guarantees accuracy and accountability in relation to scientific work.

The conventions of scientific behaviour may be summarised as follows: an emphasis on systematically observing and measuring variables of interest, the use of research designs, the application of statistical methods to interpret findings, careful and comprehensive recording of methodology and results, willing communication of the detail of one’s work to other scientists through publications and the critical appraisal and replication of the work of others. Through this approach, while one or even many scientists may fall into error, there should always be others in a position to identify their mistakes. Equally importantly, this approach maximises the cumulative impact of scientists operating in many different parts of the world so that there is no reinvention of the wheel.

Behavioural science involves the application of the scientific approach to the understanding of human behaviour in all its forms. Research, which is at the core of science, presents certain particularly acute challenges to behavioural scientists. There are serious ethical considerations involved in carrying out research on human beings. Research which may in any way harm or hurt a participant has to be questioned in terms of its morality. This acts as a major obstacle to the exploration of important factors that are harmful to individuals. Another problem in conducting research on humans has to do with the great variability in human circumstances. Findings based on studies carried out in one culture or society may not apply to differing cultures and societies. There is a particular onus, therefore, on behavioural scientists to carry out cross-cultural studies to establish the generalisability of findings. Probably the greatest challenge of all facing scientists in the study of human behaviour is that humans are intelligent creatures who act in accordance with their own personal interpretations of external events. Behavioural scientists must, therefore, try to maintain objectivity while at the same time exploring the unique subjective insights of those they study.
Science can and does result in errors. It is not perfect. Indeed, a perfectly logical case has been advanced that it can only ever prove something to be wrong, never that a rule is true in all circumstances. If even one accurate observation runs contrary to a rule, then that rule must be found false. No amount of observations can absolutely prove a rule to be true. Science cannot furnish us with absolute truths. That said, it is the best approach developed by human kind to provide information which, as a matter of probability, is likely to be correct.

REVIEW QUESTIONS

1. Referring to the problems that exist in arriving at trustworthy information, explain the contribution of science to humankind.
2. Describe the characteristics of science and the conventions of scientific behaviour, emphasising their contribution to establishing accurate knowledge.
3. Discuss the unique problems facing scientists who study the behaviour of human beings.
4. Explain:
   (a) the three approaches to obtaining knowledge;
   (b) how science contributes to the solution of the problems associated with those approaches.

REFERENCES


