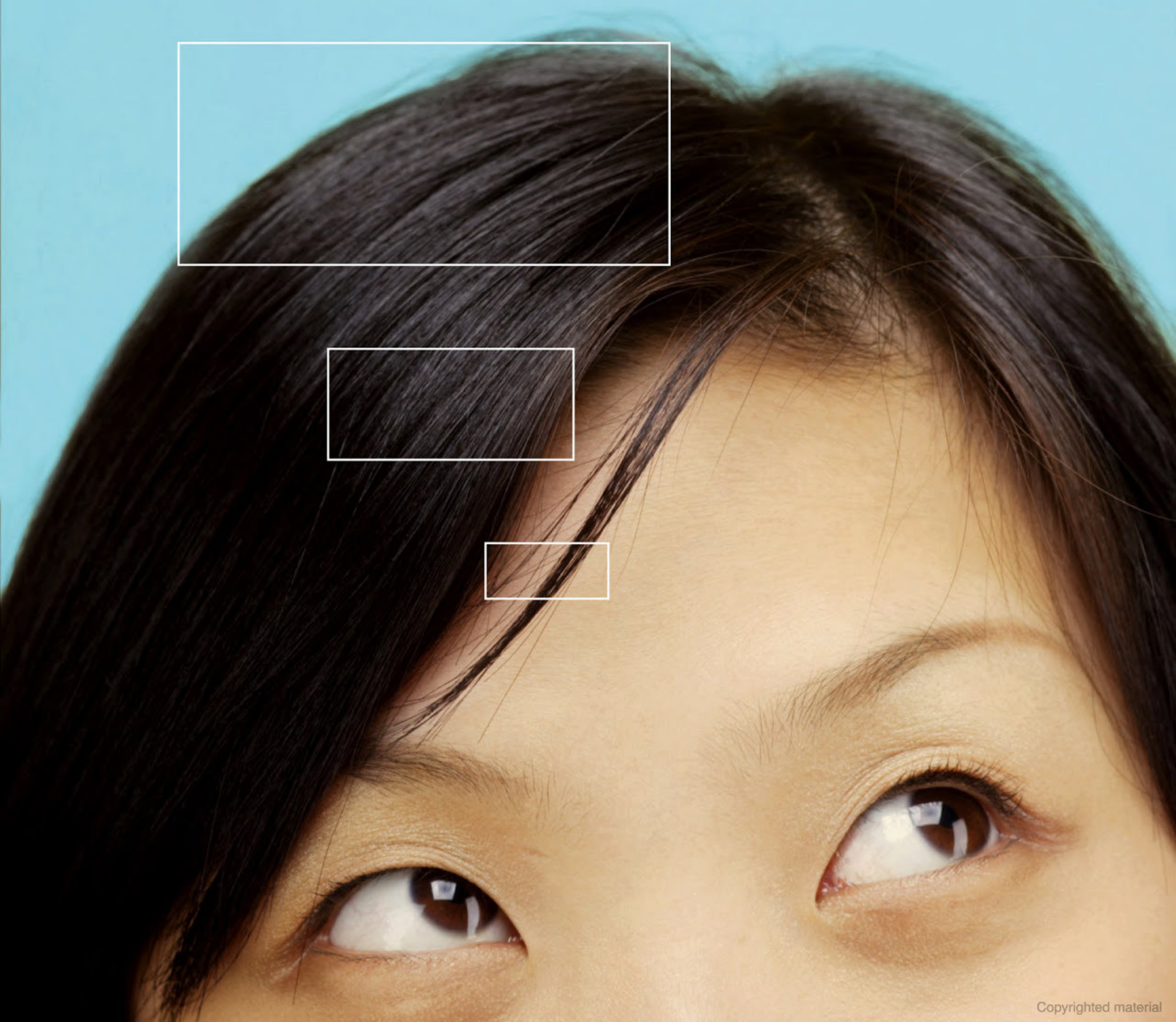
PAUL THAGARD

THE BRAIN AND THE MEANING OF LIFE



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Preface

When I was fifteen, I read a book that dramatically transformed my life, launching an intellectual journey that has taken me through philosophy and cognitive science, the interdisciplinary field that investigates how the mind works. I was shelving books in my job at the public library in Saskatoon, Saskatchewan, when I noticed a volume by Bertrand Russell, *Why I Am Not a Christian*. For a Catholic high school student and former altar boy, this was an incendiary title, especially given my growing doubts about what I was being told by my school's nuns and priests. I devoured Russell's demolition of the standard arguments for the existence of God and started reading similarly skeptical philosophers such as John Stuart Mill and Jean-Paul Sartre. Around the same time, I shelved another book in the library's careers section about the pleasant life of a university teacher and formed the ambition to become a philosophy professor.

Amazingly, this dream came true, and more than forty years later I can look back on a wonderful academic expedition that has taken me not only from religion to philosophy, but also on to psychology, artificial intelligence, and neuroscience. Today, I feel the same excitement about current developments in the understanding of how brains make minds as I did about my first discovery of philosophy. In the last decade, the explosion of experimental and theoretical results in neuroscience has generated much insight

into how people think, feel, and act. These results have major implications for traditional philosophical problems, and also for everyday issues of how people can best lead their lives.

This book is an extended argument that brain science matters for the most fundamental philosophical issues about knowledge, reality, morality, and the meaning of life. I will show how metaphysical and ethical questions, once the favored territory of religious thinking, can be better illuminated by a grasp of how brain processes enable us to perceive the world and reason about how it is and should be. The result of many emerging ideas about minds as brains is a conceptual revolution as significant as the leap of Copernicus to place the sun rather than the earth at the center of the cosmos, and the leap of Darwin to mark humans as animals originating from evolution rather than divine creation.

Unlike the Copernican and Darwinian revolutions, the current change is not associated with any one thinker, so I will call it the *Brain Revolution*. Mounting evidence in neuroscience and psychology requires the abandonment of many traditional ideas about the soul, free will, and immortality. For many people, such a transition is fraught with pain, but I will try to show how life can have meaning and value within the framework that I call *neural naturalism*. Naturalism is the view that we can best address philosophical questions by taking into account scientific evidence and theories rather than by seeking supernatural sources. Many branches of science are relevant, from physics to anthropology, but we shall see that neuroscience is especially relevant for issues about the nature of mind and meaning.

Naturalism has substantial advantages over both religious faith and conceptual reasoning based on thought experiments. Science alone cannot answer inescapable philosophical questions, but it can collaborate with philosophy to establish general theories about reality and morality. This book shows how brains can arrive at knowledge of the real world and make good decisions about how to act, in ways made meaningful by the activities of love, work, and play.

I have tried to write this book without jargon or obscurity, so that it can be understood by intelligent readers with no special background. The book is written at two levels. I have tried to make the main text as broadly accessible as possible, explaining key ideas without distracting references to the relevant literatures in philosophy and science. For scholars I have provided

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the brain and

the meaning of life

Chapter One

we all need wisdom

Why Live?

Why don't you kill yourself? Albert Camus began his book *The Myth of Sisyphus* with the startling assertion "There is but one truly serious philosophical problem and that is suicide." A French novelist and philosopher who won the Nobel Prize for literature in 1957, Camus said that judging whether life is or is not worth living amounts to answering the fundamental question of philosophy. If life is meaningless, there is no point to pursuing traditional philosophical questions about the nature of reality, knowledge, and morality.

Why life is worth living is indeed an urgent question, but it is rarely the question of suicide. The question of why you don't kill yourself arises only if you think that there are reasons why you *would* kill yourself, and people's lives are rarely so miserable that such reasons become prominent. If depression, disease, and despair were the overwhelming character of everyday life, then people would have a daily struggle about whether to go on at all. Unfortunately, such a struggle is not rare among young adults: an American survey of university students found that 10 percent said they had seriously considered suicide during the preceding year.

Most of us face the much less drastic question of *how* to go on, of how to live our lives. Then the question of the meaning of life is not the skeptical one of whether there is any meaning at all, but rather the constructive one that can have informative answers concerning what aspects of life make it worth living.

For most people today, religion provides a major source of answers to such questions about the meaning of life. When I was a child in Catholic school in the 1950s, I learned from the Baltimore Catechism that "God made me to know Him, to love Him, and to serve Him in this world, and to be happy with Him forever in the next." From a religious perspective, meaning arises not from any meager aspect of our daily lives, but from our profound connections with God, who brought us into existence and who provides the

beings, but also *why* they are important. For example, to be wise you need to have some understanding that love matters to people, that there are psychological and biological reasons why love matters, and that there are better and worse ways of finding love.

All people need wisdom of this sort in order to conduct their lives effectively, but wisdom may take on different forms as people go through the stages of life. Small children have scant need for wisdom, fortunately, as their needs and plans are normally taken care of by parents and other caregivers. But adolescents and young adults face important transitions, from play as their major focus to concerns with careers and families that elevate the importance of work and love. Finding coherence among work, love, and play is key to finding satisfaction and happiness in middle age. As people grow older, they need to figure out how to shift this balance in keeping with changes in family responsibilities and diminished capabilities due to reduced health.

The ancient Greek philosopher Epicurus eloquently expressed the need for wisdom across the life span:

> Let no one be slow to seek wisdom when he is young nor weary in the search of it when he has grown old. For no age is too early or too late for the health of the soul. And to say that the season for studying philosophy has not yet come, or that it is past and gone, is like saying that the season for happiness is not yet or that it is now no more. Therefore, both old and young alike ought to seek wisdom, the former in order that, as age comes over him, he may be young in good things because of the grace of what has been, and the latter in order that, while he is young, he may at the same time be old, because he has no fear of the things which are to come. So we must exercise ourselves in the things which bring happiness, since, if that be present, we have everything, and, if that be absent, all our actions are directed towards attaining it.

In chapter 7, I will challenge the assumption of Epicurus that happiness is the meaning of life, and I prefer to write of the health of the mind or brain rather than the soul. But I agree wholeheartedly that old and young alike ought to seek wisdom.

Wisdom operates at different levels. Most generally, it concerns recognizing major goals such as love, work, and play. In addition, much wisdom

consists in knowledge about how to accomplish these goals. For example, learning from experience how to have a good romantic relationship contributes to satisfaction of the goal of having love in one's life. Moreover, wisdom includes many kinds of knowledge that complement more specific information about primary goals and how to accomplish them. In particular, knowing how to keep yourself healthy by eating well is valuable for ensuring that illness won't prevent the pursuit of major goals. Wisdom of a particularly deep sort concerns knowing why some goals such as love, work, and play are so important to people. Chapter 8 will argue that love, work, and play are the meaning of life because they help to satisfy vital human needs.

Where can we look for all these kinds of wisdom? Philosophers have sought wisdom for thousands of years, but there is little consensus about what they have learned. The philosopher Jerry Fodor joked that anybody who thinks that philosophers have access to large resources of practical wisdom hasn't been going to faculty meetings. My own approach to wisdom is unusual in that I use experimental psychology and recent research in neuroscience to develop a systematic account of what matters to people and why it matters.

Philosophical Approaches

The approach to philosophy that I favor, attempting to answer fundamental questions by relating them to scientific findings, is called *naturalism*. Many philosophers since Plato have scorned naturalism, arguing that science cannot provide answers to the deepest philosophical questions, especially ones that concern not just how the world is but how it ought to be. They think that philosophy should reach conclusions that are true *a priori*, which means that they are prior to sensory experiences and can be gained by reason alone. Unfortunately, despite thousands of years of trying, no one has managed to find any undisputed a priori truths. The absence of generally accepted a priori principles shows that the distinguished Platonic philosophical tradition of looking for them has failed. Wisdom must be sought more modestly.

Sometimes, however, philosophy gets too modest. The highly influential Austrian/British philosopher Wittgenstein asserted that philosophy is

unlike science in that all it should aim for is conceptual clarification. In his early writings, he looked to formal logic to provide the appropriate tools, and in his later work he emphasized attention to ordinary language. He claimed that philosophy "leaves everything as it is." Much of twentieth-century philosophy in English devoted itself to the modest goal of merely clarifying existing concepts. But no one has learned much from analyzing the logic or the ordinary use of the words "wise" and "wisdom." We need a theory of wisdom that can tell us what is important and why it is important. Such theorizing requires introducing new concepts and rejecting or modifying old ones.

My approach in this book is to seek wisdom that is natural, not in the health food sense of being free of chemical additives, but in the scientific sense of being guided by experiments and theories. Philosophical naturalism is more intellectually ambitious than conceptual clarification, but rejects Platonic and religious ambitions to seek truth in supernatural realms. In chapter 2, I will give a sustained argument why we should base our beliefs on scientific evidence rather than on faith. Psychology and neuroscience are particularly rich sources of evidence relevant to the four central philosophical questions about reality, knowledge, meaning, and morality, so I call my approach neural naturalism.

The Relevance of Minds and Brains

Experimental psychology and neuroscience are still young fields of investigation, dating back only to the late nineteenth century. My goal in this book is to show how they can contribute to answers to central philosophical questions about the nature of reality, knowledge, morality, and especially the meaning of life. My arguments will be largely empirical, tying philosophical issues to experiments and theories in neuropsychology.

Like other sciences such as physics, psychology and neuroscience are both experimental and theoretical. Attempts to understand the mind are ancient, going back more than two thousand years to Greek thinkers such as Plato. Attempts to understand the physical world are similarly ancient. But experimental science began to flourish only in the seventeenth century, when thinkers such as Galileo showed the advantages of basing conclusions

about the physical world on evidence derived from systematic instrument-based observations and carefully designed experiments. Galileo used the newly invented telescope to make novel observations of the planets, achieving unexpected discoveries such as the moons of Jupiter. He also conducted experiments to determine how falling bodies behave on inclined planes. The superiority of experimental approaches to the world over traditional ones based on authorities such as Aristotle and Thomas Aquinas became increasingly apparent. Common sense, tradition, and the Catholic Church said that the earth is the stationary center of the universe; but the evidence collected by Galileo, Kepler, and others combined with the theories developed by Copernicus and Newton to make inescapable the conclusion that the earth moves.

Psychology, however, became experimental only centuries later, when Wilhelm Wundt and others established laboratories for systematically investigating mental operations. Early psychological theories were crude, because ordinary language provided a very limited vocabulary for explaining how the mind works. A major theoretical breakthrough took place in the 1950s, when emerging ideas about computing began to provide analogies about how minds can operate using representations and mechanical processes. These ideas developed hand in hand with new experimental techniques such as the precise measurement of how fast people react to different stimuli. Today the interdisciplinary field of cognitive science develops computational theories intended to explain the results of many different kinds of psychological experiments.

Neuroscience also blossomed at the end of the nineteenth century, when new techniques for staining cells made it possible to identify how neurons constitute the brain. The Spanish biologist Santiago Ramón y Cajal developed what came to be called the neuron doctrine, the idea that the brain's functions are largely carried out by its nerve cells. Through the first part of the twentieth century, psychology and neuroscience developed largely independently of each other, but began to converge in the 1980s through a combination of experimental and theoretical advances. A major experimental advance was the invention of brain-scanning machines that make it possible to observe the operation of different brain areas while people are performing mental tasks. A major theoretical advance was the development of computational ideas about how neurons can interact to generate complex

representations and processes. Together, these advances made possible the field of cognitive neuroscience, which is the theoretical and experimental study of the neural processes that underlie human thinking. Combining psychological and neurological experiments with computational theories that explain their results takes the scientific study of mind far beyond what casual introspection can tell us about mental phenomena. The main thrust of chapters 3–10 is to show the relevance of results in cognitive neuroscience for philosophical problems about reality, knowledge, meaning, and morality.

Looking Ahead

In summarizing the rest of the book, I run the risk of seeming to assert dogmatically a host of views that have not yet been defended. But I want to give the reader a good idea of where the book is going and how it all fits together. Such fitting together is a holistic, parallel process that is not easily grasped through the unavoidably serial process of reading successive chapters, but I will try to portray the whole picture in a preliminary form here and more thoroughly in the concluding chapter that will tie together preceding arguments. This look ahead will be rough and incomplete, but should serve to introduce some key ideas for providing naturalistic answers to philosophical questions.

What is reality? My answer will be that we should judge reality to consist of those things and processes identified by well-established fields of science using theories backed by evidence drawn from systematic observations and experiments. This view is highly contentious, as it rules out both religious faith and a priori arguments as sources of knowledge about reality. Chapter 2 will provide an argument why philosophy, like medicine and science, should be evidence based rather than faith based. Tying reality to the results of scientific investigations does not in itself rule out spiritual entities such as gods, souls, and angels, for there could be observations and experimental results that are best explained by theories postulating the existence of such entities. Historically, however, the development of naturalistic explanations in terms of physics, biology, and other sciences has rendered supernatural explanations dispensable. I will describe how theories in physics

neural naturalism, hope is a brain process that combines cognitive appraisal and physiological perception to produce a positive feeling about future goal satisfaction.

In chapter 9, I argue that moral judgments are produced by neural processes of emotional consciousness. Understanding the neural basis for moral judgments does not in itself answer the philosophical question concerning what makes actions right or wrong. But it does rule out two sorts of answers that have been historically influential. My naturalistic approach is incompatible with what is still the dominant cultural view, that morality derives from religious teaching. The theory of ethical intuition that I derive from my neural account of emotional consciousness is also incompatible with philosophical views that seek the basis for morality in indubitable ethical intuitions or a priori reasoning.

I will argue for an ethical position that allows us to judge the morality of acts by considering their consequences for all involved, subject to constraints that emanate from our neural constitutions, biological nature, and social needs. Inferences about how things ought to be cannot be simply derived from empirical matters, but we can nevertheless draw objective normative conclusions by coherently producing inferences to the best moral plan. Normative conclusions about the meaning of life and about human rights can be based on biological and psychological evidence concerning vital needs. Although my approach is deeply biological, it rejects many claims made by evolutionary psychologists concerning an innate basis for specific kinds of behaviors.

Finally, in chapter 10, I review the big picture of how a naturalistic approach to mind based on psychology and neuroscience provides answers to fundamental philosophical questions. As chapter 3 and 4 argue for knowledge, and chapter 9 argues for morality, inference is a matter of fitting all relevant conclusions into a coherent whole, and I will try to display what I think is the overall coherence of neural naturalism. Whole systems of philosophy are out of fashion, but I try to show the general fit, with each other and with scientific findings, of my conclusions about realism, coherence, moral consequences, and the multiple dimensions of the meaning of life. I will sketch the beginnings of naturalistic answers to some additional important questions. What kind of government is desirable? How can brains be creative? What is mathematical knowledge? Why is there something rather

than nothing? My treatment of these questions will be highly preliminary, but it will point to avenues for future collaborations between philosophy and science.

Conclusion

Plato said that philosophy begins in wonder, but he was only partly right. For many thinkers such as Camus, philosophy begins in anxiety, the intense and hard-to-overcome feeling that life may be meaningless, absurd, irrational, futile, and lacking in morality. Modern science helps enormously to satisfy the feeling of wonder, by providing answers to questions about what is strange and surprising in the natural world. But science may seem to be helpless to deal with anxiety about lack of meaning in people's lives, and indeed may even increase such anxiety. Suppose physics is right that our universe began around fourteen billion years ago in a big bang that produced billions of stars; and suppose biology is right that human beings are just a kind of highly evolved ape. Then our lives cannot have the special, central place in the universe promised by religion based on faith, and by philosophy based on a priori reasoning. Hence it is unsurprising that the Brain Revolution encounters opposition from those who fear its practical as well as its intellectual consequences.

This book aims to show that neural naturalism can serve to satisfy wonder about the nature of mind and reality, and also to alleviate anxiety about the difficulty of life in a vast and apparently purposeless universe. Philosophy and neuropsychology can do little to remove the many hardships that people face as their lives develop, with inevitable bouts of failure, rejection, disease, and eventually death. But together philosophy and science can paint a plausible picture of how minds, even ones that are merely brains, can apprehend reality, decide effectively, act morally, and lead meaningful lives enriched by worthwhile goals in the realms of love, work, and play. To begin this picture, we need to understand how scientific evidence provides a better source of knowledge than does religious faith or pure reason.

Chapter Two

evidence beats faith

Faith versus Evidence

When you have a medical problem, where do you look for information that might help you deal with it? Perhaps you consult a medical expert such as your family doctor, or maybe you go looking on the Web to see what practitioners of alternative medicine have to say about it. Or else you might ask a religious leader to whom you look for medical as well as spiritual guidance. My preference in medicine as well as philosophy is to look for scientific evidence rather than religious faith or a priori reasoning, but what justifies this preference? Isn't it just a matter of having faith in science rather than in religion?

No: this chapter will provide good reasons for basing beliefs and decisions on evidence rather than on faith. After a brief history of the conflict between scientific evidence and religious faith, I will describe how faith and evidence differ in the way they affect beliefs and decisions. I will use medicine as an informative area in which the superiority of evidence over faith is clear, and generalize this superiority to other domains, including philosophy. Although the tradition of a priori reasoning in philosophy is not usually allied with religious faith, I will argue that its reliance on intuitions and neglect of evidence is similar to faith-based thinking. The currently common use of thought experiments in philosophy is akin to reasoning based on faith rather than on evidence.

Plato and Aristotle, long the most influential philosophers, saw no deep conflict between reason and religion. Both included theology as a crucial part of their thinking about the nature of reality and morality. They differed in that Plato argued for the superiority of a priori knowledge based on abstract ideas, whereas Aristotle's approach was more empirical, drawing much more on what was known at the time about the physical and biological worlds. Medieval philosophers in various religious traditions—Averroes for Islam, Maimonides for Judaism, and Thomas Aquinas for Christianity—attempted to integrate their religious views with Aristotle's philosophical

approach. Whereas much of Aristotle's work was based on empirical observations of the physical, biological, and social worlds, medieval discussions of Aristotle tended to treat his writings as a kind of sacred text almost as venerable as the Bible or Koran.

Veneration of texts was challenged by the scientific revolution of the sixteenth and seventeenth centuries. After the Royal Society of London was formed in 1660, its motto became "Nullius in verba," Latin for "nothing in words." This phrase expressed the determination to base conclusions on experimental methods such as those used by founding members Robert Boyle and Robert Hooke. Such methods contrasted starkly with reliance on sacred religious and philosophical texts, although many scientists, like Isaac Newton, remained religious. In the eighteenth century, however, the conflict between science and religion became explicit in the writings of philosophers such as Voltaire and David Hume. Today, most leading scientists are atheists or agnostics, either denying the existence of God or expressing doubts about it. At the other extreme, religious fundamentalists in both the Christian and Islamic traditions reject science as propounding views that are not just false but also evil.

Some thinkers today attempt to reconcile science and religion, either by loosening religious doctrines in ways that make them compatible with scientific findings, or by delegating different areas of responsibility to science and religion. For example, the biologist Stephen Jay Gould argued that science and religion occupy separate areas of concern, with science having responsibility for empirical matters such as whether evolution occurred, but with religion remaining autonomous and paramount for questions of morality and meaning. My view is that even morality and meaning are better approached via scientific evidence than by religious faith. Let us now look at the difference between faith-based and evidence-based thinking.

How Faith Works

According to the Website adherents.com, 84 percent of the more than 6 billion people in the world today support some religious group. The largest religions are Christianity, with 2.1 billion members in various denominations, and Islam, with around 1.5 billion. Both of these religions believe in just

one god, unlike the third largest religion, Hinduism. And both have central texts, the New and Old Testament Bible for Christians, and the Koran for Muslims. They also have historically important religious leaders, such as St. Paul for Christians and Muhammad for Muslims, as well as contemporary leaders such as the pope and cardinals for Catholics and ayatollahs for Shiite Muslims. Christianity and Islam both have subgroups, with many different kinds of Protestants opposed to Catholics, and Sunni Muslims often in conflict with Shiites over doctrines and practices.

Religious faith is a belief in, trust in, and devotion to gods, leaders, or texts, independent of evidence. For example, Catholics believe in God and saints such as Mary the mother of Jesus, and they also trust the pope and the Bible as sources that reveal the word of God. A belief is faith based if the source of its acceptance is supposed communication from a deity, leader, or text. If you are religious and have a moral dilemma about whether to lie to a friend, you can pray to God, consult a religious leader such as a priest, or read a religious text such as the Bible. Your aim is to get a faith-based answer that will tell you what you are morally obliged to do. Faith can also propose answers to factual questions, such as the age of the universe: fundamentalist Christians consult the Old Testament and their ministers and conclude that the universe began around six thousand years ago, in contrast to the fourteen billion or so years that scientific evidence suggests.

Religious faith is enormously important to the lives of billions of people, but it faces three serious problems as a means of deciding what to believe or what to do: variations among religions, falsity of religious beliefs, and evil actions based on religion. The first problem is that religions vary greatly in what gods, leaders, and texts they propose to believe in, and faith provides no basis for choosing among them. Should you have faith in the single Christian God, or in the dozens of Hindu gods such as Shiva? Who is a better guide to life, St. Paul or Muhammad? Should you listen to the Catholic pope or to a Protestant minister? Should you seek wisdom in the Bible, the Koran, or the Book of Mormon? There are major disagreements within and across various religions, and faith provides no way of settling such disagreements other than simply shouting that your faith is better than the others. Religious faiths cannot all be right, but they can all be wrong.

For most people, the religious faith that they acquire is an accident of birth. Consider two prominent examples, former American president

I was walking across a bridge one day, and I saw a man standing on the edge, about to jump. I ran over and said: "Stop. Don't do it."

"Why shouldn't I?" he asked.

"Well, there's so much to live for!"

"Like what?"

"Are you religious?"

He said, "Yes."

I said, "Me too. Are you Christian or Buddhist?"

"Christian."

"Me too. Are you Catholic or Protestant?"

"Protestant."

"Me too. Are you Episcopalian or Baptist?"

"Baptist."

"Wow. Me too. Are you Baptist Church of God or Baptist Church of the Lord?"

"Baptist Church of God."

"Me too. Are you original Baptist Church of God, or are you Reformed Baptist Church of God?"

"Reformed Baptist Church of God."

"Me too. Are you Reformed Baptist Church of God, Reformation of 1879, or Reformed Baptist Church of God, Reformation of 1915?"

He said: "Reformed Baptist Church of God, Reformation of 1915."

I said: "Die, heretic scum," and pushed him off.

Faith often tells people that the beliefs of those who disagree with them are not only false but immoral, so that heretics deserve not just argument but punishment as well.

Religious faith has also been used to justify social inequality, as in the Christian doctrine of the Divine Right of Kings. If the authority and legitimacy of the monarch derives from God, then it cannot be challenged by people subject to tyrants. Similarly, the Hindu ideas of karma and reincarnation may seem benign, but have helped to legitimize the oppressive Indian caste system. If you are born into a miserable life, it must be because you did something horrible in a previous one. Religions focus people on eternal rewards, diverting them from the need to change conditions in their current lives.

Faith is usually used to support major religions, such as the variants of Christianity and Islam, but also contributes to a host of practices observed by people who consider themselves spiritual rather than religious. New Age beliefs in phenomena such as astrology, channeling, reincarnation, psychic experience, numerology, angels, crystals, and holistic health are supported by selective personal experience and attention to dubious authorities. Books by popular authors such as Deepak Chopra and Andrew Weil play the same role of fostering faith as do the Bible and Koran for adherents to Christianity and Islam, providing answers to difficult life questions whose appeal owes much more to confirmation bias and motivated inference than to careful marshaling of evidence.

An egregious example of New Age motivated inference is the 2006 best-selling book *The Secret*, which trumpeted the "Law of Attraction," according to which a person's thoughts attract corresponding positive or negative experiences. People find very appealing the idea that they can dramatically change their lives merely by positive thinking that improves their financial status and romantic relationships. Unfortunately, support for the law of attraction relies only on motivated inference, confirmation bias, and confused allusions to allegedly related scientific facts about energy, vibrations, and quantum physics. New Age spirituality does not defer to deities to the same extent as do traditional religions, but it has the same arbitrary reliance on leaders and texts as sources of ideas that are emotionally appealing but unsupported by evidence.

Evidence-based thinking can also lead to false beliefs and evil actions, but there are crucial differences. When disagreements occur, scientists do not have to resort to empty pronouncements about whose faith is stronger; instead they can attempt to assess competing beliefs with respect to the available evidence. It can take years or decades for scientific disputes to be resolved, but the method of resolution is not in dispute: collect more evidence and determine which of the conflicting views fits with it best. Strikingly, this process can lead to the abandonment of beliefs previously held, as has occurred in scientific revolutions and in much more mundane cases where scientists have been led by evidence to change their minds. Faith-based thinking provides no basis for resolving disagreements by changing minds, but evidence-based thinking does. Let us now look in more detail at how it works.

How Evidence Works

To begin with a familiar use of evidence, consider the reasoning in criminal investigations frequently portrayed in books, movies, and television. Such reasoning has been performed by Sherlock Holmes, the detectives in Agatha Christie novels, the investigators in TV shows such as *CSI* and *Law & Order*, and many other fictional characters. Reasoning to identify the criminals responsible for illegal actions is also performed by real-life investigators and prosecutors, as in the famous case of O. J. Simpson, a football player and movie star whose ex-wife was killed in 1994. Los Angeles detectives collected many kinds of evidence, such as Simpson's bloodstained glove, that led many people to conclude that he was guilty. Nevertheless, a jury in 1995 acquitted Simpson on the grounds that the prosecution had not shown beyond a reasonable doubt that he had killed his ex-wife. The jurors were legitimately influenced by evidence that racist members of the Los Angeles Police Department had fabricated some of the evidence. But it also appears that some of the jurors were motivated to find Simpson not guilty because of his achievements in football and movies.

Such motivations aside, here is how legal reasoning is supposed to work. Detectives and forensic investigators of a crime collect all the available relevant evidence, such as fingerprints. The best evidence is gleaned by carefully conducted observations, as when investigators thoroughly go over the undisturbed crime scene using techniques such as dusting for prints, collecting hairs, and taking photographs. Evidence can then be supplemented by scientific tools for analyzing blood and DNA. Contrast these kinds of evidence with information unlikely to have any connection with the actual crime, such as a psychic who reports seeing a killing in a dream.

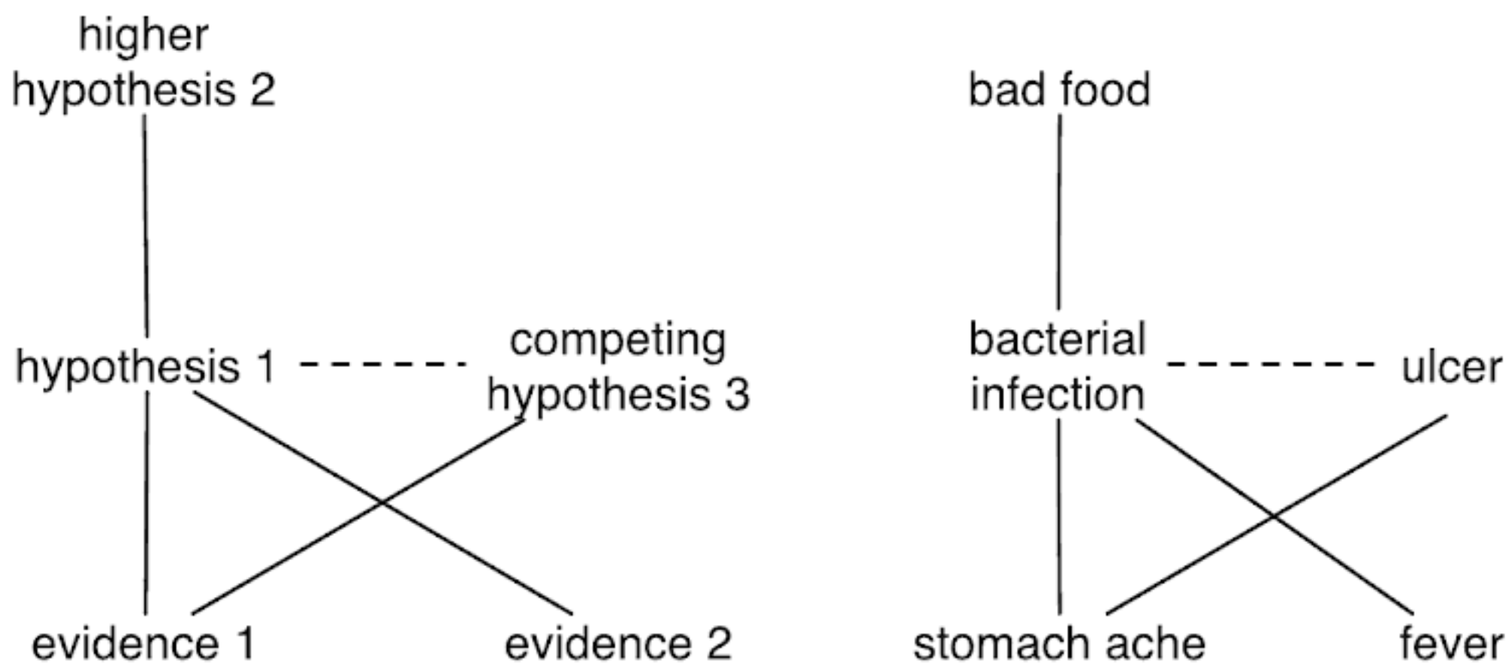
On the basis of evidence and information about the victim, investigators form hypotheses about who committed the crime, and evaluate these hypotheses according to how well they explain the full range of evidence. A hypothesis is a guess about what might have caused something to happen. For example, the hypothesis that Simpson killed his ex-wife provides an explanation of why her blood was found on his glove. The explanation here is causal: the event of Simpson's stabbing her could have produced blood that got onto his glove. The job of the defense is to propose alternative explanations, in this case that the blood on Simpson's glove was planted

there by police officers, and that Nicole Simpson was killed by drug dealers rather than by O. J. The jury is supposed to impartially determine whether the hypothesis that the accused committed the crime is the best explanation of the full range of evidence, beyond a reasonable doubt. Philosophers call this kind of reasoning *inference to the best explanation*.

Such reasoning is commonplace in everyday life. You use it whenever you are puzzled by the behavior of someone you know, as when a normally good-natured friend treats you in a hostile matter. In such cases you naturally seek explanations—for example, your friend is depressed because of troubles at work or school. An alternative hypothesis might be that you inadvertently said something that your friend found insulting. You need, then, to collect additional evidence that might tell you whether work stress or a perceived insult is the best explanation of your friend's hostile behavior. We use similar reasoning in dealing with mechanical problems. When your car won't start and you have to take it for repairs, the mechanic's job is to find the underlying breakdown that is the best explanation of what's wrong. Mechanics carry out a number of tests to try to figure out whether it is the battery, the ignition, or some other component that is preventing your car from starting.

Similarly, when you go to the doctor with a medical complaint—say, a pain in your stomach—your doctor collects additional evidence by probing your abdomen and possibly ordering tests such as blood work and X-rays. Your doctor's diagnosis is an inference to the best explanation about what underlying disease is responsible for the full range of evidence, including both your reported symptoms and the test results. The television show *House* portrays an obnoxious but brilliant doctor who every week has to find an unusual diagnosis for a patient suffering from an unusual range of symptoms. Dr. House is carrying out the same kind of reasoning as would Sherlock Holmes and your automobile mechanic: collecting evidence and trying to find out the best explanation for it.

Legal and medical hypotheses often involve multiple layers of explanations. Detectives looking for evidence that a suspect is guilty of a crime collect observations, such as fingerprints on the murder weapon, that are explained by the hypothesis that the suspect did it. But they also investigate possible motives that would explain *why* the suspect did it: perhaps the suspect was angry at the victim because of a previous fight. Similarly, a



2.1 Structure of inference to the best explanation, with a higher hypothesis explaining a hypothesis that competes to explain the evidence. The solid lines indicate explanatory relations, whereas the dotted lines show competition between alternative explanations.

doctor looking for the best explanation of your stomach symptoms will try to ascertain not only the condition that caused them, but also what might have caused your condition. For example, your having eaten some exotic food might explain how you got a gastrointestinal infection that is the cause of your stomach pain.

Figure 2.1 depicts the structure of how hypotheses such as those about diseases serve to explain observed evidence and are themselves explained by higher-level hypotheses. The general case is on the left, and a very simple medical example is on the right, with solid lines indicating explanatory relations and dotted lines indicating competition between hypotheses. In the general case, hypothesis 1 is highly coherent because it explains two pieces of evidence and is explained by a higher hypothesis 2, which makes hypothesis 1 superior to a competing hypothesis 3 that explains only one piece of evidence. Similarly, in the stomach example on the right of figure 2.1, the hypothesis that the ache is caused by a bacterial infection wins out as the best explanation both because it explains more evidence than does the competing ulcer explanation, and because it can be explained by the hypothesis of having eaten bad food. Choosing the best explanation requires not just counting the pieces of evidence explained, but also evaluating which of the competing hypotheses have most overall coherence with all the available information.

Fourth, scientists are trained not to focus on just those observations that fit with their biases, but rather to conduct systematic observations that collect broad and representative samples of relevant data. Astronomers scan the skies systematically, making a broad range of observations that furnish evidence for evaluating competing theories about the nature and origins of the universe.

Fifth, whereas ordinary people gain evidence only from their senses such as sight, scientists use instruments to observe things and events that are out of reach of direct sense experience. Since the seventeenth century, scientists have been able to use telescopes, microscopes, X-ray machines, and many other kinds of instruments to make systematic observations of things that are too far away, too small, or too hidden to be directly perceivable.

The sixth and probably most important way in which evidence-based inference in science differs from everyday life is the use of experiments. All people learn from perceiving the world and make inferences about what best explains what they observe. But the use of carefully designed and controlled experiments is relatively recent in human history. Rough experiments were performed by ancient Greek and medieval Arab thinkers, but laboratory experiments with quantitative measurements began only around the seventeenth century. Galileo was one of the pioneers. Although he may never have conducted the famous experiment of dropping heavy and light balls from the Tower of Pisa, he did employ inclined planes to test the Aristotelian doctrine that weight does affect the speed of descent. He used musical beats to measure the time it takes heavy and light balls to roll down a plane, and concluded that heavy and light balls fall at the same rate.

Such laboratory experiments have several advantages over more casual observations. First, experimenters perform planned manipulations, changing only a small number of the features of a situation in order to be able to identify causes and effects. Second, experiments are repeatable by different scientists; they can duplicate the same situation and events to see whether the results are the same even if the experiments are done at different times by different people. Third, the experimental situation can be designed to make possible precise quantitative measurements rather than vague qualitative ones. Precise and repeatable observations furnish evidence that can be challenging to different hypotheses, so that the results of laboratory experiments greatly aid the contribution of evidence to inference to the best explanation.

All inferences from observations presuppose a kind of inference to the best explanation. You cannot, for example, directly infer from "I see a bear" to "There is a bear that I see." That there actually is a bear in front of you is just one possible explanation of why you seem to see one; other possible explanations are that you are misled by a picture of a bear or by a large dog, or that you are hallucinating. Similarly, even from many observations of bears with teeth you cannot directly infer that all bears have teeth, for the best explanation of your many observations might be that you have been presented with an unusual sample of bears. However, if you have carried out many observations under good conditions and have evidence against alternative explanations, then you can be justified in concluding in the particular case that there is a bear, and in the general case that bears have teeth.

Laboratory experiments create special situations that help to rule out ways in which observations may be unreliable. For example, it is fortunate that Galileo conducted his falling balls experiment on inclined planes rather than only at the Tower of Pisa, where interfering factors such as gusts of wind might have produced less reliable results. For our theories to be well justified as the best explanation of what is observed, we need assurance that the observations are correct, which requires that the best explanation of their occurrence comes from the reality of what is observed rather than bias, chance, or incompetence. I will return to the importance of experiments in discussing evidence-based medicine later in this chapter. A much fuller discussion of how brain mechanisms make possible the perception of reality is found in chapter 4.

In science as in everyday life, inference to the best explanation often licenses inferences that go far beyond what can actually be observed. For example, when you think that a friend might be depressed, you are hypothesizing a mental state that you cannot directly observe. In law, a jury may conclude that someone had a malicious intention and therefore deserves to be convicted of murder rather than manslaughter. The jury members cannot see the past or current intentions of a suspect, but they can reasonably infer them from the suspect's behavior. In medicine, the occurrence of a disease may sometimes be perceived, but often it must be inferred. For example, a diagnosis of Alzheimer's disease cannot be directly confirmed without an autopsy that identifies plaques in a patient's brain, but it can nevertheless be established in a living patient by inference to the best explanation of

behavioral symptoms such as severe memory loss. In all these cases, we accept a hypothesis as the best explanation of the evidence even though we cannot directly observe what is hypothesized.

Science also very frequently goes beyond the observable. Positivism is the philosophical view that such leaps are illegitimate, that science should stick to what can be observed with the senses. But why should observation be restricted to what the human senses, with their particular evolutionary limitations, can perform? There are other species that have a broader range of visual, auditory, or olfactory sensing than humans have. Humans have excelled, however, in developing instruments that vastly expand our sensory abilities, from telescopes to electron microscopes to brain-scanning machines. Chapter 4 will have much more to say about how brains have the capacity both to observe the world and to make inferences that go beyond observation.

The scientific leap beyond what is directly observable has had enormous theoretical and practical benefits. Physics and chemistry tell us that objects consist of atoms whose constituents include protons and electrons. We can observe atoms only by using electron microscopes, presupposing that there are electrons, which are not at all observable. But we have ample reason to believe that electrons exist, because the theories that postulate their existence have so much explanatory power. Countless phenomena of electricity and magnetism are best explained by the hypothesis that matter includes extremely small negatively charged particles. Without electrons, we have no credible explanation of how electric lights turn on and how computers enable us to process information.

In sum, the scientific use of evidence is radically different from and more effective than religious faith. Science uses explanations that are mechanistic and mathematical, observations that are systematic and made by instruments more powerful than human senses, and experiments that generate evidence acutely relevant to the choice of the best explanatory hypotheses.

Medicine: Evidence or Faith?

To further illustrate the nature and value of basing beliefs on careful collection and evaluation of evidence, consider the practice of medicine. When

I first heard of the movement for evidence-based medicine, my initial reaction was: what, there's another kind? I was shocked to learn that many medical treatments are based more on lore and common practice than on rigorous tests of efficacy. The movement for evidence-based medicine was started by visionaries such as Archie Cochrane, David Sackett, and Gordon Guyatt to make medical practice more scientific. They argued that the highest standard of medical evidence should be the randomized, double-blind, placebo-controlled clinical trial. Suppose you have the medical hypothesis that vitamin C helps prevent colds. You might start taking the vitamin yourself and noticing when you get colds, or you might convince a bunch of friends to take vitamin C and track their health. However, such evidence would not be worth much, as you would unavoidably be prone to confirmation bias and motivated inference, which incline you to notice the successes of vitamin C and ignore the failures. Most people who try something new from their health food store such as an herbal or homeopathic remedy are similarly prone to confirmation bias and motivated inference. The best explanation of conviction that a treatment works may well be such biases, rather than the actual efficacy of the treatment.

If you really want to know whether vitamin C prevents colds, you need to conduct a clinical trial that is controlled, which means that in addition to having a group that gets vitamin C, you have another group that does *not* get vitamin C. Having these two conditions allows you to assess whether the group that got vitamin C had fewer colds than the group that did not. If the vitamin C group gets fewer colds than the control group, then you have some grounds for thinking that the best explanation of the observed cold reduction is vitamin C, rather than bias or chance in the observation.

Another way to reduce bias is to randomize your controlled study by picking a homogeneous population of people and dividing them randomly (say, by flipping a coin) into two groups, one of which takes vitamin C and one of which does not. Otherwise, if people could simply choose whether to take vitamin C, it might be that this choice is made by people who are generally health conscious and therefore would get fewer colds for other reasons. Similarly, you do not want people's doctors to decide who gets vitamin C, because the doctors may have a selection bias that would assign more or less healthy or compliant people to the vitamin C condition. If your study finds that people who take vitamin C get fewer colds, the best explanation

of this finding should be that people really do get fewer colds, not that there was a biased selection concerning who took the vitamin.

The demand of inference to the *best* explanation also justifies the ideal requirements that randomized, controlled trials be double-blind and placebo controlled. Double-blind means that neither the participants in the study nor the experimenters know who is in the treatment condition or in the control condition. Otherwise, it might happen that people who know they are in the treatment condition might get better because of their expectations. The placebo effect is well known in medicine: giving patients a biologically inert treatment such as a sugar pill can help them have less pain or improve in other ways, even though the pill has no direct effect on the underlying disease. Thus in your vitamin C study you would want to make sure that participants in both conditions receive identical pills, so that they cannot tell whether or not they are getting the vitamin. Moreover, in addition to keeping the participants blind to whether they are getting vitamin C, you should ensure that the people giving the vitamin or placebo to people do not know who is getting what. Otherwise, experimenters who know who has taken vitamin C might expect that group to do better and treat them differently, perhaps leading them to actually have fewer colds. Double-blind experiments using placebos help to rule out the hypothesis that an observed effect of vitamin C is due to biased expectations of the participants or experimenters rather than to the causal efficacy of the treatment.

I hope this makes it clear why well-designed controlled clinical trials are a particularly good form of evidence: they give us strong grounds for thinking that the best explanation of medical observations is a hypothesis concerning the real cause or effective treatment of a disease, rather than an alternative hypotheses such as bias or chance. Strictly controlled experiments also set the highest standard of evidence in other scientific fields such as physics, molecular biology, and cognitive psychology. Unfortunately, there are many real-world domains—among them, astronomy, economics, and ecology—where controlled studies are difficult to carry out. In economics, for example, no one has the power or ethical justification to divide a set of countries randomly into two groups in order to see what kind of monetary policy is most effective. Similarly, in medicine there are often biological or ethical reasons why it is difficult to conduct randomized, controlled clinical trials. For example, surgery can rarely be conducted in a double-blind