the brain and the meaning of life

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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

possibility of eternal happiness. However, for Camus and others like myself who have abandoned the beliefs produced by our religious upbringings, the theological answer to the meaning of life is implausible. Does this imply that life is absurd, ridiculous, and pointless, so utterly devoid of meaning that suicide should be a daily preoccupation of everyone?

Not at all. The eminent clinical psychologist Martin Seligman remarked that the three great realms of life are love, work, and play. For most people, these realms provide ample reasons to live. If your life is rich with love of family and friends, with work that is productive and pleasant, and with varieties of pastimes and entertainments that bring you joy, then the general issue of the meaning of life need rarely trouble you, eliminating Camus' extreme question of suicide. In chapters 7 and 8, I will use evidence from psychology and neuroscience to show how love, work, and play make life meaningful for most people, whether or not they are religious.

In the absence of the threat of absurdity, narrower issues about the meaning of life arise when the three realms conflict. For example, couples with young children often experience severe conflicts between love and work, when the intense needs of children compete for time and energy with the demands of career development. Young adults need to figure out how to render compatible the delights of playful pastimes such as sports and music with the imperative to get a job and support themselves. One of the few advantages of growing older is that the reduction of family responsibilities and the satisfaction or diminishing of career goals can make conflicts between the realms of love, work, and play much more manageable. I will describe how the meaning of life is no single thing such as a devotion to God, but rather depends on multiple dimensions that shift in importance over the course of a person's life. Hence life need never sink into the kind of absurdity embraced by Camus when he was writing in his twenties.

My aim in this book is to use experimental and theoretical research in psychology and neuroscience to provide a much richer and deeper understanding of how love, work, and play provide good reasons for living. Thus an answer to Camus' philosophical question about the meaning of life becomes tied to scientific findings, which many philosophers and religious thinkers would consider cheating. They think that philosophy should be concerned with truths that are eternal and absolute, not with the messy and sometimes transient findings of empirical science. Unfortunately, philosophy

has been no more successful at finding such eternal truths than religion has been. In contrast, I will try to show that neuropsychology is richly relevant not only to the question of the meaning of life, but also to questions that I think are just as fundamental, concerning the nature of reality, knowledge, and morality.

Without any ranking, here are what seem to me to be the most fundamental philosophical questions:

- What is reality?
- How do we know reality?
- Why is life worth living?
- What makes actions right or wrong?

In contrast to Camus, I think that it is useful to address the question of the meaning of life *after* considering the nature of our knowledge of reality, although we will see that all these questions are intimately interconnected. For example, the question of why life is worth living raises issues about the moral legitimacy of ends such as love, work, and play. Moreover, issues about the nature of knowledge and reality are crucial for the pursuit of questions about morality and the meaning of life. We need to know what persons are and how they can gain knowledge in order to be able to figure out how to assess the objective value of human lives and the rightness or wrongness of actions.

Sources of Wisdom

The word "philosophy" arose from Greek words for love of wisdom, but what is the wisdom that philosophy is supposed to be seeking, and how can it be found? Wisdom is not just knowledge, as there are many pieces of knowledge of little general importance. I know that Toronto is a city in Ontario, but would hardly claim that this knowledge makes me wiser. Rather, we should think of wisdom as knowledge about what matters, why it matters, and how to achieve it. Knowing what matters should guide us to acquire other kinds of important knowledge rather than acquiring a wealth of beliefs that may be true but rather trivial. At the deepest level, wisdom involves knowing not only what kinds of things are important to human

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

and biology have demolished theological arguments for hypotheses about divine creation to explain the origin and nature of the universe. Chapter 3 will similarly argue that neuropsychological theories are now sufficiently powerful to make it plausible that minds are brains, so that hypotheses about the existence of the soul are as superfluous as ones about gods and angels. Reality is what science can discover.

In arguing for a scientific approach to reality, chapter 2 also provides the beginnings of an answer to my second major philosophical question, concerning how we know reality. I will go into detail about how scientific thinking works, including how observations and experiments constitute evidence that can be explained by competing scientific theories. Evidence-based medicine provides an accessible example of the advantages of using science rather than faith or a priori reasoning to reach conclusions. Philosophy and science are not restricted merely to what can be observed, but instead can go beyond observation to develop theories about things and processes that surpass the reach of human senses and available instruments. We can use a reasoning process called inference to the best explanation to justify the adoption of theories that go well beyond what we directly observe.

Chapter 2 will not depend on any neuropsychological findings, but the argument in chapter 3 that we should identify minds with brains will set the stage in the following chapter for a discussion of how brains know reality. Here I will draw heavily on recent experimental and theoretical results in neuroscience to explain how brains represent the world, using both sensory processes such as vision and reasoning processes such as inference to the best explanation, enabling scientists to develop knowledge that goes beyond our rather limited senses. Chapters 2, 3, and 4 propose integrated answers to some of the most central questions in metaphysics (the theory of reality) and in epistemology (the theory of knowledge). Scientific reasoning is the best way to gain knowledge, and minds are brains equipped with all the observational and inferential capacities we need to comprehend how the world works. Thinking is multimodal, requiring both verbal and sensory representations, and multidimensional, employing representations that acquire meaning by relations to each other and to the world.

To address ethical questions about the nature of morality and the meaning of life, we need to go beyond the cognitive processes described in chapters 2–4 to consider how the brain accomplishes emotional feelings and

makes decisions. Chapter 5 defends a theory of emotional consciousness that serves two purposes. First, it fulfills a promise in chapter 3 to show how it is possible to give a naturalistic explanation of consciousness. Second, it provides the basis for the attempts in chapters 6–8 to describe the neural basis for meaningful decisions and moral judgments. I will argue that our emotional feelings are the result of parallel brain processes that involve simultaneous cognitive appraisal of the situations we face and internal perceptions of the states of our bodies. Our everyday decisions about what to do are tied in with the same kinds of processes, which generate the gut reactions that tell us what actions to pursue. According to chapter 6, decision making is inference to the best plan, selecting actions that accomplish our goals, which are emotionally marked neural representations of desirable states of affairs. Such inferences require a dynamic interaction of cognition and emotion. Good decision making requires the ability to adopt, abandon, and revalue goals on the basis of experience.

With theories about reality, knowledge, and decision making in place, we can return to the question that began this book: why is life worth living? For chapter 7, I draw on recent findings about the neural processes involved in love, work, and play to offer an account of how these realms can provide all the meaning to life that people need. Just as chapter 4 discussed the meaning of mental representations such as concepts in terms of multiple dimensions, chapter 7 defends a multidimensional, neural-based view of the meaning of life. Chapter 7 also completes the account in chapter 6 of how brains make decisions by describing how love, work, and play constitute major goals that affect what actions people choose.

Philosophy addresses normative concerns about how things ought to be, not just descriptive matters of how things are. Chapters 6 and 7 touch on normative issues about how people should think and act, but these are addressed more thoroughly in chapters 8 and 9. Chapter 8 shows how love, work, and play deserve to be meaningful because they contribute to vital human needs for relatedness, competence, and autonomy. Love, work, and play satisfy requirements that people need to live as human beings, and so provide the meaning of life normatively as well as descriptively. Finding a balance among competing goals and needs is not easy, but the prospect of satisfying even some of them is enough to generate hope, which is the opposite of the despair that leads to thoughts of suicide. From the perspective of

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 Ten

making sense of it all

Connections Made

In one of my favorite jokes, a man goes into a movie theater and is surprised to see a woman enter with a dog. When the movie starts, the dog watches it, laughing at the funny parts, crying at the sad parts, and bouncing up and down at the exciting ending. When the movie finishes, the man chases after the woman and says: "Excuse me, I was amazed that your dog actually seemed to be enjoying the movie." The woman responds: "I was surprised too—he hated the book." Like most jokes, this one is funny because it sets up one coherent set of expectations and then violates them in another coherent direction. Jokes make sense in surprising ways.

Scientific and philosophical explanations are not generally funny, but they also achieve coherence in surprising ways. I have tried to pursue an integrated approach to what I take to be the four most important philosophical problems: What is reality? How do we know it? Why is life worth living? What is right and wrong? Coherence comes in part from a commonality of method, relying on evidence drawn from observations and scientific experiments rather than from religious faith, a priori arguments, or thought experiments. I have tried to keep in mind the Jewish proverb "For example is not proof." Anecdotes are at best a weak form of evidence, and the made-up thought experiments favored by many philosophers are not evidence at all.

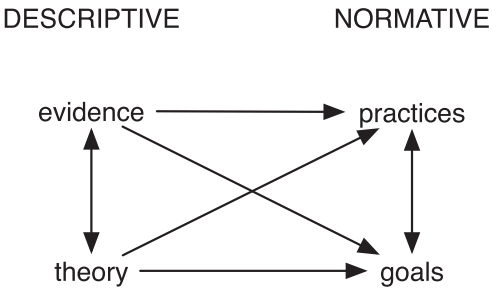
I have used more systematic forms of evidence to argue for two main claims about reality, that minds are physical systems constituted by brains interacting with bodies and the world, and that the world exists independently of anyone's mind. We know reality not just by collecting the results of observation and experiment, but also by forming theories that we can evaluate to see whether they are part of the best explanation of the full range of available evidence. Scientific theories such as Newtonian mechanics, electromagnetism, and the germ theory of disease have been hugely

successful in enabling humans to interact with the world, providing strong indication that the method of evidence-based inference is far more effective than methods based on faith or intuition.

Similarly, scientifically collected evidence can aid us in developing the kinds of normative theories we need to answer questions about ethics and the meaning of life. There is no simple leap possible from "this is how things are" to "this is how things should be," but evidence is nevertheless highly relevant to questions of value. Such relevance is most easily seen in instrumental reasoning, where something is assigned value because it is a way of achieving something else already identified as valuable. For example, if we value truth, and scientific method is a good road to truth, then scientific method can also be valued. The main problem is how we manage rationally to assign value to our top-level goals, such as truth and explanation. I have ruled out any transcendent, a priori arguments for such goals, so it might seem that one must be either arbitrary or circular in defending them.

I have tried to show that coherence of goals with each other and with various kinds of evidence provides a middle way between arbitrariness and circularity. Just as scientific theories and experiments are justified because of their fit with each other, similarly we can look for general descriptive and normative accounts that are justified because of their mutual coherence. The specter of circularity is avoided through the relative objectivity of evidence collected through the senses, which we know to be generally reliable because of past experience and growing scientific understanding of the underlying physical mechanisms by which vision, touch, hearing, and smell interact with the physical world. Sciences such as biology and psychology enable us to identify the needs of human beings, which are the factors that enable us to operate as persons in our complex physical and social worlds. Truth and explanation are such factors, because we cannot operate as human beings without some reliable understanding of how the world works around us. Other objective needs include material subsistence, autonomy, and social relatedness.

The easily recognized importance of such factors enables us to reject nihilism about the meaning of life as well as the minimalist pursuit of slacker serenity. I have tried to show how it is possible to be naturalistically normative about knowledge (chapters 2 and 4), the meaning of life (chapters 7 and 8), and questions of right and wrong (chapter 9). Figure 10.1 provides



10.1 How descriptive information can be relevant to normative conclusions. Arrows indicate inferential relevance.

a schematic summary of the use of scientific evidence and theories to inform deliberation about the justification of practices through their contributions to appropriate goals. We can use evidence to help us select theories and to identify practices and goals, at the same time that evidence is influenced by theories, and practices and goals are influencing each other.

The kind of parallel process presented in figure 10.1 can be hard to grasp, so here is a more linear depiction of how descriptive evidence can help to establish prescriptive norms. I will call this sequence the *normative procedure*.

1. Identify a domain of practices, such as scientific inference (chapter 2) or ethical reasoning (chapter 9).
2. Identify candidate norms for these practices, such as inference to the best explanation (chapter 2) or consequentialism (chapter 9).
3. Identify the appropriate goals of the practices in the given domain, such as truth (chapter 4) and vital needs (chapter 8).
4. Evaluate the extent to which different practices accomplish the relevant goals.
5. Adopt as domain norms those practices that best accomplish the relevant goals.

Step 3 is the trickiest, because it requires complex consideration of relevant goals, taking into account evidence, theory, and practices, as shown in figure 10.1. To establish goals for inference about what to believe and do, we can ask such questions as the following. What do people aim for? Why do they have those aims? Are the aims coherent with other goals? Step 4

is also difficult, because it requires evidence about what practices causally produce goal satisfaction, not just correlations between practices and goals. Nevertheless, these steps provide a way of using descriptive evidence to address normative questions, as I will illustrate later in this chapter with respect to the nature of government.

I certainly don't pretend in this short book to have made sense of everything, but I have tried to identify some connections among plausible answers to the most serious philosophical problems. Questions about how to pursue knowledge and how to pursue morality require answers that are both descriptive and normative. We want to know both how we do form beliefs and how we ought to form beliefs, just as we want to know both how people behave and how they ought to behave. In both epistemology and ethics, however, the descriptive and normative questions can be tied together by considerations of past experience and coherence of different kinds of practice with different kinds of goals, such as the most fundamental needs and interests. Such links between descriptive and normative conclusions fit well with the naturalistic view of reality that minds are a complex, brain-based part of an entirely physical universe.

The same combination of empirical, theoretical, and normative considerations has served to generate answers to the question of why life is worth living. Goals concerning love, work, and play are connected to vital needs of human beings that can be identified through empirical investigation. This research is often part of the social sciences, using empirical techniques established in psychology, economics, and sociology. But insights are increasingly streaming from the investigation of the biological mechanisms operating in human brains. We know more and more about how activities are marked as rewarding through interactions of brain areas involved in cognition and emotion, such as the prefrontal cortex, the amygdala, and the nucleus accumbens. These investigations enable us not only to use the social sciences to identify *that* love, work, and play matter to people, but also to use neuroscience to learn *how* they matter to people through brain functioning. We thus get an understanding of how the goals related to these realms of life are tied to the deep objective interests of human beings.

I have, however, steered clear of many strong claims that have been made in recent years about the direct relevance of evolutionary biology. I have no doubt that the human brain evolved by natural selection, but available

evidence does not particularly well support claims commonly made by proponents of evolutionary psychology that the brain is a collection of special-purpose innate modules such as ones for language and social behavior. Given the current lack of evidence about just how brains evolved, it is at least as plausible that the major effect of natural selection has been to allow the development of powerful methods of individual and social learning. The brain clearly has a built-in architecture of areas such as the dopamine-based reward system, but it functions more in the direction of flexible learning strategies than in the direction of fixed modules. The Brain Revolution does not condemn us to using patterns of thinking fixed in the Stone Age by biological wiring.

Rather, cultural developments such as literacy, mathematics, argument, and scientific experiments have opened rich possibilities for developing human societies in ways that can immensely enrich the lives of people. I argued in chapter 5 for a multilevel approach to explaining the mind that is neither reductionist nor antireductionist. We should draw on all the insights about mental processes that the Brain Revolution is providing, while acknowledging the continuing relevance of psychological and social explanations to understanding how things are and how they can be improved.

Wisdom Gained

Many readers will unavoidably be disturbed by my evidence-based arguments for the conclusions that minds are brains, that reality is independent of our thinking of it, and that the meaning of life and morality is to be sought in human biology and psychology rather than in some transcendent realm. Historically, people have found it hard enough to undergo the cognitive change required to reorganize our conceptual systems to think that humans are just another kind of animal and that the earth is just another planet among billions of solar systems and galaxies. Even more psychologically difficult is the emotional conceptual change that requires abandoning feelings about the cosmic centrality of human existence, along with naturally valued ideas about immortality, free will, and a caring God. The cognitive conceptual change is justified by the overwhelming evidence for scientific theories such as the theory of evolution by natural selection and

the big bang theory of the universe. These theories also put heavy pressure in the direction of emotional conceptual change, because they challenge the assumptions needed for religion-based views about souls.

But the emotional conceptual changes accompanying the replacement of faith by evidence do not have to be entirely negative, nor need they generate an existential crisis of deep despair. Hope is to be sought not in eternal deliverance or divine oversight, but in the much more mundane and realistically achievable pursuit of goals connected with love, work, and play. Secular lives do not have to be empty or immoral, but can have the same primary pursuits as those of religious people, who also have families, jobs, and entertainment. Moreover, people can avoid the tedium of church services and the terrifying threat of eternal punishment. The fact that the universe doesn't care about you should not be horribly distressing as long as there are people who do. If you can develop confidence that moderately successful pursuit of love, work, and play will satisfy your vital needs for relatedness, competence, and autonomy, then you shouldn't need the religious belief that God is looking out for you or the spiritual belief that everything happens for a reason. Recognizing that minds are brains is unavoidably a conceptual revolution, but it does not have to be a complete emotional revolution, because the values that drive most of people's activities in everyday life can be retained.

In chapter 1, I characterized wisdom as knowledge about what matters, why it matters, and how to achieve it. I hope you agree that evidence-based answers to questions about the nature of reality, knowledge, morality, and meaning constitute important kinds of knowledge that matter. In particular, I have tried to show that the realms that do and should matter most in people's everyday lives are love, work, and play, rather than happiness or the pursuit of wealth. I have not gone into detail about how to accomplish goals associated with love, work, and play, but for such practical advice you would do better to consult psychologists rather than philosophers.

Many important philosophical, neuropsychological, and social questions remain. Although I will not attempt to answer any of them in depth, I want to sketch the kinds of answers to some key questions that can be developed within the neural naturalistic framework that I have defended. What kind of government should countries have? How can creative change be produced?

What is mathematical knowledge? Why is there something and not nothing? My answers to these questions will be very preliminary but will serve to indicate some of the future tasks for neural naturalism.

What Kind of Government Should Countries Have?

The central question in political philosophy concerns what kind of state is most legitimate. This is not the descriptive question of what forms of government different countries have used, but rather the normative question of what form of government ought to be used. We can attempt to answer the question using the normative procedure outlined earlier in this chapter.

The first step is to identify a domain of practices. Around ten thousand years ago, humans began to settle in larger groups than the hunter-gatherer clans that were the original social organizations. The development of farming in river valleys in Mesopotamia and Egypt allowed for greater concentration of populations, which required centralization of power for economic and military purposes. Governments formed and over the following millennia took on different organizational structures, which constitute the domain of political practices that is our current concern.

The second step is to identify candidate norms for these practices, which consist of actual and hypothetical forms of government. Early governments were monarchies, but subsequent centuries have brought new forms such as liberal democracy, state socialism, fascism, and hypothetical forms of anarchism in which the state is ideally abolished in favor of either mutual cooperation (left-wing anarchism) or free market forces (libertarianism). Looking around the world today, we can identify different forms of government that can serve as candidate norms concerning how the state should be run, including the following:

- Liberal democracy, with representative government and individual freedom, e.g., the United States
- Communism, with state ownership and one-party control, e.g., Cuba
- Religious nationalism, e.g., Iran
- Absolutism, with no constitutional government, e.g., Saudi Arabia

Within these forms, there are important variants, such as the social democracies like Sweden that place more emphasis on economic equality than countries such as the United States that emphasize economic freedom.

The third step in my normative procedure is to identify goals of political practices, which requires asking what the state is for. Some conservatives prefer the minimalist answer that the state is legitimately concerned only with keeping people from harming each other, whereas religious fundamentalists see the state as ideally dedicated to pursuing divine commands. Should the state be primarily concerned with people's freedom, or with issues of fairness and social justice, or with some other goals? My preferred answer to this question follows directly from the needs-based ethics developed in chapters 8 and 9: the appropriate goals of the state are to help meet people's vital needs. These include basic physiological needs such as safety, food, shelter, and health care, and also the fundamental psychological needs of autonomy, relatedness, and competence.

We should not expect the state to provide complete equality with respect to wealth or happiness, as long it works to promote equality with respect to the satisfaction of vital needs. Once again, the concept of need straddles the descriptive and the normative: needs can be identified through evidence about what people require to avoid harm and to thrive; needs then generate obligations that people and the state work toward satisfying those needs. Empathy and caring are a crucial part of this generation, as the structure of our brains gives most of us the human capacity to appreciate the needs of others.

Now we can proceed to the fourth, more directly evidence-based step of evaluating the extent to which various forms of government accomplish the goals of satisfying vital human needs. Here we have a wealth of data to consult, such as the United Nations Human Development Index, which calculates average values for 177 countries based on how well they succeed in providing their citizens with a long and healthy life, education, and a decent standard of living. In 2008, the top ten countries on the Human Development Index were Iceland, Norway, Canada, Australia, Ireland, the Netherlands, Sweden, Japan, Luxembourg, and Switzerland.

Another way to try to assess human needs satisfaction in different countries is to look at surveys of subjective well-being that have been made since 1981. The countries with highest subjective well-being include Mexico,

Denmark, Columbia, Ireland, Iceland, Switzerland, the Netherlands, Canada, and Austria. Looking at the countries on both lists, we might reasonably conjecture that the currently available form of government most conducive to satisfaction of human needs consists of a liberal democracy operating in a capitalist economic system with substantial state support for education, health care, and other egalitarian social requirements.

Obviously, we would need much more evidence and argument to advance to the fifth step in the normative procedure of concluding that liberal-capitalist-social democracy should be adopted as the norm for governing states. Difficult issues about the relative importance of particular needs such as autonomy and relatedness must be discussed, along with whatever evidence is available for assessing how the world's countries succeed in meeting those needs. We should also not rule out the possibility that some form of government not currently practiced might actually be better for meeting vital human needs than those now in operation. Perhaps future social experiments will find creative new ways of governing states that will be more effective than those now observed.

How Can Creative Change Be Produced?

Where do new ideas come from, and how can creative solutions be found for the serious problems that the world now faces? Pressing global problems include economic crises, poverty, unemployment, climate change, overpopulation, and looming energy shortages. Dealing with these problems will require major social innovations emanating from creative decisions that arise through psychological, neural, and molecular processes in human brains. Here I will sketch some research just beginning on the emergence of new concepts through interconnected patterns of brain activation.

At its simplest, creativity can be understood as a process of novel conceptual combination, in which existing concepts are joined for the first time to produce something new. My home town of Waterloo, Ontario, is the headquarters for Research in Motion, the company that makes the popular Blackberry wireless handheld device. In the mid-1990s, this company was a tiny manufacturer of wireless pagers, when its founder, Mike Lazaridis, got the idea of developing ways of using pagers for electronic mail. The concept

of wireless communications was already widespread, and email had been around for decades, but the conceptual combination *wireless email* was new and creative, as shown by the subsequent huge success of the Blackberry and the development of Research in Motion into a multibillion-dollar company.

If chapters 3 and 4 are on the right track, then concepts such as *wireless* and *email* are patterns of neural activation. My collaborators and I are working on a neurocomputational model of how a new pattern of activation can emerge in a neural population integrating the patterns of activation in two neural populations that encode two previous concepts. We are trying to identify neural mechanisms by which new concepts can be formed out of the neural activations that constitute existing concepts. These mechanisms should suffice for explaining how creative concepts such as *wireless email* can emerge, and also how other forms of novelty can arise. We hope to build a unified neural account that applies to how scientific hypotheses such as Darwin's theory of evolution can arise (chapter 4), as well as to how creative new goals can be generated (chapter 6). Explaining creativity in areas as diverse as conceptual combination, hypothesis formation, and goal generation would be another piece of evidence that minds really are brains, as chapter 3 argued.

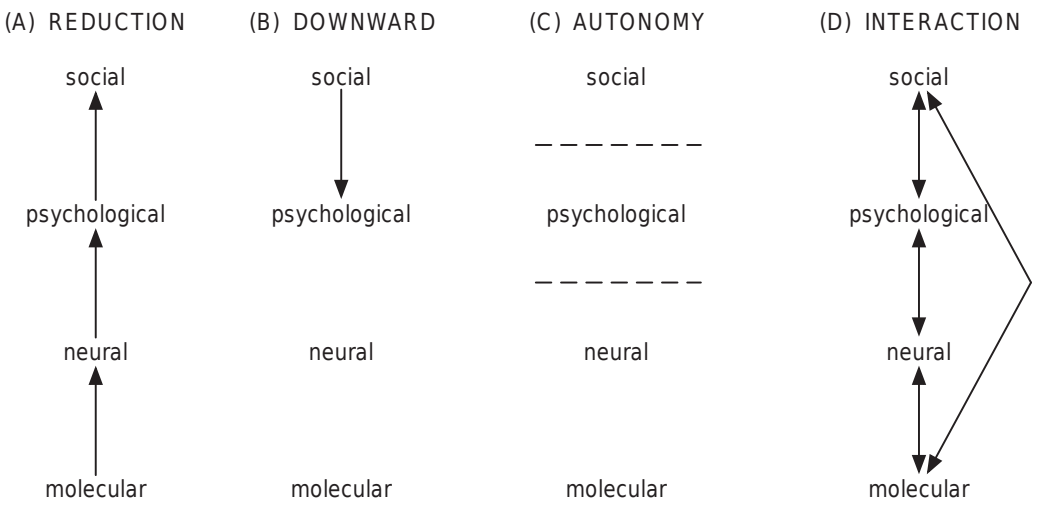
Of course, generating new ideas in brains is not the only process needed for developing solutions to social problems. As chapter 5 argued, we need to think of people in terms of multilevel systems that include social, psychological, and molecular mechanisms as well as neural ones. Here are some conjectures about how best to attempt to change complex systems such as human minds and societies:

1. To change a multilevel system, intervene at all accessible levels.
2. At a particular level, intervene by understanding the relevant mechanisms in sufficient detail to identify the manipulations of parts, interactions, and feedback loops that are most likely to produce the desired changes.
3. Pay attention to the interactions between mechanisms at various levels.
4. Coordinate interventions so that they are complementary rather than incompatible.

For a concrete example of change in multilevel systems, consider the most effective treatment for cases of serious depression. The available evidence suggests that the best way to improve the mood of depressed people is a combination of cognitive therapy and antidepressant medication. This combination intervenes at all four relevant levels: social, psychological, neural, and molecular. A cognitive therapist assists patients at the psychological level by helping them to identify and overcome negative beliefs, goals, and emotions. The therapist often also assists the patient in improving personal and work relationships, so cognitive therapy intervenes at the social level as well. Antidepressants such as Prozac and Wellbutrin affect levels of neurotransmitters including serotonin and dopamine, so they operate at the molecular level, but they also change the firing rates of neurons, as well as the generation of new neurons in the hippocampus. Hence it seems that the combination of cognitive theory and antidepressant medication is beneficial owing to their synergistic intervention at all four relevant levels of mechanisms. More effective interventions will become possible through greater knowledge about the social, psychological, neural, and molecular mechanisms underlying depression, including their interconnections described in conjectures 2–4.

Many more examples of changes in complex systems are needed to evaluate the plausibility of my conjectures about system change. We desperately need to develop further evidence-based theories about how to change psychological, political, and social systems in ways that can address the daunting list of problems that humans now face. The account of multilevel explanations that I defended in chapter 5 should pave the way for multilevel interventions that avoid simplistic models of causality.

Figure 10.2 displays four commonly advocated views of such relations. The most familiar is (A), the classical reductionist view that changes at lower levels cause changes at higher levels. On this view, causality runs upward, and so should explanation: social changes are explained as the result of psychological changes, which are the result of neural changes, all the way down to subatomic changes. In the social sciences, some writers go far in the other direction, suggesting that the social level is the key source of causality, as in (B). On this view, causality and explanation run only downward, from the social to the psychological, and everything is a social construction; the neural and molecular levels are largely ignored.



10.2 Four views of the relations between levels of explanation in cognitive science. Arrows indicate causality. © Cognitive Science Society.

A more moderate, less imperialistic form of antireductionism is the autonomy view, (C) in figure 10.2, where the dotted lines indicate that explanations at each level can proceed independently. This view is popular among sociologists, economists, and anthropologists who want to maintain their independence from psychology without making strong claims of social constructivism. Similarly, some psychologists and philosophers of mind have wanted to defend psychology from the rapidly increasing incursion of neuroscience. The autonomy view is dwindling in plausibility, as cognitive, social, clinical, and developmental psychology are being increasingly tied to neural processes. Similarly, at the social level, economics is coming to be influenced by behavioral and neural approaches.

My own preferred view is the highly interactive one (D), in which there are causal interactions and hence explanatory relations among all levels. This view is not reductionist, because it rejects the one-way causal connections shown in (A), nor is it antireductionist, because it recognizes that molecular processes are part of the explanation of neural events, neural processes are part of the explanation of psychological events, and psychological processes are part of the explanation of social events. I hope that increased knowledge about interconnected multilevel mechanisms will be useful for

explaining human thinking, and, further, for creating new ways to approach difficult social problems. Then philosophy and neuroscience will serve not only to interpret the world, but also to help change it.

What Is Mathematical Knowledge?

Interpreting the world remains a large objective, and one important unanswered question concerns the nature of mathematical knowledge. Why is it true that 3 + 4 = 7? In chapters 2 and 4, I briefly mentioned how mathematical knowledge has spurred numerous philosophers and mathematicians to reject naturalism. For Plato and many successors, there must be an a priori basis for truths of arithmetic, geometry (such as the Pythagorean theorem), and many other branches of mathematics. They think that it is necessarily true (in all possible worlds) that 3 + 4 = 7, in a way that natural science cannot explain.

Puzzles about how people manage to grasp mathematical truths have long been a source of the view that ideas are supernatural. A full-blown plausible naturalistic alternative requires learning much more about the nature of mathematical concepts as they develop in human brains. Already there is some understanding of concepts of number in animals and infants, but the neural underpinnings of mathematical knowledge are just beginning to be investigated.

As a first pass, we can say that mathematical concepts from *three* to *right triangle* to *infinite number* are all patterns of brain activation of the sort discussed in chapter 4. This does not assume that such concepts are derived directly from experience, because we have seen that new concepts can be formed by conceptual combination that go far beyond perception. Moreover, some basic concepts like *object* may be innate. Activation of concepts like *number* and *addition* may begin with specific examples when children observe collections of objects and are taught to count and add, but conceptual combination can quickly generate abstract combinations such as *number divisible only by itself and 1*. The kinds of neural mechanisms I mentioned in discussing creativity should suffice equally well for producing representations of mathematical abstractions.

But there is a crucial difference between theoretical entities such as *sound wave* and mathematical entities such as *infinite number.* Even though we cannot observe sound waves, we are justified in believing that they exist by inference to the best explanation. We cannot hear or see sound waves, but we can observe their causal effects whenever we hear sounds. In contrast, purely mathematical entities like numbers do not have any direct causal effects, so how can we be justified in thinking they exist?

I was once tempted to say that numbers exist because numbers are concepts, and concepts are patterns of neural activation that exist in real brains. The problem with this view is that there would seem to be far more numbers than patterns of brain activation. Assuming that neurons can fire or not fire about 100 times per second, and that there are 100 billion neurons, then we can calculate that there are at least $(2^{100})^{100,000,000,000}$ possible patterns of activation in the human brain. This is an extraordinarily large number, far greater than the number of kinds of things there are in the universe, which is usually estimated to contain only about 10^{80} elementary particles. But the number of integers (1, 2, . . .) is infinite, because we can always produce a greater integer just by adding 1. (A similar proof shows that there are an infinite number of reality TV shows, because an even worse one is always coming along.)

Intensifying the problem, the nineteenth-century mathematician Georg Cantor showed that there are more real numbers (e.g., pi, 3.14159 . . .) than there are integers, and indeed that there are an infinite number of sets of infinite numbers of different sizes, an infinity of infinities. Clearly the brain cannot hold an infinite number of patterns. So numbers cannot all be brain concepts, any more than they can be theoretical entities inferred by inference to the best explanation.

I think the most plausible way out of this impasse is to conclude that numbers and other mathematical objects are just fictions: they don't exist in the real world, any more than Harry Potter, Hamlet, and angels do. Then purely mathematical claims are fictional too, although they can be plausible or implausible within the context of the fictional worlds they describe. Fictionally, Harry Potter is a boy wizard rather than a dog, and angels have wings rather than jet engines. Similarly, within the context of the axioms of number theory, numbers can be infinitely large or small; and within the

context of set theory, there is an infinity of infinite sets. But numbers, sets, and wizards do not exist in the real world.

The major problem with understanding mathematical objects as fictions resides in comprehending how mathematics can be so useful in describing and explaining the world. It seems that there are straightforward arithmetical truths such as 2 + 2 = 4, and many branches of mathematics, such as algebra and calculus, that are invaluable in scientific fields ranging from physics to theoretical neuroscience. How can mathematical models of brain functioning tell us anything about thinking if math is fictional?

The most plausible answer is that many mathematical claims can be understood as being about the real world rather than about some abstract domain of objects. I think that the following claim is true: Putting 2 objects together with 2 other objects makes a total of 4 objects. This is a claim about objects, not about numbers, so it can be true of the real world. Similarly, algebra and calculus are neither true nor false, but they are used to express evaluable claims about physical systems, claims that can be judged to be true or false on the basis of experimental evidence and inference to the best explanation. Mathematical statements are not true a priori, nor are they generalizations about the world; but we can combine mathematical concepts with concepts about things and processes to make claims about the world. Abstract mathematical statements such as those in set theory and number theory are fictional assertions rather than necessary truths.

Yet these fictions do sometimes turn out to be very useful for describing the real world. Imaginary numbers and group theory, for example, were ideas developed in pure mathematics that turned out to be important for theories in physics. I think that pure mathematics sometimes turns out to be scientifically useful for the same reason that good fiction can tell us much about human psychology and social relations. Harry Potter and wizards do not exist, but J. K. Rowling's characters are based on her familiarity with and understanding of human social relations. My favorite authors (such as Shakespeare, Tolstoy, and Carol Shields) produce intensely interesting fictional characters and events because they know so much about human nature derived from their own experience. Similarly, the abstractions that mathematicians produce are often not pure creations; rather, mathematicians develop them by imaginatively combining concepts that originated

in reflections on aspects of the real world. The writer Julian Barnes said that the novel tells beautiful, shapely lies which enclose hard, exact truths. Mathematics tells beautiful, exact lies that sometimes approximate to messy truths.

To make this view of mathematics plausible, we need to know much more about the nature of mathematical concepts. A wealth of experimental evidence is accumulating concerning the nature of numerical thinking in human adults and infants, as well as in other animals. In accord with the view of concepts defended in chapter 4, mathematical concepts are patterns of neural activation that encode many different kinds of representation—visual and spatial as well as verbal and formal. But the development of mathematics will not be well understood until we have a better account, to be provided by theoretical neuroscience, of the mechanisms by which neural populations in multiple brain areas can generate new, more abstract mathematical concepts.

Why Is There Something and Not Nothing?

Surely there is one major question that I haven't been able to answer, one central issue that a naturalistic approach cannot possibly address. Why does anything exist at all? Much astrophysical evidence supports the theory that the universe emerged from a very hot, dense state around fourteen billion years ago, in a big bang that instituted time and space. But where did the big bang come from? Few educated people now buy the biblical picture that the world was created just six thousand years ago, but there is still some appeal to the idea that God made the big bang and thereby created the universe. Problems with this view are easily spotted, such as how a nonmaterial being managed to create matter and energy, but there is something more satisfying about the idea of a creator than about the idea of our universe just popping into existence through some kind of inexplicable quantum fluctuation. Theology still seems more explanatory than does magic.

Recently, however, an alternative to both theology and magic has been proposed by two distinguished physicists, Paul Steinhardt and Neil Turok. They have developed a new theory of a cyclic universe, according to which our universe came into existence because of the repeatable collision between

two strange objects called *branes*. The cyclic model is based on the leading approach to fundamental physics, string theory, according to which matter is composed of vibrating stringlike objects operating in more dimensions than the one temporal and three spatial ones familiar from our everyday experience. A brane (short for "membrane") is a multidimensional surface that can move, stretch, curve, and collide with similar constituents. According to Steinhardt and Turok, our universe began with a violent transition from a low-energy density state to a very high-energy density state consisting of the hot plasma that constituted the big bang. The energy produced will eventually decay, leading back over a trillion years or so to the state in which a brane collision could produce another big bang, with repetitions at regular intervals throughout cosmic history, past and future. In each cycle, there is a big bang followed by stages dominated successively by radiation, matter, and energy, leading to contraction and eventually another big bang.

Steinhardt and Turok present evidence that the cyclic theory matches all the current astronomical observations with the same accuracy as the modified big bang theory, and show how it potentially can explain and unify some aspects of the universe beyond the range of the big bang theory. No one yet knows whether the cyclic universe theory will become an accepted part of astrophysics, in part because it has been difficult to perform experiments to provide evidence that would support the acceptance of string theory, which the cyclic theory presupposes. Nevertheless, I mention the cyclic model here because it shows the possibility of an evidence-based answer to the question of why there is something and not nothing. According to the model, there has always been something, namely, branes, which are the historical causes of the existence of an infinite number of universes, including ours. The main explanation of the existence of familiar things such as the sun, the planets, and members of our own species is the big bang history of our universe, which originated through the brane mechanism that Steinhardt and Turok propose. Perhaps the cyclic universe is not emotionally satisfying, because it stands far from providing any kind of reassurance about the meaning of the universe and our place in it. But it is potentially cognitively satisfying because it provides a nonmysterious mechanism by which our universe could have come to be. If I someday write a second edition of this book, I hope it will have a chapter section called "Branes and the Meaning of Life."

Steinhardt and Turok reject the popular *anthropic principle,* according to which the complexity of the universe is connected with our ability to exist in it as observers, as if the universe were somehow fine-tuned to produce humans. They grant that the physical laws and conditions that govern the universe must be compatible with the fact that life exists, but this fact tells us nothing about the origins of those laws and conditions. Some physicists suggest that our planet lies in an unusual universe out of a multiverse of possibilities, finely tuned as a prerequisite for life to evolve. In contrast, the cyclic model sees our universe as arising from physical mechanisms, not abstract ideas such as the multiverse and fine tuning to support life.

I see the anthropic principle as yet another attempt to stage a Ptolemaic counterrevolution, aiming to put human minds back at the center of reality. This attempt is no more successful than its many predecessors, including Kant's theory of knowledge, Husserl's phenomenology, Buddhist mysticism, New Age wishful spirituality, postmodernism, the Wittgensteinian defense of everyday concepts, and consciousness-based interpretations of quantum mechanics. Rejecting idealism and the lure of dualism, we need to comprehend the insights of physics, biology, and neuroscience that our minds are just another physical process in a vast universe. The cyclic theory shows how this universe might have come into existence through a physical mechanism, without generating spurious reassurance about the centrality of human thinking to reality. Only in the past few hundred thousand years, out of the many billions of years that the universe has existed, have human minds been around to interpret reality. We have no way of ever knowing whether other kinds of minds evolved in previous cycles of expansion before our universe was formed, or whether new kinds will evolve in future cycles trillions of years from now.

The Future of Wisdom

I wonder how long the human species will survive. Perhaps disasters such as epidemics, drastic climate change, or nuclear war will prevent *Homo sapiens* from enjoying the few million years that most vertebrate species last. More optimistically, given our intelligence and adaptive powers, we may be able to hang on for the five billion years or so before the sun starts to die

from lack of hydrogen. If scientific knowledge continues to expand at the increasingly rapid rate of the past few centuries, humans may even have the capability to move on to other solar systems.

Much more immediately, we can look forward to a far richer understanding of how the brain produces the mental processes that I have discussed in this book. Within the next decade or two, I hope to see major neuroscientific advances concerning the kinds of thinking people do to know reality, feel emotions, make decisions, act morally, and lead meaningful lives. I expect to see continuing rapid progress concerning the neural mechanisms responsible for basic cognitive processes such as perception, memory, learning, and inference. I hope to see a deeper understanding of how scientific thinking works, especially the most creative processes in which new hypotheses and concepts are generated. New neurocomputational models should shed light on the nature of people's understanding of causality.

In addition, much more remains to be learned about the neural basis of human emotions, including their integration with cognitive processes and their generation of conscious experience. I have been able only to sketch some of the neural mechanisms underlying emotional consciousness, and much more detailed accounts are needed of particular emotions such as fear and anger. I expect that these accounts will include both cognitive appraisals and bodily perceptions, but will provide more specific details about how the brain generates particular kinds of emotional experiences. One of my major plans for future research is to develop a neural model of emotional change that will apply both to individual psychology and to social improvement. A new collaborative project is attempting to identify the emotional deep structure of national conflicts.

Innovative mechanistic theories of cognition and emotion should pave the way for much richer accounts of human decision making, including ethical evaluations. Much more needs to be said about how goals are represented in human brains and how we use them to choose among possible actions for both instrumental and ethical reasons. I hope that a fully developed neural theory of goal-based decision making will provide the basis for a more psychologically realistic theory of economic behavior. In particular, a richer theory of goal revision should provide the basis for an explanation of the major emotional changes that take place in human enterprises ranging from psychotherapy to social innovation. Ideally, it would also suggest

more creative forms of conflict resolution that would provide insights into disputes between individuals and between groups.

Finally, much fuller neural theories of cognition, emotion, decision making, and consciousness should point the way to a better understanding of the kinds of wisdom that we all depend on when we face difficult life decisions. Psychology and philosophy need more investigation of how realms of life such as love, work, and play help to satisfy people's basic needs. I look forward to detailed theories about the neural mechanisms that underlie such phenomena as romantic attachment, friendship, job satisfaction, and entertainment. The academic disciplines most in need of these developments are literary and cultural theory, which have tended to rely on philosophical and psychological ideas borrowed from evidence-poor research traditions. Fortunately, cognitive approaches to literature and neural approaches to aesthetics are starting to emerge.

The legal scholar Anthony Kronman chides universities for having given up the attempt to understand the meaning of life, and argues for the importance of the humanities in this endeavor. I certainly agree that much can be learned about the meaning of life from the appreciation of great works of literature and art, as well as from consideration of classical philosophical and historical issues. But I have tried to show that neuropsychology is also valuable for investigating what makes life worth living, and I hope to see much richer connections in the future between the humanities and the social sciences. My intent has not been to use science as a replacement for philosophy, which remains important for pursuing very general descriptive and normative questions. But I have tried to show how we can evaluate answers to those questions using evidence from neuroscience and other areas of science. I said in chapter 1 that philosophy originates in anxiety as well as in wonder, and both motivations are better served by naturalism than by faith or pure reason.

Problems about reality, knowledge, morality, and meaning are all connected, not by transcendental truths, but by the history and nature of human beings in a physical universe. The resulting naturalistic system of evidence-based philosophy is, I hope, highly coherent both with the available scientific information and with reasonable aspirations for human life. I have displayed a strong fit between coherentism as a theory of knowledge and constructive realism as a theory of what exists. Both support the

multidimensional theory of the meaning of life based on love, work, and play, as well as the consequentialist theory of morality tied to objective human needs.

Like science, evidence-based philosophy is never a finished project, and I hope to see metaphysics, epistemology, and ethics evolve further in step with scientific developments. Unlike the quick fixes offered by faith and a priori reasoning, naturalism requires patience and tolerance as scientific theories and evidence fallibly develop. Faith-based thinking should increasingly be understood as a cultural tradition stemming from motivated inferences that can be defused by recognition of how love, work, and play can suffice to meet human needs. Julian Barnes wrote: "I don't believe in God, but I miss him." Appreciation of how love, work, and play provide life's meaning should quell such yearning.

When I was an undergraduate, professors often smoked in class. One day, my logic teacher threw a match into the wastepaper basket, setting the paper in it on fire. When he tried to extinguish the fire by stomping it out, his large foot got caught in the basket, as students looked on with a combination of horror and hilarity. Similarly, philosophers sometimes start intellectual fires that they have trouble escaping, but that is not because the most important problems they pursue arise from minor errors in language or logic. Rather, philosophical problems arise whenever there are challenging questions about action and belief. Such questions are inescapable at the frontiers of science and technology, as well as in the dilemmas of people's personal lives.

The physicist Richard Feynman is supposed to have said that scientists need philosophers like birds need ornithology, but philosophical issues abound in cutting-edge science, such as current attempts to develop a theory of quantum gravity. Let me reformulate what Santayana said about history: Those who ignore philosophy are condemned to repeat it. To amplify, let me adapt what Keynes said about economic theory: Those who disparage philosophy are usually slaves of some defunct philosopher. Philosophical issues about knowledge, reality, meaning, and morality cannot be ignored by anyone who wishes to think deeply about what to believe and what to do.

It has become unfashionable to propose systems of philosophy, but I have tried to show that scientific evidence provides grounds for an integrated

set of answers to the most fundamental and important philosophical questions. Despondent obsession with problems of doubt, death, and power can give way to more positive reflections on how humans frequently manage to achieve knowledge, morality, and lives that meet vital needs through the pursuit of love, work, and play. The Brain Revolution will continue to generate insights into how we think, feel, and make decisions, including ones about the morality of actions and good directions for a meaningful life.