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# ANSWERS FOR ARISTOTLE



How Science *and* Philosophy Can  
Lead Us to a More Meaningful Life

MASSIMO PIGLIUCCI

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**ANSWERS**  
for  
**ARISTOTLE**

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**Also by Massimo Pigliucci**

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*Nonsense on Stilts: How to Tell Science From Bunk*

*Making Sense of Evolution* (with Jonathan Kaplan)

*Denying Evolution*

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How Science and Philosophy  
Can Lead Us to a  
More Meaningful Life

**Massimo Pigliucci**

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# CONTENTS

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1 Sci-Phi and the Meaning of Life

## **PART I: HOW DO WE TELL RIGHT FROM WRONG?**

2 Trolley Dilemmas and How We Make Moral Decisions

3 Your Brain on Morality

4 The Evolution of Morality

5 A Handy-Dandy Menu for Building Your Own Moral Theory

## **PART II: HOW DO WE KNOW WHAT WE THINK WE KNOW?**

6 The Not So Rational Animal

7 Intuition Versus Rationality, and How to Become Really Good at What You Do

8 The Limits of Science

## **PART III: WHO AM I?**

9 The (Limited) Power of the Will

10 Who's in Charge Anyway? The Zombie Inside You

## **PART IV: LOVE AND FRIENDSHIP**

11 The Hormones of Love

12 Friendship and the Meaning of Life

## **PART V: THE (POLITICAL) ANIMAL INSIDE YOU**

13 Right, Left, Up, Down: On Politics

14 Our Innate Sense of Fairness

15 On Justice

## **PART VI: WHAT ABOUT GOD?**

16 Your Brain on God

17 The Evolution of Religion

18 Euthyphro's Dilemma: Morality as a Human Problem

Conclusion: Human Nature and the Meaning of Life

*Acknowledgments*

*Digging Deeper*

*Index*



## SCI-PHI I AND THE MEANING OF LIFE

“Everything must have a purpose?” asked God.

“Certainly,” said man.

“Then I leave it to you to think of one for all this,” said God. And He went away.

—KURT VONNEGUT, *CAT’S CRADLE*

WHEN I WAS A CHILD I WAS CHUBBY. THIS WAS A cause of major distress, between the taunting of some of my friends and the obvious disapproval of my parents, who kept bringing me one diet doctor after another. Mind you, by the standards of today’s obesity epidemic my condition would have been barely noticeable, and it is quite amusing that nowadays I have to order my clothes online because it is difficult to find clothes in stores that are small enough to fit me. Still, the problem significantly affected my quality of life from the time I can remember being conscious of it (when I was in elementary school) to my early thirties, when I decided that I ought to do something about it, my way.

I began by doing the obvious things: I read about the problem, signed up for a gym membership and started forming an aesthetic and healthy relationship with food, as opposed to seeing it as a source of consolation for whatever might be going wrong in my life at any particular moment. It took effort and to some extent it still does, but my quality of life—both physical and psychological—significantly improved in the span of mere months. Without knowing it yet, I was practicing what this book I call “sci-phi”—short for the wisdom (and practical advice!) that comes from contemplating the world and our lives using the two most powerful approaches to knowledge that human beings have devised so far: philosophy and science.

The basic idea is that there are some things that ought to matter, whatever problem we experience in life: the facts that are pertinent to said problem; the values that guide us as we evaluate those facts; the nature of the problem itself; any possible solutions to it; and the meaningfulness to us of those facts and values and their relevance to the quality of our life. Since science is uniquely well suited to deal with factual knowledge and philosophy deals with (among other things) values, sci-phi seems like a promising way to approach the perennial questions concerning how we construct the meaning of our existence.

So, for example, let’s go back to the problem of diet and weight gain. As you might imagine, science has quite a bit to say about this subject, and yet the public is hardly aware of most of that knowledge, which is drowned out by shouts about yet another miracle diet, another miracle pill, another superficially easy solution to the problem. For instance, Gina Kolata, in her 2008 *Rethinking Thin: The New Science of Weight Loss*, describes a landmark study by Rockefeller University researcher Jules Hirsch, who subjected a group of obese people to a monitored diet while they lived for a grueling eight months at the Rockefeller hospital. Hirsch started out knowing that obese people have much larger fat cells than people of normal weight, and he wondered what would happen to those cells after a rigorous diet: Would they degenerate? Would they get smaller? The results were clear.

the fat cells of formerly obese patients had shrunk considerably by the end of the experiment, reaching standard size. Now that his subjects were back to normal, Hirsch thought, not only in overall weight but even on the cellular level, surely they would be able to stay thin, their problem solved. (This was in 1959, much earlier than the current obesity epidemic.)

But things did not quite work out as Hirsch predicted: within a few months, all of his former obese subjects had gone back to approximately their original weight, despite the fact that they *wanted* to maintain their newly achieved thinness. Since this was science, and the patients were studied from a variety of perspectives under controlled conditions, the researchers were able to figure out what had happened. The metabolism of an obese person is actually normal, meaning that it is calibrated by the body to maintain the status quo. When the researchers put their obese subjects on a severe diet, they of course lost weight (simply as a result of basic laws of physics), but their metabolism slowed down enormously compared to that of a naturally thin person. In other words, their bodies interpreted the new regime as one of starvation, and a basic survival mechanism (keep the metabolism down, consume less) kicked in. Once the dietary restrictions were lifted, the subjects' metabolism level went back to normal, they felt an uncontrollable hunger, and they ate their way back to obesity.

Later studies not only confirmed these findings but uncovered the symmetrical truth that the people who attempt to gain weight (sometimes by eating as much as an astounding 10,000 calories a day!) cause their metabolism to accelerate dramatically. As soon as they stop overeating their bodies burn all the extra fat, and they are back where they started. (Lucky bastards, one might add.) This kind of research, as well as studies on the genetic inheritance of body mass index (a function of your weight, and your height), all point to the conclusion that most of us have a "set range" in terms of both our metabolism and our weight and that our bodies become increasingly resistant to attempts to move much above or below our natural range. This most certainly does not mean that the environment has nothing to do with our weight, or that we cannot do anything about it. But it does mean that not only are there limits to what we can do, but there is a cost to be paid for doing it in terms of the precious psychological resource of willpower (more on that in [Chapter 9](#)). If people were more widely aware of this sort of research, they would have more realistic expectations about how to handle their weight problem, they would devise smarter ways to deal with it, and they would stop pursuing the chimera of a "silver bullet" that will quickly make them happy. Then again, the huge cottage industry that has flourished by exploiting people's weaknesses about food would probably collapse overnight, with presumably disastrous consequences for all those who keep making money out of the craze for eating diets.

So much for the science. Where does the philosophy come in? All the facts about the inheritance of human weight, rates of metabolism, the size of fat cells, and so on are of only academic interest until they affect the lives of real people. But why do these facts affect our lives? One answer comes again, from science: there are negative health consequences to being seriously overweight or obese. People who suffer from severe weight problems are more prone to diabetes and heart conditions, their life expectancy is significantly shorter, and of course the quality of that life is much diminished. Moreover, there are practical consequences for society, which devotes significant financial and other resources to treating conditions related to obesity.

But that is, of course, only part of the story. I was never obese, not even close, and yet the problem of being overweight has been with me my entire life. And I am most certainly not an isolated case: a multimillion-dollar industry of diets and exercise machines exploits the obsession with weight shared by millions of Americans. What is going on is that we make judgments concerning the issue of weight, judgments that range from aesthetic to moral in nature, and both aesthetics and ethics a



branches of philosophy, not science.

If we feel ugly because we are overweight, it is because—probably unconsciously—we deploy certain aesthetic theory of what an attractive human being should look like. This theory is informed of course, by the culture in which we live (the concept of physical beauty has demonstrably changed over space and time throughout human history) and perhaps to some extent even by basic biological instincts. (There is evidence, for instance, that we prefer symmetrical features in a potential partner because such features are a reliable indicator of healthy genes that could be transmitted to our progeny.) Similarly, if we blame our excess fat on our lack of self-control, we are making a moral judgment about how we *ought* to live and behave, what we should strive for in life, and how much of our resources (both mental and financial) we should invest in achieving certain aesthetic standards. We are doing philosophy without realizing it, and there is a distinct possibility that bad philosophizing may make our lives more miserable than they perhaps should be.

This idea that philosophy and science can be combined to give us the best possible knowledge about the world and how to act within it is an old one, encapsulated by the classic concept of *scientia*, a Latin word that means “knowledge” in the broader sense, encompassing both the sciences and the humanities. In German, a similar term is *wissenschaften*, which also refers to more than just the English “science.” Arguably the first philosopher in the Western tradition to take the concept of *scientia* (or what I call sci-phi) seriously was Aristotle (384–322 BCE), a fellow whom the reader will see popping up throughout this book (which explains the title of the same). What is important about Aristotle and some of his fellow ancient Greek philosophers is not the content of their science, which has been dramatically outpaced by the developments of the past twenty-four centuries, and not even some of their specific philosophical positions, which are also no longer tenable in light of subsequent discussions. Rather, what is crucial to the idea of this book is the ancient Greeks’ fundamental concept that life is a project and the most important thing for us to do is to ask ourselves how we are to pursue it. In a sense, then, Aristotle was among the first to approach the big questions in both a philosophical and a scientific manner, and we are now beginning to have some good (if still provisional) answers to those questions.

For Aristotle this project meant engaging in a quest for *eudaimonia*, a Greek word that literally means “having a good demon” and that is often translated as “happiness,” though it should more properly be understood as “flourishing.” *Eudaimonia* is achieved by engaging in virtuous behavior—that is, doing the right things for the right reasons—throughout one’s existence. Since life thus conceived is a project, a full assessment of a life’s worth is actually not possible until we reach the end, a notion that still has a powerful intuitive appeal for us moderns. For instance, the lifelong reputation of someone who led a good life up to a certain point but then engaged in unethical behavior is diminished or crippled, and vice versa: we consider praiseworthy someone who began by faltering but then regained a high ethical ground.

Aristotle, a good psychologist, realized that it is often difficult to align our rational assessment of what we ought to do with our emotional inclinations toward doing what comes easily to us or what is pleasurable. Going back to our example of physical well-being, we all know that it is good for our long-term bodily (and psychological) fitness to eat moderately and exercise regularly. Yet our penchant for immediate rewards pushes us to overindulge our appetites and makes us lazy when it is time to get on the treadmill. Aristotle never saw a fast-food joint, but he knew about human fallibility. Indeed, he thought that the major obstacle to increasing our *eudaimonia* was something the Greeks called *akrasia*, translatable as “weakness of the will.” In a sense, to be virtuous means to rise above one’s weaknesses to do the right thing, both for ourselves and for others. That is the way toward

human flourishing.

It should be clear, then, that eudaimonia is not “happiness” in the generic sense of a positive emotion, but that it is value-laden—that is, it is an intrinsically moral concept. The ancient Greeks would have argued, for instance, that a life devoted to the exclusive pursuit of physical pleasures, wealth, or power, is not eudaimonic, regardless of how “happy” the person seeking such pleasures, wealth, or power might feel. In an important sense, these pursuits would all be distractions from eudaimonia, because the individual in question has done nothing to improve himself or to affect the world in a positive manner. Eudaimonia should not be confused with the Christian virtue of asceticism, or with Buddhist detachment: the Greeks from Aristotle to Epicurus (341–270 BCE) thought that physical pleasures like good food, love and friendship, and even a good dose of luck were all necessary ingredients of a eudaimonic life. They also thought, however, that we are best able to pursue the eudaimonic life by taking the time to reflect on it.

All of this notwithstanding, to most people these days philosophy seems like a quaint activity best left to a bunch of old white men with a conspicuous degree of social awkwardness. This is the twenty-first century: if science tells us that a certain weight range is good for our health and another is likely to trigger disease, shouldn't a rational human being simply follow the doctor's orders, philosophical disquisitions about aesthetics, ethics, and the meaning of life be damned? I don't think the answer to this question is quite so simple, because of a crucial and much underappreciated distinction between facts and values. To derive the latter from the former is a type of logical error known as the “naturalistic fallacy” (because one is attempting to equate what is natural with what is good). One of the first to discuss the naturalistic fallacy (though he didn't use that term) was the eighteenth-century Scottish philosopher David Hume (1711–1776) in his aptly titled *A Treatise of Human Nature*. Hume noticed that some people who wrote on a variety of factual issues (what is/what is not) eventually and seamlessly, and without explanation switched to an altogether different kind of discourse concerned with ethical imperatives (what ought to be/what ought not to be). Hume is not saying that there is no connection between facts and values, but he points out that a person invoking such a connection should explicitly justify it.

Hume's conception of the naturalistic fallacy informs this book and its central idea that the conjunction of science and philosophy has much to offer in making the lives of reasonable human beings significantly better. Taking the naturalistic fallacy seriously, we acknowledge that science (dealing with matters of fact) is not enough; we also need philosophy (dealing with matters of value). But our philosophy can and should be informed by the best science available, and vice versa: our quest for scientific knowledge should be guided by our values. Our aesthetic judgment may want our bodies to be close to a particular weight range, and our moral judgment may fault us for not quite getting there. But a serious understanding of the biology of human metabolism will help us cut ourselves some slack and reach a compromise between what we would like to do and what biological reality allows us to do. Here science helps us revise our philosophical intuitions. That science should in turn be guided by our philosophical choices is also clear upon a moment's reflection: why does so much money go into research on human weight loss and gain? Because according to our aesthetic and ethical values, that sort of investment is justified, presumably at the expense of other possible kinds of medical research, considering that our societal resources are not unlimited. Philosophy, then, guides the general direction in which science (and science funding) goes.

Of course, a clear distinction has been made between science and philosophy only rather recently in human history; not so long ago, in the seventeenth and eighteenth centuries, people like Galileo Galilei (1564–1642) and Isaac Newton (1642–1727)—who today would be considered scientists—sa

themselves as “natural philosophers.” If science and philosophy were once one and the same, how do we account for their peculiar evolution so that nowadays they are treated as distinct enough to often be housed in different colleges on university campuses? And what can I possibly mean by “sci-phi,” the attempt to bring them back together in the service of human flourishing?

The evolution of science is perhaps easier to understand, if for no other reason than that most people are familiar with its products, from its discoveries about the nature of the world to the technological and medical applications of its principles. This familiarity notwithstanding, there are many misconceptions about science, which I tried to clear up in *Nonsense on Stilts: How to Tell Science from Bunk*. To begin with, there is no such thing as the “scientific method.” Science is a somewhat methodical enterprise, but every practicing scientist has one basic guiding principle: whatever works. Scientists are by nature pragmatic, and they will approach a problem from a variety of points of view, deploying an array of methods of investigation, until they reach a satisfactory answer to their questions.

One of the uncanny things about science is that, in often reaching improbable conclusions about how the world works, it repeatedly defies common sense and provokes widespread rejection of its findings. We now think, for instance, that quantum effects (in particular, the Pauli principle) are responsible for the fact that solid objects occupy space; we know that our planet is a speck of dust on the periphery of a giant galaxy, itself just one of many billions that populate the universe; and we have excellent reasons to believe—contrary to a surprisingly still popular opinion—that human beings are very close relatives of chimpanzees and gorillas. Science proceeds in a way similar to Sherlock Holmes’s explanation to Dr. Watson in “The Adventure of the Beryl Coronet”: “It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth.”

Another commonly misunderstood characteristic of science is that it is not in the business of delivering permanent truths, but offers instead provisional conclusions that have a certain probability of being true. So, for instance, when I said in the previous paragraph that we know that our planet orbits around an average star in the suburbs of the Milky Way galaxy, what I meant was that this is the best supported conclusion arising from a myriad of astronomical observations and from our theoretical understanding of planets, stars, and galaxies. It is certainly possible that either the observations or our theories (or even both!) may turn out to be wrong or deeply flawed in some manner, and that future generations of astronomers will look upon us with the same condescending smile that we reserve for Ptolemy’s idea that the earth was the center of the universe and the rest of the cosmos went around it, moved by invisible celestial spheres.

The tentativeness of scientific conclusions is a source of continuous inspiration to scientists, but also of perennial frustration and misunderstandings for policymakers and the general public, all of whom would much rather be told “the Truth” by scientists and be done with it—especially after paying millions of dollars to finance scientific research. And yet there is a profound lesson in humility to bring home here. It is rather ironic that science is often portrayed as the ultimate refuge of the arrogant, but that scientists themselves keep trying to explain to us the limits inherent in the human quest for knowledge about the world (discussed in [Chapter 8](#)).

What, then, constitutes science as a distinct field, separate from philosophy, literary criticism, or whatever else? Although a precise definition of science is probably impossible because of the nature of the beast itself, I would say that science is a form of inquiry into the natural world characterized by the continuous refinement of theories that are in one way or another empirically verifiable. It is this unique blend of theorizing and empirical investigation that is at the core of the scientific enterprise.

As the philosopher Immanuel Kant (1724–1804) famously put it, “Experience without theory is blind but theory without experience is mere intellectual play.” If science were just about facts, it would be the same as stamp collecting, but if scientific theories were not continuously checked against empirically verifiable facts (through either experiment or observation), they would quickly degenerate into pseudoscience, the kind of thing we see with astrology, parapsychology, or creationism.

What about philosophy? If science is difficult to define precisely, the task is pretty much hopeless in the case of philosophy, a much older discipline that has evolved along very distinct and sometimes contrasting lines. Broadly speaking, philosophy is traditionally divided into a number of branches that deal with questions concerning the nature of reality (metaphysics), our access to that reality (epistemology), what we ought or ought not to do (ethics), how we should reason (logic), and what is beautiful (aesthetics). More recently, the emergence of a spate of new fields—typically labeled “philosophy of science,” “philosophy of mind,” “philosophy of religion,” and so on—has advanced concerns with the philosophical aspects of other disciplines.

One of the most influential philosophers of the twentieth century, Ludwig Wittgenstein (1889–1951), said, “Philosophy is a battle against the bewitchment of our intelligence by means of language,” and that is certainly a good way of looking at what philosophers do. What Wittgenstein meant was that human language is by its nature imprecise and prone to confusion (providing an ever-renewable source of material for comedy, which in turn has seriously been compared to philosophizing) and that we therefore ought to be perennially on guard against being misled by how we use words. Then again, it can also be argued that sophisticated thinking about the world simply cannot be achieved without language, so we seem to be in a bind. The problem is no different, in principle, from the one that scientists encounter in their line of work: every tool they use is by necessity limited and flawed in some respect, and yet they need to use those tools to move forward with their investigations. The difference is that philosophy, in this way of looking at things, deals with the power and limits of the ultimate human tool: language itself. (Incidentally, this is not to say that philosophy reduces to linguistics; to make things even more confusing, you might not be surprised to learn that there is also a philosophy of language.)

Of course, if you asked one hundred philosophers what philosophy is, you would probably receive the proverbial hundred (and one) different answers. And yet, thinking of philosophy as the discipline that deals with the rational use of language seems to me the easiest way to understand why philosophy is also the broadest possible discipline: because it deals with our most basic tool for knowing and communicating things, it in some sense encompasses all of human knowledge. There are plenty of other conceptions of philosophy, but my take on it is that ultimately philosophy is founded on the construction (and deconstruction) of reasoned arguments. Typically, a philosopher will pose herself a set of questions, examine what is known about them, and explicitly reason her way to a particular conclusion. Other philosophers will then examine and pick apart her reasoning and see how it withstands critical scrutiny, probably presenting arguments of their own in favor of a different conclusion. And so on. There are traditions that are commonly counted as philosophy that do not follow this *modus operandi*—for instance, the so-called Eastern philosophies, and also part of what is today referred to as “continental” philosophy (because it originated with the work of some eighteenth- and nineteenth-century philosophers from continental Europe, such as Immanuel Kant and Friedrich Nietzsche [1844–1900]). What I consider philosophy in this book is the sort of intellectual activity that started out in ancient Greece before Socrates (469–399 BCE) and whose Greek root charmingly translates to “love of wisdom.”

Just as with science, there are several common misconceptions about philosophy, and one

definitely needs to be put to rest at the outset: philosophy, like science, does make progress, even though its progress has to be measured differently from scientific progress. Science, roughly speaking, can be said to make progress in proportion to how its understanding of the world matches the way the world actually is. (This idea is a bit simplistic, as any good philosopher of science will tell you, but you will take it as a good enough approximation for our purposes.) For instance, the Copernican theory of the solar system is better than the Ptolemaic one because, as a matter of fact, it really is the sun and not the earth that is at the center of the system. And the Keplerian theory that succeeded the Copernican one is even better, because it comes even closer to reality: Kepler (1571–1630) realized that the planets follow elliptical orbits, not circular ones, as Copernicus (1473–1543) thought, and that the sun is not quite at the center of the whole thing but rather occupies one of the foci of those ellipses.

Analogously, philosophy also makes progress when it understands better and better the meanings and implications of human concepts and how they relate to the world. For instance, philosophers have produced several theories of human morality, exploring a variety of logical possibilities (discussed in [Chapter 5](#)). As I have already hinted, Aristotle said that morality is about what makes human beings flourish (so-called *virtue* ethics); Jeremy Bentham (1748–1832) and John Stuart Mill (1806–1873) in the eighteenth and nineteenth centuries advanced the idea of *utilitarianism*, according to which what is ethical is whatever increases the happiness of the greatest number of people; and Immanuel Kant, also in the eighteenth century, articulated a view of morality as a set of rules based on certain duties we ought to have with regard to other human beings (a rule-based, or *deontological*, ethics).

Philosophers have worked out the implications of these and other systems, criticized them, and proposed refinements and alternatives. No philosopher today would be so naive as to espouse any of these ideas in anything like their original form, because discussions in the field have led to more sophisticated versions of them, and indeed, the debate is still moving forward from this new level of understanding.

Regardless of how we think about philosophy as a discipline, its relationship with science will take some interesting turns in this book. As I mentioned earlier, science started out as a branch of philosophy known as natural philosophy, and it stayed that way until the seventeenth century or thereabouts. With the advent of modern academic specialization, however, not to mention the explosion of discoveries in science, the two fields have become largely separated. There are some interesting fields that are still at the borderline today and that show us how areas of philosophy can turn into corresponding areas of science. One of them is philosophy of mind, which concerns the nature of consciousness. Until very recently, this was an exclusively philosophical enterprise, but more and more neuroscientists have tackled the question because of the availability of new experimental techniques; functional magnetic resonance imaging (fMRI), for instance, now permits a researcher to note which parts of the brain are active when a subject is immersed in particular mental tasks, such as reading, or thinking about ice cream.

Nowadays academic conferences and journals dedicated to the study of consciousness are populated by both philosophers and scientists, and my guess is that the field will gradually come to be dominated by scientists, as has already happened in, say, psychology (which, before William James [1842–1910], was also a branch of philosophy). Such an evolution does not reflect the relative value of philosophy and science, but rather results from the fact that the two approaches are complementary: when a problem is vaguely defined and empirically unassailable, it is the task of philosophers to clarify matters and prepare the conceptual ground for the time when science has developed the appropriate experimental tools to investigate it.

But this sort of transition is not the only possible path. There will probably always be questions for which Hume's naturalistic fallacy precludes a transition between fields. Indeed, these are the cases that interest us the most in this book. Morality will figure in much of what we discuss here, for the very good reason that the moral sphere makes up a lot of what goes into making our existence meaningful. The naturalistic fallacy prevents us from simply accepting scientific answers (is/is not) to moral questions (ought/ought not), though our philosophical discussions of meaning and values should most certainly be informed by the best available scientific understanding of the relevant issues.

As we will see, there are plenty of other areas where the combined insights of the best science and the best philosophy make it easier for us to consider our problems from a more informed, more rational position. A conceptual map of the territory ahead in this book would range from how to tell right from wrong to what counts as knowledge and why; from considerations of who we are to discussions of love and friendship; from an analysis of justice and politics to the ever-present issue of gods and what they might contribute—if anything—to the meaningfulness of our existence. In all this, the practice of what I call sci-phi makes one crucial assumption: that you are interested in using reason and evidence to guide your life and make it better. If you'd rather be led by mysticism, superstition, or "other ways of knowledge"—whatever they may be and however they may work—this is not the book for you. But if you agree that the most precious organ a human being possesses is his brain and that we owe it to ourselves to make the best use of it that we can, then by all means turn the page and let's get started.



# HOW DO WE TELL RIGHT FROM WRONG?



# TROLLEY DILEMMAS AND HOW WE MAKE MORAL DECISIONS

Moral excellence comes about as a result of habit. We become just by doing just acts, temperate by doing temperate acts, brave by doing brave acts.

—ARISTOTLE

IMAGINE THAT YOU ARE AT THE HELM OF A TROLLEY, GINGERLY carrying passengers from one stop to another along the city's streets. Suddenly you see five people standing close, right in front of you, about to be hit by the trolley! You slam on the brakes, and they don't work! You shout to them to get the hell out of your way, but they don't see or hear you! In desperation, you realize that there is only one option available to you: the trolley tracks are about to split, and if you pull a lever you will change course and save the five people. In so doing, however, you will inevitably end up hitting, and probably killing, an innocent bystander. Would you pull the lever?

Most people who are surveyed answer affirmatively, if reluctantly, across cultures. This is one version of one of ethical philosophers' favorite thought experiments, the trolley dilemma. The idea of the experiment is to see what people's moral intuitions are when faced with difficult ethical quandaries. The results would suggest that most people adopt what philosophers call a utilitarian, or *consequentialist*, form of moral decision-making: saving five people is the right thing to do, even though another person will be killed in the process. It's an example of what Jeremy Bentham—the originator of utilitarianism—would call “moral calculus.”

Almost every time I explain the trolley dilemma someone inevitably begins to rattle out the obvious objections: But what if the five people are all Nazis and the one you kill is your mother? Could you not alert the people to move? Is there no other option available? Or some variant thereof. But the point of the experiment is precisely that there are no other options, and that we do not know anything about the people involved. This kind of experiment allows us to examine people's moral intuitions, other things being equal. Incidentally, the scenario may appear far-fetched, but it isn't. There are plenty of situations in real life, from medical emergency rooms to police or military actions, where people are suddenly confronted with the need to exercise some sort of moral calculus quickly, with few available options, and on the basis of very little information. Philosophy sometimes is a question of life and death.

The trolley exercise does not stop there. A variant of the trolley situation reveals something even more interesting about how we think about morality. Imagine now that instead of driving the trolley you are walking on a bridge, below which you see the trolley, on its tracks, about to hit the five bystanders. Now your only course of action, the only way to save the five people, is to quickly grab a large person standing near you and throw him off the bridge, thereby blocking the advancing trolley. Would you do it? (Again, no other options are available; you cannot sacrifice yourself, perhaps because your body mass is too small to stop the advancing car.) It turns out, somewhat surprisingly to philosophers, that in this version of the dilemma most people recoil from sacrificing the one for the many. This is unexpected because clearly the new course of action is not consequentialist at all.



Rather, it seems to fit with some other general way of thinking about morality, perhaps a type of *deontology*, or rule-based ethics, similar to the ones adopted by many religions. (The Ten Commandments are the obvious example.) Maybe the rule here is “Thou shall not kill an innocent person,” or the Kantian imperative not to use other people as means to ends. Yet that can’t be the whole story, because people who adopt a deontological morality in the bridge version of the dilemma are directly contradicting their obviously consequentialist approach in the lever version. We return to the problem created by contradictory ethical doctrines in [Chapter 5](#).

At any rate, here is where cognitive scientists enter the picture. A group of researchers led by Michael Koenigs of the University of Iowa and Antonio Damasio of the University of Southern California in Los Angeles performed an interesting neurobiological experiment using the trolley problem. They compared normal subjects with people who had suffered a specific kind of neurologic damage in the ventromedial prefrontal cortex of the brain, an area known to affect emotional reactions. After presenting both sets of subjects with both versions of the trolley dilemma, Koenigs and his colleagues discovered something very interesting about how the brain works when it is engaged in moral decision-making. There was no difference between normal subjects and neurologically damaged patients in their responses to the lever version of the dilemma: most subjects in both groups agreed that it was acceptable to pull the lever, thereby trading five lives for one. However, when faced with the bridge version of the problem, twice as many brain-damaged patients said that the utilitarian trade-off was still acceptable (that is, that it was okay to throw the big guy off the bridge) compared to the controls. What gives?

Joshua Greene, a cognitive scientist at Harvard, thinks he knows what’s going on. His group has shown that different areas of the brain are activated when someone is considering a personal versus an impersonal ethical problem—just like the difference between the bridge and lever versions of the trolley dilemma. Predictably, the lever situation elicits a strong response from areas like the medial frontal gyrus, which is known to be associated with emotions, while the bridge situation stimulates those sections of the brain known to be involved in problem-solving and abstract reasoning. The difference between the brain-damaged and normal subjects in the Koenigs study, then, is explained by the fact that their emotional circuits were impaired, so to speak.

So, does the available science favor consequentialism or deontological ethics? A philosopher would say that this is a strange question, since neurobiology can tell us how people think, but not how they *should* think. Indeed, a naive scientist could make the claim that the neurobiological evidence favors a consequentialist ethical philosophy over a deontological one based on the observation that when people use their reasoning faculties—and isn’t that the logical thing to do?—they “go consequentialist.” Then again, a neuroscientist with Kantian inclinations could equally reasonably point out that it is the people with incapacitated emotions—people whose brain isn’t working the way it is supposed to—who favor the consequentialist solution in the bridge version of the dilemma. You can see how simple facts, however interesting they may be, are just not enough to decide what’s the right thing to do.

Jonathan Haidt is a social psychologist who has made some intriguing observations about the question of human moral judgment. He has proposed the “mere rationalization hypothesis,” which essentially states that a lot of our moral decisions arise from evolutionarily ingrained instincts and emotions and are not ethical at all. Haidt refers to a study he conducted in which he exposed subjects to actions that caused no harm and yet were likely to provoke a strong emotional reaction. For instance, he looked at how people responded to the idea of cleaning the toilet with one’s national flag. Predictably, most people recoiled from the action, and when asked to elaborate they produced

explanations that used moral terms to condemn such a use of the flag. But, Haidt argues, since the actions do not actually harm anyone, in what philosophically coherent sense can they be considered immoral? Instead, he suggests, this is one example of people *rationalizing* their evolutionarily culturally engrained emotions and dressing them up as moral when in fact they are arbitrary. According to Haidt, we should learn to distinguish valid moral judgments from those caused by our evolutionary or cultural background and make an effort to discard the latter in favor of the former.

But then the obvious question becomes: How do we tell the difference between spurious and valid moral explanations? Why doesn't the mere rationalization hypothesis hold all the way down, so to speak, providing scientific backing for the "anything goes" idea of moral relativism? Philosopher William Fitzpatrick points out that in some cases we can clearly distinguish between evolutionary and ethical considerations, as when people make decisions that seem to be guided by moral reasoning that flies straight in the face of their evolutionary instincts. For instance, we may decide not to have more than two children because we are concerned about world population (thus violating the Darwinian imperative to reproduce as much as possible); or we may give up part of our time to volunteer for a humanitarian organization; or we may send a check to a charitable organization so that a child on the other side of the world will have a chance at survival, health care, or education; or, at the extreme, we may even sacrifice our own life for a cause we deem worthy (which amounts to nothing less than evolutionary suicide). None of these decisions make sense from a purely biological standpoint, which would have us focus our efforts on two and only two things: survival and reproduction (and the first imperative is important, from the point of view of natural selection, only if it leads to the second one).

The widespread existence of human behaviors like the ones just mentioned (and many others, of course) is a real problem for any strong evolutionary theory of morality. Still, Fitzpatrick points out that such behaviors do not mean that evolution has no bearing on why we are moral animals. He articulates what he calls a "modest evolutionary explanatory thesis," according to which our evolutionary history tells us something about why we have the tendency and capacity for moral thinking, as well as why our moral thinking is accompanied by certain emotions. We will examine what evolutionary biology has to say about morality in more depth in [Chapter 4](#). For now, we are still left with a serious problem. Consider the following moral judgments (MJs) (again, from Fitzpatrick's work):

MJ1: Interracial marriage is wrong.

MJ2: Homosexuality is wrong.

Until recently, both MJ1 and MJ2 were considered true in Western societies, and both are still considered valid in many non-Western societies. However, most Westerners have moved away from MJ1, and an increasing number of them have also abandoned—or at least seriously questioned—MJ2. But the moral skeptic would obviously say: Doesn't this variety of opinions clearly show that moral judgments are culturally relative? That what is morally "true" in one place or time is not necessarily true in another cultural or temporal context? This is a crucial question. We saw in the last chapter that we cannot derive moral oughts from matters of fact (at least according to Hume). If it now turns out that we have no reason-based approach that leads us to say that something is moral or not, then the relativist might win the field after all, leading to a situation where we have no moral guidance other than our tastes and idiosyncrasies.

This is the territory of so-called *metaethics*—the discipline that examines the rational justifications for adopting any moral system at all (as opposed to ethics, the branch of philosophy that

debates the relative merits of different views of morality and how they apply to individual cases. Metaethical issues are notoriously hard to settle, for a reason very similar to why it has proved doggedly difficult to provide rational foundations even for mathematics and logic, the quintessential areas of pure reasoning. Throughout the twentieth century the top logicians in the world embarked on an epic quest to find a tight logical foundation for mathematics (a quest delightfully recounted in the graphic novel *Logicomix* by Apostolos Doxiadis and Christos Papadimitriou). That search for the holy grail of reason ended in defeat when Kurt Gödel (1906–1978) demonstrated (logically!) in 1931 that it just wasn't possible to find such a foundation. Then again, Gödel's so-called *incompleteness theorem* has not induced mathematicians to hang up their pencils and paper and go fishing, so maybe we too can set metaethics aside for another day without having to give up the idea of moral reasoning.

That said, it turns out that philosophers think that neither MJ1 nor MJ2 are valid moral judgments. Moreover, they think that the following moral judgment is a valid one:

MJ3: The unmotivated killing of another human being is wrong.

Why? Fitzpatrick summarizes what a philosopher would say about MJ1 and MJ2 in this way: first, both statements fail to withstand critical reflection; second, the reason some people think that MJ1 and MJ2 are true (even though they are not) is nonmoral in nature.

Let's start with the second criterion: it is easy to attribute an endorsement of MJ1 to racism and an endorsement of MJ2 to homophobia, both of which explanations can be tested independently (that is, we can tell via other means whether a person is racist or homophobic). In the case of MJ3, however, it is hard to think of a nonmoral motive for the judgment.

The first criterion is, of course, trickier, as the type of critical reflection one applies to the alleged moral judgments depends on what type of ethical system (consequentialism, deontology, and so on) one accepts more generally. Still, we could argue that both MJ1 and MJ2 are wrong for a variety of reasons: they discriminate against an arbitrary group of people (members of another race or homosexuals); we would not want to have these sorts of judgments applied to our own decisions on matters of marriage and sexual practices; or such prohibitions infringe on personal liberty in situations where no one is being harmed by individuals' choices. MJ3, by contrast, stands up to such critical evaluation because, if we did allow random killings, we would soon not have a society we could speak of, since a society is a group of individuals who band together for reasons that include increased personal safety. (Notice, of course, that the word *unmotivated* in MJ3 is a big caveat: it allows for the moral acceptability of killing someone in, say, self-defense, or for other reasons that need to be specified and analyzed. The point is that such reasons cannot be arbitrary and at the whim of cultural trends.)

To take stock, it would seem that moral judgment is still an area where philosophy dominates because it is hard to justify the equation of what is natural (as in the result of evolutionary processes or the brains' way of connecting analytical thinking and emotional reactions) with what is right. This does not mean, of course, that philosophers have an easy time settling ethical disputes or even rationally justifying why we should be ethical to begin with. Still, science does tell us quite a bit about how our brains work when we do exercise ethical judgments, and even about how we acquired this somewhat strange idea that there are "right" and "wrong" things out there. In the next two chapters we turn to more neurobiology and evolutionary biology to help us make sense of what it means to be a moral animal.



## YOUR BRAIN ON MORALITY

As for morality, well, that's all tied up with the question of consciousness.

—ROGER PENROSE

**I**N 1667 ONE THOMAS CORNELL WAS HANGED BECAUSE he had been found guilty of murdering his mother. A little more than two hundred years later, one of his descendants, Lizzy Borden, was controversially acquitted of charges of having killed her father and stepmother. At the onset of the twenty-first century, yet another descendant of the same family, Jim Fallon, is a professor at the University of California at Irvine, where he studies the brains of serial killers. The interesting thing is that until a few years ago Fallon was not aware of his family's, shall we say, interesting history or how pertinent that history was to his own academic interests. It apparently was after a casual conversation with his mother that he began to look into it, and the more he looked the more worried he got.

To satisfy his own curiosity, he had several members of his family brain-scanned, including himself. You see, Fallon's research shows that serial killers tend to have very little activity in the area of the orbital cortex. This makes sense, because that area of the brain is known to interact with and repress the activity of the amygdala, which—to simplify a bit—is the seat of our strong emotions, particularly fear, but also the spring for our aggressive behavior. No activity in the orbital cortex means that the normal brakes on the amygdala have been lifted, so to speak, making an individual more prone to violence. None of Fallon's close relatives turned out to have the brain signature of a serial killer—but he did!

At this point the biologist began to feel a bit uneasy, but he pressed on with his quest nonetheless. There was a second test he could run that would be pertinent, one that didn't deal directly with the structure of the brain, but rather with the genetic bases of aggression. The monoamine oxidase-A (MAO-A) gene is found in different variants in the human population, just like most genes. It happens, however, that one of these variants is associated with particularly violent behavior and, again, is frequently found among serial killers. That variant, nicknamed "the warrior gene," was absent from the DNA of Fallon's relatives, but as I'm sure you'll be less than surprised to discover, he had it. And yet, Jim Fallon is not a serial killer—he just has an academic interest in the phenomenon. What's going on?

Welcome to the increasingly fascinating field of *neuroethics*, where philosophers and scientists come together to better understand (and perhaps improve) the way human beings reason and act from a moral perspective. This book is about what philosophy and science together can tell us concerning the big questions in life, and if we want to understand these questions in a new light we also need to look under the hood, so to speak. We will employ not only the logical scalpel of philosophy to parse what people mean by the different ideas that guide their lives but also the microscope of science to try to figure out how and why people behave in certain ways. In this chapter, then, we focus on the how

of moral reasoning from a neurobiological perspective. We will turn to the whys—what we can tell about the evolution of morality—in [Chapter 4](#). And we will wrap up this topic by returning to philosophy in [Chapter 5](#), this time armed with a better understanding and ready for better guidance on how to live an ethical life.

Jim Fallon does have an idea about why he is not a serial killer. Despite his family history, being a carrier of the warrior gene, and having the characteristic deadness in his orbital cortex, another element is missing, he believes: the right (or rather, wrong) environment. Fallon had a nice childhood with no traumas and plenty of affection from his family, but if it had been different—had he been abused, for instance—then the perfect neuro-genetic-environmental storm would have been unleashed, he thinks, and he might have been a subject for someone else’s studies on serial killers. Perhaps, but we do not know—we can only speculate about such things. At the very least, the strange case of Jim Fallon highlights the fact that particular genetic or neurological signatures are not *sufficient* to trigger a given set of behaviors. They may, however, be sufficiently important factors to be admitted in a court of law.

According to a National Public Radio investigative report in 2010, American courts have allowed evidence about the neurobiology or genetics of violent behavior in about 1,200 cases so far, and it looks like this is just the beginning of a trend. For instance, in 2006 in Tennessee one Bradley Waldroup was accused of killing his wife and a female friend of his wife’s during a violent outburst at the end of an altercation. From a forensic point of view, Waldroup’s culpability was obvious and the prosecutors asked for the death penalty. But the defense attorney argued that evidence should be admitted to the effect that Waldroup had the very same MAO-A variant, the “warrior gene,” that Jim Fallon found himself carrying. The attorney argued that the defendant was prone to snap under pressure and engage in violent acts because of his genes, and in a stunning outcome the jury agreed. Waldroup was convicted of voluntary manslaughter and avoided the death penalty.

From a philosophical perspective, there are two reasonable ways of looking at this case, and they carry us to very different conclusions. On the one hand, it is a well-established principle of modern American law that people with extremely low intelligence should not be sentenced to death, even if they have demonstrably committed a crime for which capital punishment might otherwise be considered. (Remember that the United States is the only Western country where the death penalty is possible to begin with.) The reasoning behind this principle is that, because such people are incapable of the same degree of understanding and decision-making that most of us can muster, the ethical thing to do is to *restrain* them from doing additional harm, but not to punish them for something over which they had little deliberative power. On the other hand, there clearly has to be a limit to how much biological considerations can enter into our system of laws or the concept of justice will simply lose any coherence. If the defense is that “my brain made me do it,” or “my genes made me do it,” simply consider that pretty much anything we do is affected by our genetic makeup, and certainly our brains get involved in everything we do. You see the dilemma.

Moreover, our moral judgments can be skewed by factors that are not nearly as dramatic as having a silent orbital cortex or a warrior gene. For instance, what if I told you that watching an episode of *Saturday Night Live* affects not just your mood (if you appreciate that sort of comedy) but measurably alters your immediate moral judgment? (You become more of a utilitarian, or consequentialist, if you watch comedy.) Or how about the fact that if I were to ask you about an ethical issue while you were sitting at a dirty desk or smelling an unpleasant odor, you would be more likely to render a severe judgment than if you were at a clean desk or your nostrils were not under assault? Clearly much more than calm and rational deliberation goes into our moral decision-making, and indeed, much of which

influences that decision-making flies quite easily below our conscious radar—unless we know it there and we keep our guard high.

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We already encountered some of these additional factors in [Chapter 2](#), when we considered scientific research into the trolley dilemmas, and now it is time to return to the ideas of one of the scientists we have already met, Joshua Greene of Harvard. Greene has reviewed much of the literature on the neurobiology of moral decision-making and has come up with what he calls a “dual-process” theory of moral judgment. According to Greene’s theory, we change the type of moral judgment we employ—going, for instance, from being utilitarians in the lever version of the trolley dilemma to being deontologists in the bridge version of the same problem—because we are literally of two minds when it comes to ethical decision-making.

The basic idea is that our cognitive processes (broadly speaking, our ability to think rationally) are engaged in utilitarian ethical judgment, while our emotional responses (our “gut feelings,” or intuitions) enable deontological judgment. This concept creates an interesting situation, considering that philosophers think of the two types of ethical theory as logically distinct: thus, we may end up with irreconcilable and contradictory judgments depending on whether one form of judgment or the other takes over in our brains.

What is the evidence for Greene’s dual-process theory? Perhaps the earliest clue came with the famous case of Phineas Gage, a nineteenth-century railroad construction foreman who survived the freak accident of a long metal rod passing through his head. Much of Gage’s left frontal lobe was destroyed, but this damage did not result in any obvious impairment in his cognitive reasoning compared to before the accident. What did change, however, was his social behavior: suddenly he found it difficult to control his impulsive and emotional reactions. This was the earliest suggestion that the areas of the brain affecting cognition are at least partially different from those controlling emotions, and that it is possible to disrupt (in this case, by accident) the balance between the two.

In the 1990s, research conducted by neurobiologist Antonio Damasio’s group zeroed in on a more specific area of the brain, the ventromedial prefrontal cortex (VMPFC), to show that patients with damage there made bad decisions when it came to risk assessment, significantly underestimating the risk associated with certain simulated scenarios. The patients responded normally, however, to tests measuring their ability to engage in moral reasoning; the problem seemed to be caused by the inability of their brains to generate the feelings that normally help guide most of us in analogous situations. Interestingly, studies on the neurobiological underpinning of psychopathy also show a connection with the VMPFC (among other areas of the brain): apparently, psychopathic behavior can be generated by reduced functioning of the amygdala (the same area that lost its cognitive “brakes” in Jim Fallon’s brain), which in turn may be caused by a malfunction in—you guessed it!—the VMPFC. One of the intriguing consequences of psychopathic breakdown of normal brain activity is that psychopaths don’t seem to be able to make the distinction that comes easily to most of us between moral rules and arbitrary rules of conduct (such as etiquette-related ones). For them, all rules are arbitrary conventions and can therefore be ignored at will. In a sense, a psychopath is the ultimate moral relativist.

Of course, neurobiological studies focusing on exceptional situations—be they freak accidents or socially deviant individuals—can tell us only so much. Is there evidence for Greene’s dual-process theory from more standard situations that affect all of us? Indeed there is. In a study carried out by Greene’s group, subjects were presented with what the researchers referred to as a “high-conflict personal dilemma”—something along the lines of the various versions of the trolley dilemma, for instance. The trick was that some of the subjects were simultaneously asked to engage their attention with an unrelated (and morally neutral) cognitive task, such as detecting when the number 5 was

presented to them in the midst of a string of numbers. The idea was to cause a simple interference with cognitive moral processing by diverting some cognitive resources to another problem. The dual-process theory would predict that utilitarian moral judgment should be partially impaired by the interference, but not deontological judgment. And that's exactly what the researchers found! It is as if one of the moral channels of the brain shares bandwidth (so to speak) with functions like calculation and identification tasks and the more we are engaged with the latter the worse we do with the former. In addition, we have seen that the experiment can be done in reverse: researchers can interfere with subjects' deontological judgment simply by altering their emotional state in an unrelated fashion—for instance, by exposing them to noxious odors. And of course, all of these findings have more than just scientific import: imagine the endless possibilities for willful manipulation of juries by unscrupulous attorneys bent on shifting the balance of jurors' moral compass toward either a utilitarian or deontological extreme.

The dual-process theory is also consistent with what we do when faced with very different sorts of moral judgments—those that have to do with the concept of justice (a subject to which we return in [Chapters 14](#) and [15](#)). Consider the following, not too hypothetical, scenario: you have one hundred kilos of food available to be distributed to a population affected by famine. However, it takes some time to deliver the food, and this will cause about twenty kilos to spoil and become unusable. If you choose instead to deliver the food to only half of the population, the spoiled amount will decrease to five kilos. What do you do? If you choose to send more food to only half of the population, you are giving priority to the efficiency of your aid program, but if you still try to deliver to the entire population, despite the greater loss of food, then you are prioritizing fairness over efficiency.

This is precisely the sort of conundrum explored by Ming Hsu and collaborators, who presented subjects with a set of scenarios in which fairness and efficiency could be manipulated independently of each other, and who also obtained brain scans of the participants to figure out not only what they would decide to do under each scenario, but which parts of their brains were involved in the decision-making process. They found that three areas contribute to weighing issues of justice: the putamen is the part that responds to issues of efficiency, the insula is involved with judgments of inequity, and the caudate-septal subgenual region essentially mediates between the two to come up with a unified judgment once the person has considered the relative importance of equity and efficiency in the given situation. Looking at these results, it is hard to resist the conclusion that human beings come equipped with a sophisticated “moral calculator,” in much the same way as we are endowed with brain machinery that enables us to learn the complex rules of just about any language during the first few years of our existence.

What is particularly interesting about these results in light of Greene's dual-process theory is that the insula (the inequity-encoding region) is also known to be part of our emotional system; the putamen (the efficiency-encoding region) is involved with the brain's reward system (it is sensitive to dopamine, a natural reward drug produced by our neurons), which in turn has been demonstrated to be linked with feeling good about both charitable giving and punishment of free-riders; and finally, and most revealingly, the area integrating these two functions, the subgenual, has been implicated in trust and social attachment. In other words, it looks like a socially well-adjusted person has to constantly weigh issues of fairness and efficiency and that three distinct but interconnected areas of the brain help us do just that. Hsu and his collaborators conclude:

More broadly, our results support the Kantian and Rawlsian intuition that justice is rooted in a sense of fairness; yet contrary to Kant and Rawls, such a sense is not the product of applying a

rational deontological principle but rather results from emotional processing, providing suggestive evidence for moral sentimentalism.

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We will get to both Kant and John Rawls (1921–2002) in due time, but if you read this carefully you will find that it is an example of scientists attempting to override philosophy based on experimental results, a violation of Hume’s separation between is and ought. As I argue at several junctures in this book, however, this counterposition between science and philosophy is misguided and not particularly fruitful. A more interesting reading of these results is that humans have a built-in emotional sense of fairness analogous to the one advocated by philosophers like Kant and Rawls. But this doesn’t mean that, just as with any other biological instinct, rational discourse and learning cannot improve on what mother nature gave us.

Although Greene’s dual-process theory is beginning to look like a good way to think about the relative roles of reason and emotion in moral judgment, it is not without its critics. Bryce Huebner of Tufts University, Susan Dwyer of the University of Maryland, and Marc Hauser, formerly of Harvard, have pointed out the obvious problems: from a correlation between emotions and ethical decisions it doesn’t follow that the first causes the second; it may just as easily be the case that certain decisions of moral import cause us to experience specific emotional reactions. Huebner and his collaborators do not, of course, deny that emotions are an integral part of the psychology of moral decisions. For instance, it is hard to ignore the fact that the emotions of guilt and shame not only are felt after certain actions but are powerful factors preventing the recurrence of such actions. Still, their paper presents not one but five different models of what they call “the moral mind.” Interestingly, four of the five models are associated with the name of a philosopher because each of these four models reflects a well-known type of moral philosophy. Let’s take a quick look.

The first possibility considered by Huebner and his colleagues is what they call a “pure Kantian” model: just as philosopher Immanuel Kant thought, in this model Reason influences Emotion, and that in turn generates moral Judgment (thus the causal chain looks like  $R > E > J$ ). Alternatively, a “pure Humean” model is characterized by the fact that Emotion gets the process started, generating Judgment, followed by our ability to come up with Reasons why we made that judgment ( $E > J > R$ ). The third possibility, not surprisingly, is a hybrid Kant-Hume model, where both Reason and Emotion interact to yield moral Judgment ( $E,R > J$ ); this, of course, is essentially a restatement of Greene’s dual-process theory. A fourth model is termed by the authors “pure Rawlsian” because it is based on John Rawls’s ideas about justice as fairness (to be discussed in [Chapters 14](#) and [15](#)); here moral Judgment comes first (the result of an Analysis of possible Actions), and both Reason and Emotion are deployed to justify it and to act on it ( $AA > J > E,R$ ). Finally, a “hybrid Rawlsian” model enlists Emotion to carry out action analysis, which then leads to Judgment and finally to the articulation of Reasons in its support. (This would look diagrammatically a lot like the pure Humean model, except for the added interaction between Emotion and Action Analysis:  $AA/E > J > R$ ).

The interesting point raised by Huebner and his colleagues is that the current empirical evidence does not conclusively discriminate between the five models; indeed, the fifth had not even been articulated in print until they published their paper. Things, therefore, are a bit more complicated than what I have already outlined, though I remain convinced that some version of the Kant-Hume model (that is, a dual-process model) is the one currently favored by the totality of the available evidence.

There is another fairly big set of caveats that an intelligent user of scientific investigations into the functioning of the brain has to keep in mind. As pointed out by Kristin Prehn and Hauke Heekeren, studies like the ones we have examined so far (and to which we return in [Chapter 16](#) when we look



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