"I am extremely pleased that Heidi Furey, Scott Hill, and Sujata Bhatia have written this impressive text …. In my legal practice of almost 40 years and as an engineering society executive, I have had the opportunity to review a range of books and publications addressing the issue of engineering ethics. In my opinion, *Beyond the Code* is singular and exceptional in the manner in which it addresses the topic of engineering ethics. The text combines the theoretical and the practical in a way that will delight readers …. I congratulate the authors on a job well done!"

Arthur E. Schwartz, Deputy Chief Executive Officer,
NSPE (writing in his Foreword to the book)

"*Beyond the Code: A Philosophical Guide to Engineering Ethics* is a unique text for engineering educators to teach the complex topic of ethics, as well as for professional engineers seeking to deepen their knowledge on the subject. It is organized such that each chapter focuses on one of the six Fundamental Canons of the NSPE Code of Ethics, providing the reader with underpinnings from a philosophy perspective (ideas and literature that most engineers may not be exposed to or even seek out on their own) coupled with relevant case studies for discussion and reflection. A well-written, interesting, and enjoyable read!"

J. Patrick Abulencia, Chemical Engineering,
Manhattan College, USA

Beyond the Code

For over 80 years, the National Society of Professional Engineers (NSPE) has been a leader in the promotion of ethical practice within the field of engineering. One of the Society's greatest contributions is the formation and adoption of the NSPE Code of Ethics. But the code, with its six "Fundamental Canons," is only truly instructive if engineers can bridge the gap between principles and action. Here there is no substitute for personal reflection on the ethical and philosophical issues that underlie the code. If done well, such reflection provides an indispensable basis for moral problem solving. *Beyond the Code: A Philosophical Guide to Engineering Ethics* is designed to complement the NSPE Code of Ethics by helping readers "go beyond" in their understanding of the philosophical issues bound up in the code. Each chapter addresses one of the Fundamental Canons of the NSPE code, and provides a philosophical analysis of the various parts of each canon by employing contemporary and classical texts. This unique approach to engineering ethics guides students and professionals in their readings of the appended selections to refine their understanding of the code in order to apply it to the practical challenges of today's engineers.

Key Features:

- Is the first introduction to engineering ethics that helps students understand and apply the NSPE Code of Ethics to engineering practice
- Includes a Preface from Arthur E. Schwartz, NSPE Deputy Chief Executive Officer and General Counsel, and NAFE Executive Director
- As a hybrid text, includes primary philosophical texts with extensive introductions from the book's three authors
- Offers case studies from the NSPE Board of Ethical Review, allowing students to see a direct connection between the issues discussed in the text and real-world engineering practice

- Includes the following pedagogical aids:
  - "Key Terms and Concepts" for each chapter
  - "Preparing to Read" sections before each primary source reading
  - "Guided Reading Questions" after each primary source reading
  - "Going Beyond—Our Questions for a Deep Dive" after each case study.

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Beyond the Code

A Philosophical Guide to Engineering Ethics

Heidi Furey, Scott Hill, and Sujata K. Bhatia

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Foreword

Arthur E. Schwartz, Deputy Chief Executive Officer of the NSPE

Are there many more significant issues confronting our society today than engineering ethics? I do not think so.

In its essence, engineering ethics constitutes an inquiry and understanding of the role that professional engineers and the technology they employ plays in shaping our everyday world. Because of the profound role that professional engineers possess in conceptualizing, designing, building, manufacturing, operating, maintaining, and disassembling products, structures, buildings, systems, processes, and other we live in, walk in drive in, eat, drink, and breathe, few issues could be more important to us. That is why I am extremely pleased that Heidi Furey, Scott Hill, and Sujata Bhatia have written this impressive text, *Beyond the Code*.

As the book clearly demonstrates, engineering ethics reflects the customs, habits, and values of engineering as a profession, and embodies the time-tested experience, seasoning, and training of practicing engineers. As with law and medicine, professional engineering is a learned profession. Professional engineering involves the exercise of expert judgment and discretion in the performance of services, and professional engineers are expected to use their education, training, and experience in a manner that comports with public health and safety.

Often engineers look for guidance in determining the most appropriate course of action to follow in what is contained in the law. Statutes, regulations, and court decisions certainly provide a basis to make certain decisions about conduct and behavior. The law, however, does not always address the many issues relating to appropriate professional conduct. Other sources of guidance might be professional colleagues, family members, or friends. While these sources may be valuable as a sounding board, in other cases, these perspectives may lack the necessary technical education or professional experience to provide practical feedback. In yet other cases, the guidance might be biased or prejudiced by subjective facts or circumstances.

For that reason, professional organizations, such as the National Society of Professional Engineers (NSPE), have developed codes of ethics to assist

professional engineers in making decisions in their everyday professional practice and employment. Codes of ethics reflect basic established and sometimes evolving norms of behavior and conduct that exist within the profession, and provide general but consistent guideposts on the practice issues that professional engineers confront daily.

Except at the most basic level, professional engineering codes of ethics do not provide easy answers or solutions to ethical questions faced by most professional engineers. Most of the significant ethical dilemmas faced by professional engineers tend to be complex and textured, requiring careful and thoughtful analysis as well as an examination of multiple code of ethics provisions. At the same time, professional codes of ethics identify important guideposts that can help engineers evaluate and weigh the facts and circumstances they face, and provide a possible roadmap to addressing the ethical issues involved.

As you will note in reviewing the many NSPE Board of Ethical Review opinions contained in *Beyond the Code*, those opinions serve to illustrate that the NSPE Code is a living code that reflects significant changes in everyday professional engineering practice. In some ways, the NSPE Code of Ethics constitutes an ongoing professional engineering timeline, reflecting changing professional conventions, routines, customs, practices, and patterns.

While some of the historic modifications to the code reflect a consensus of opinions within the engineering profession, other changes have essentially been forced on the profession. For example, in the mid-1980s, during the liability insurance crisis, many engineers who had been performing professional services in connection with hazardous waste, pollution, and other related services saw those services eliminated from their errors and omissions professional liability insurance policies. Professional liability insurance protection to cover the risk of professional liability claims for hazardous waste and pollution-related services became impossible to obtain in the market. In response to this problem, many engineers sought to reduce their personal and professional risk exposures by employing contractual indemnification provisions in their professional services agreements with their public and private clients, whereby clients would agree to "defend, indemnify, and hold the engineer harmless" for the ordinary negligence of the engineer. This approach was in direct conflict with then Section III.9. of the NSPE Code, which stated:

> Engineers shall accept personal responsibility for their professional activities.

After careful review and deliberation, and in response to the growing need for guidance to engineers regarding professional liability exposure, the

NSPE Board of Directors agreed to a limited modification to Section III.9 to state:

> Engineers shall accept personal responsibility for their professional activities; provided, however, that Engineers may seek indemnification from professional services arising out of their practice for other than gross negligence, where the Engineer's interests cannot otherwise be protected.

This change illustrates the fact that the NSPE Code of Ethics is not an inalterable static document but a living document reflecting evolving circumstances that arise in professional engineering practice. It is also a recognition that a code of ethics must be adaptable to changing times, or its legitimacy and acceptance will be questioned.

In another example of adaption and change, the NSPE Code was, at one time, modified to reflect changing practice relating to the issue of conflicts of interest. NSPE Code of Ethics Section II.4.d. originally admonished engineers in public services not to participate in decisions concerning professional services solicited or provided by them or their organizations in public or private engineering practice. Because of instances in which the code was held not to apply to certain conflicts of interests involving engineers serving on quasi-governmental bodies, Section II.4.d. was later broadened in the late 1980s to add "quasi-governmental" bodies as areas of public service where engineers should avoid conflicts of interest. This change was a recognition of the proliferation, and involvement, of professional engineers on quasi-government bodies (e.g., condominium boards and not-for-profit entities) that often step into a partial governmental role, and the potential for conflicts of interest to arise.

There have also been instances where the NSPE was required, as a matter of law, to modify the code. During the 1970s, the codes of ethics of several engineering and other professional societies were challenged by the US federal government as constituting an "agreement in restraint of trade" and therefore violative of the Sherman Antitrust Act. Following litigation in the federal courts, national architectural and engineering groups, including the NSPE, were directed under penalty of law by the United States Department of Justice to modify their codes of ethics to remove provisions prohibiting (1) competitive bidding for engineering services and (2) the supplanting of one engineer by another. Later, following a civil investigative demand by the United States Federal Trade Commission, the NSPE agreed with federal antitrust officials to eliminate provisions from the NSPE Code that made it unethical to engage in certain types of promotional advertising.

Another recent change to the NSPE Code of Ethics involved recognition by the professional engineering community that professional engineers play an important role in sustainable development. As a result, in 2007, a new Section, III.2.c. was added to the NSPE Code of Ethics, stating:

> Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations.

A footnote was also added to the code at the time that defines "sustainable development" as:

> the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

More recently, in early 2019—in an effort to highlight the importance of diversity and to encourage broader antidiscrimination efforts within society generally and the professional engineering community in particular—the NSPE was expected to approve a recommendation to add language to its Code of Ethics imploring professional engineers to treat all persons with dignity, respect, fairness and without discrimination.

Opinions of the NSPE Board of Ethical Review

While a code of ethics is an essential part of any profession's efforts to assist practitioners in matters of ethics, a code of ethics alone is insufficient to provide anything more than general guidance on specific issues that confront practicing professional engineers. Most, if not all, so-called learned professions have some type of deliberative body to consider ethical questions raised by members of the profession. The legal and medical professions have established boards and committees under their organizational bylaws and procedures to consider a wide range of ethical issues facing their members. In a similar manner, the NSPE's Board of Ethical Review serves the same role for professional engineers and engineering students. Since its founding, the Board of Ethical Review has rendered and published over 500 ethics opinions, and thousands of informal opinions interpreting the NSPE Code of Ethics in cases involving factual situations that have been submitted by members, government officials, and the public.

At the time the NSPE Code of Ethics was developed, there were continuous requests from individuals as well as state societies and local chapters

for interpretations of the Code in specific circumstances. The NSPE saw this need as an opportunity for service to the profession, and in 1954 created a Board of Ethical Review. Composed of seven individuals serving three-year terms and representing various areas of professional practice (e.g., industry, government, education, private practice, construction) as well as the NSPE's six geographic governance regions, the Board is not empowered to evaluate actual ethical violation cases or take formal disciplinary action against NSPE members. Instead, the Board of Ethical Review receives factual circumstances submitted by NSPE members and others, analyzes the ethical issues involved, and renders a written advisory opinion. These decisions are published and disseminated to NSPE members solely as guidance and for educational purposes. Originally, each Board of Ethical Review decision was presented to the NSPE Board of Directors, which then determined whether the decision would be published. In 1963, the applicable governing bylaw was changed to give the Board of Ethical Review final authority regarding release and publication. Today, more than 500 NSPE Board of Ethical Review opinions are available at www.nspe.org.

The following are among the numerous ethical issues considered by the NSPE Board of Ethical Review:

- What is the role of the professional engineer in protecting public health and safety?
- When does a professional engineer have the competence to perform a particular professional engineering service?
- Are the contents of a professional engineer's report objective and truthful?
- Is a professional engineer engaged in a circumstance that constitutes a conflict of interest?
- Does a professional engineer have an obligation not to disclose certain information to another party?

The NSPE Board of Ethical Review has confronted these and countless other factual situations in response to requests from professional engineers, public officials, and members of the public.

In my legal practice of almost 40 years and as an engineering society executive, I have had the opportunity to review a range of books and publications addressing the issue of engineering ethics. In my opinion, *Beyond the Code* is singular and exceptional in the manner in which it addresses the topic of engineering ethics. The text combines the theoretical and the practical in a way that will delight readers, particularly those who, over the years, have encountered the NSPE's "You Be the Judge" and "On Ethics" articles as

well as other versions of the NSPE Board of Ethical Review's opinions. The authors have created something special—highlighting the essence of the NSPE Code of Ethics and identifying key NSPE Board of Ethical Review opinions to illustrate the critical ethical concerns contained in those Code sections. I congratulate the authors on a job well done!

Fundamental Canons of the NSPE Code of Ethics for Engineers

Preamble

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.

I Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Read the full NSPE Code of Ethics for Engineers online: www.nspe.org/resources/ethics/code-ethics

Note from the Authors

We created this book in response to some frustration we, as engineering ethics instructors, had encountered in choosing texts for our courses. In the process of text selection, we noted two gaps in the set of engineering ethics literature designed for students and professionals.

First, we noted that, while there are a number of excellent textbooks on engineering ethics, there exist few anthologies. But, rather than simply creating an anthology, we sought to address what we suspected was the reason behind this lacuna. The reason, in our minds, was that engineers were not aware of the ways in which reading philosophical articles might be relevant to their professional practice. For this reason, we wanted to create a hybrid textbook/anthology that would accomplish this task.

Second, we noted that while many of the ethical concepts behind various codes of ethics (concepts such as loyalty, responsibility, risk, etc.) were discussed indirectly in various engineering texts, no text existed that spoke directly about the ethical complexities involved in applying the codes in real life.

We hope that this text will help fill these gaps. This text is not intended to replace a standard engineering ethics textbook; nor is it designed to serve as a comprehensive anthology in engineering ethics. Rather, it is a unique text designed with three goals in mind:

1. To introduce engineers to the ethical complexities involved with interpreting and applying the NSPE Code of Ethics
2. To connect engineers with academic articles from the vast literature on engineering ethics that might help them better understand these ethical complexities and begin to develop their own solutions
3. To offer students the opportunity to grapple with ethical complexities as those complexities manifest themselves in real life as represented in case studies from the NSPE Board of Ethical Review archives.

This text is by no means intended to offer the final word on any of the ethical complexities surrounding the NSPE Code of Ethics. Instead, it is meant to serve as a gateway to ethical inquiry. If we as authors have done our job well, readers should finish this book with many more questions than when they began.

Preface

Here's a fact: ethics, the study of right and wrong, is not a branch of psychology, sociology, or even law. Instead, ethics is actually a branch of philosophy. Here's another fact: engineers make great philosophers—really great ones, actually. And, what is more, once they've have been exposed to them, many engineers find they genuinely enjoy thinking about the kinds of complex philosophical issues involved in ethics.

Maybe you are an engineer who has had some exposure to the philosophical study of ethics in the past. In that case, none if this is news to you. However, to some, these facts might be surprising. To begin with, ethics does not exactly seem like a topic for philosophers. Ethics is about being good. You are either good or you aren't. How could this be a topic for philosophical investigation? Next, in the minds of some, nothing seems further from engineering than philosophy. Engineers make stuff—real, useful, important stuff. Philosophers ponder things—abstract things, not so useful, and (if we are honest), maybe not so important. What's more, ethics is just about following the rules, right? And, unless you are a bad person, following the rules is a pretty straightforward affair. This is why many engineering students think of the required ethical component of their curriculum as a waste of time. Granted, ethics is important. But most people already know what is right and what is wrong. So spending time on ethics when you could be working on that overdue project seems unnecessary at best. Many professional engineers feel similarly about professional codes of ethics. Sure, it's great we have them. No one would say that we *shouldn't* have codes of ethics. But ethical codes don't actually help us behave ethically—we already know how to do that (or we don't, in which case it's unclear how much a code of ethics would help). A code of ethics is just a thoughtful reminder to keep on the right side of the rules. Of course, we all need a reminder now and then, but there is no reason to spend too much time thinking about ethics.

Of course, as you are reading this, you'll have suspected that we, the authors of this book on engineering ethics, have a different opinion. To find

out if we are wrong, you would have to read this book. If you are already skeptical, sinking time into an ethics text might not seem like such a good bet. But, before you decide, let us say a few things about why you might want to take that bet.

Ethics, it turns out, is not simply a matter of being a good person (though it might involve that). And it isn't just about learning a set of rules (though rules may be involved). It is about asking and answering (or trying to answer) fundamental questions about how we ought to live. And because we live in a world of competing needs and values, we often find ourselves confronted with situations in which it isn't at all clear what the right thing to do is. These ethical problems, as they are called, are at the center of applied ethics—the branch of ethics that asks what we ought to do in particular, real-world situations.

One reason that ethics falls under the umbrella of philosophy is that ethical problems are deeply complex and almost never admit of straightforward answers. Finding the answers to these questions matters quite a bit because they affect the most fundamental decisions we, as human beings, can make. For this reason, ethical questions are quite compelling. Philosophers are usually known as "deep thinkers" (sometimes there is a bit of an eye roll included here for the wishy-washy sound of "deep"). But what most people don't realize is that, for many philosophers, "deep thinking" translates to analytical thinking. These sorts of philosopher enjoy shifting through complex problems in a precise and reasoned way. They live to clarify a problem, offer creative and well-supported solutions, and test their solutions to that problem in a rigorous way. And if they don't solve the problem, they are more than willing to gather what they've learned from their failure, and start again.

Hopefully, for the engineers reading this preface, this process sounds familiar. Engineers are very often skilled analytical thinkers who love to carefully dissect a problem and creatively construct an answer. Engineers take pride in testing their work; tinkering and tailoring their solution until they get it right. They aren't afraid to revisit the problem, looking at it from another angle, trying a new approach. Engineers aren't afraid of complexity. They live for a challenge. And that sort of mindset is exactly what is required for moral problem solving.

Too often, engineers are asked to blindly follow various codes of professional conduct, and to pay lip service a set of ethical ideals they have never really thought about. Considering that engineers have the perfect skill set to think deeply about moral questions, this seems like a waste. What's more, it can be argued that no one, not even philosophers, are in as good a position to engage in the ethical issues surrounding the practice of engineering as engineers. True, philosophers who study ethics are often skilled moral

problem solvers. However, as we will see, many of the ethical issues facing engineers are as much technical problems as they are ethical ones. Arguably, finding solutions to these problems requires both philosophical and technical competencies. As engineers, you already have the required technical knowledge. What we hope to offer you the philosophical knowledge that you need to begin to seriously engage with moral problems.

The title of this book, as you've seen, is *Beyond the Code*. This title is meant to refer in general to the code of professional ethics in engineers, of which there are many. However, it is also meant more specifically to refer to the Code of Ethics endorsed by the National Society of Professional Engineers (NSPE.) As one of the largest and most influential professional organizations for engineering in the United States, the NSPE has long been a leader in ethical engagement in the field. The NSPE offers a wealth of ethical resources for engineers including an impressive code of ethics. The six Fundamental Canons of its Code of Ethics are both inspiring and, to some extent, platitudinous. To some, these tenets, which tout abstract ideals such as honor and dedication, may even seem banal. However, in the words of David Foster Wallace, "banal platitudes can have a life-or-death significance."

This book is designed to complement the NSPE Code of Ethics by helping readers "go beyond" in their understanding of the philosophical issues bound up in the code. While reading this book, you will be confronted with various ethical dilemmas that arise as we attempt to apply the code to engineering practice. And you will be offered guidance on how to clarify these problems and how to begin working on solutions to them.

This book is also intended to fill a particular lacuna in the resources offered by the NSPE. Although the NSPE Code of Ethics is thoughtful and well-constructed, it is necessarily open to interpretation. In reality it takes substantial philosophical deliberation to be able to apply the principles articulated in the code to real-world practice. The NSPE offers a great deal of support in helping professionals interpret the code, including a huge volume of actual cases from its Board of Ethical Review (BER) which engineers can look to as examples. However, there is no substitute for personal philosophical reflection on the ethical issues that underlie the code. Such reflection is the basis for moral problem solving, and it is indispensable.

There are a great many philosophical journal articles that can aid in philosophical reflection about engineering ethics. However, engineers outside of academia rarely have any exposure to these texts. Furthermore, these texts are often aimed at academics with specialized knowledge in ethics. Unfortunately, this can act as a barrier—keeping those with the most direct connection to the issues discussed in the engineering ethics literature, the engineers, from engaging with it. Finally, because of the abstract nature of some philosophical texts, it isn't always clear to engineers how philosophical

articles relate to professional codes of ethics. It's no wonder then that engineers are not usually regular consumers of the latest research in engineering ethics. They have never really been invited to be.

It is our hope that this book can help resolve some of these issues. Each of the main chapters of *Beyond the Code* is centered on one of the Fundamental Canons of the NSPE Code of Ethics. The chapters begin with an introduction designed to draw out the ethical complexities involved with interpreting and applying a particular canon. Be forewarned: our intension here is in a sense to complicate the issues, not to simplify them. The reason, as you will see, is that real life is messy and ethical matters are themselves very complicated. Because of this, it's rarely easy to perfectly apply abstract codes of conduct in real-world situations. Better to be exposed to these ethical complications now than to be blindsided by them in real life. That way, you'll have a head start in creating a game plan to deal with them. The second component of each chapter is designed to offer you some tools to create that game plan. Here we have selected excerpts from the philosophical literature on ethics and engineering ethics that offer some future insight with regard to the ethical complexities we've uncovered in the first part of the chapter. Will reading these excerpts answer all of the questions we've raised regarding how to interpret and apply the code? Absolutely not. But reading them will help you begin to develop your own answers to these questions. Next you will find a section containing cases from the NSPE BER archives that we think embody some of the ethical complexities discussed in the chapters. Along with presenting questions from the NSPE, we've included our own questions. These "Questions for a Deep Dive" are designed to help you "go beyond" the surface level of each case, and to offer a judgment in those cases that takes account of the ethical complexities. As you will see, there are no easy answers to the questions we propose. But it is our sincere belief that when faced with an ethical dilemma it's better to wisely answer "it's complicated" than to foolishly answer "it's simple." Finally, we have included a section of "Guided Further Reading." Here we have included links to articles that help take the reader to the "next level" of philosophical engagement with the underlying issues covered in each chapter. We introduce each reading and follow up with discussion questions. These more advanced readings are aimed at readers who wish to further extend their engagement in the field of engineering ethics.

Our survey of the ethical issues involved with interpreting and employing the NSPE Code of Ethics is by no means comprehensive. As a field, engineering ethics is constantly growing, evolving, and reshaping itself. We hope to offer both students of engineering and professional engineers an entryway into that field. It is our most sincere hope those reading this book will become contributing participants in the field themselves.

Introduction

The introduction discusses some of the philosophical background needed to address the problems we discuss throughout the book. We discuss normative ethics, including consequentialist and deontological theories. We discuss applied ethics, including the use of moral theories as imperfect tools, value conflicts, and the differences between legal and moral requirements. Along the way, we illustrate these applied issues with discussions of some NSPE cases. Finally, we turn to issues in metaethics and philosophy of science that sometimes get in the way of teaching applied ethics. Students are often puzzled by the possibility of moral knowledge or how morality could be objective. Students sometimes think that there is nothing puzzling about scientific knowledge, and that it is completely unproblematic to suppose that it is objective. We address these issues to clear the way for applied discussion. We make the status of moral knowledge and moral objectivity a bit less puzzling. And we make the status of scientific knowledge and scientific objectivity a bit more puzzling. The main goals of this chapter are to introduce students to ideas and methods we employ in the book—and to clear away some epistemological and metaphysical issues that sometimes raise pedagogical difficulties in ethics courses.

Chapter 1

Chapter 1 begins with an examination of the first Fundamental Canon of the NSPE Code: "To hold paramount the safety, health and welfare of the public." This canon may seem straightforward, but its simplicity is deceptive. To begin with, we might wonder about what, if anything, differentiates public welfare from health and safety. We open Chapter 1 with a discussion of the nature of public welfare, which we refer to as "public wellbeing." This leads us to a much larger discussion regarding the three potential issues that engineers must address if they hope to meet their professional obligation to safeguard the public. These are: paternalism, technological mediation, and distributive justice.

As we explore these issues, we raise a number of ethical questions, including: Are there cases in which the public may not know what is in their best interest? In that case is it permissible for engineers to make decisions on behalf of the public? And might engineers be permitted to "influence" the public's choices through design? Finally, do all members of the public share a common interest? In other words, what if what is beneficial to certain members of the public comes at the expense of other members?

To help you begin to answer some of these questions, we've included two excerpts from articles belonging to the contemporary literature on

engineering ethics. The first is Mary L. Cummings's "Integrating Ethics in Design through the Value-Sensitive Design Approach," in which she discusses one approach to integrating human values into engineering design: value-sensitive design. The second article, by Erin A. Cech is, "The (Mis)Framing of Social Justice: Why Ideologies of Depoliticization and Meritocracy Hinder Engineers' Ability to Think about Social Injustices." In this article, Cech identifies two potential cultural ideologies within engineering that she claims contribute to the (mis)framing of social justice issues within the engineering profession.

Chapter 2

Chapter 2 centers on the second Fundamental Canon, which insists that engineers "perform services only in their area of competence." This principle is intended mainly to prohibit engineers from engaging in technical work for which they are not properly qualified. However, its adoption raises interesting questions about the nature of competence itself. In this chapter, we ask particularly about moral competence. How does one become morally competent? What is the role of mentors in developing moral competence? How does moral competence relate to technical competence, and what does this relationship mean in engineering practice? And how do we go beyond competence—how does one progress from moral competence to moral expertise?

Here we turn to the work of Aristotle, who was the first in the Western canon to articulate the role that practical/ethical judgment plays in ethical competency. Our discussion of Aristotle makes clear the importance of exemplars or mentors in moral development. Here we connect to the work of Vivian Weil, who examines the various ethical considerations involved with mentorship. Next, we probe the relationship between technical competence and moral competence. Here we address the work of the twentieth-century philosopher Herbert Marcuse, who asks whether what he calls "technological rationality" actually compromises one's moral sense. Finally, we consider an Aristotelian inspired proposal by Jon Alan Schmidt. Schmidt argues that technical creativity holds the key to avoiding many moral dilemmas—essentially narrowing the gap between technical and moral expertise.

Chapter 3

Objectivity is a notion that relates to truth. In Chapter 3, we raise questions about truth and objectivity, and the relation that these concepts bear on both forming and reporting beliefs. We think about what it means for a belief to be "objective" and for a person to be "objective" in their thinking.

We recount some of the history of the pursuit of objectivity in relation to both science and philosophy by delving into the writings of seventeenth-century philosopher René Descartes. We view his famous search for indubitable knowledge in the context of his interest in finding a "firm foundation" for the science in a time before the scientific revolution. Taking a cue from Descartes, we look to understand some of the ways that objectivity can be corrupted. We present an article by Sven Ove Hansson which discusses a major threat to objectivity in science and engineering, "Fallacies of Risk." We give special attention here to the phenomenon of social engineering—discussing the potential moral dangers surrounding it. Next we turn to the role of scientific integrity in the public's perception of science and engineering. We argue that maintaining objectivity in these areas is essential both to maintaining public trust and to ensuring the survival of science and engineering. Here we bring in the work of Susan Haack, whose writing on scientific integrity helps illuminate the importance of objectivity in science and engineering. In the final sections of this chapter, we turn our attention to the connection between epistemic obligation—the obligation to form beliefs well—and moral obligation. As Willard van Orman Quine suggests, all rational agents, including engineers, have an epistemic obligation to resist bias in forming beliefs. However, because an engineer's beliefs inevitably affect the wellbeing of the public, might she have a special moral obligation to pursue scientific objectivity as well? We investigate an article by Sheralee Brindell that answers, "yes." She attempts to broaden the concept of scientific inquiry by arguing that requests for scientific and technical explanation reveal a set of moral criteria related to the issue of trust.

Chapter 4

In Chapter 4 we examine the topic of loyalty in the profession of engineering. We start with the case of computer engineer Edward Snowden. Snowden had various loyalties that came into conflict. There is a question about how those loyalties should be balanced, and whether Snowden made the right decision in leaking classified US National Security Agency (NSA) documents. This sort of conflict was the principal concern of Josiah Royce, a nineteenth-century American idealist who wrote *The Philosophy of Loyalty* in 1908. This book explains what degenerate loyalty (loyalties that are too exclusive or shortsighted) might look like and proposes an ideal model, which Royce calls "loyalty to loyalty." This model is helpful for readers to consider as they move toward careers in engineering because it suggests that not only do they have to be faithful to particular individuals or groups, but they also have to be loyal to an overarching ethical principle that can apply to all situation and cases. Royce is quite good in articulating this position.

Next we introduce the concept of "attitudinal loyalty" by guiding the reader through selections from Hannah Arendt that address the "banality of evil"—the idea that great evil can be perpetrated by groups of people who fail to take the appropriate moral responsibility for their actions.

Although the question of loyalty has deep roots in the history of philosophy, it emerges in the contemporary literature in the problem of whistleblowing. Does an engineer's obligation to be loyal to her employer outweigh her obligation to the public? And must an engineer's loyalty to the public outweigh her personal loyalties—for instance, obligations to family or self? We end Chapter 4 by considering Mike W. Martin's answers to these questions. Martin notes that whistleblowing has become a "preoccupation" in engineering. Because of this, he claims, engineers are in danger of ignoring personal factors when considering public obligations. Martin argues that although engineers have a strong prima facie obligation to report wrongdoing, this obligation must be weighed against personal obligations, such as the obligation to protect one's family or career. Furthermore, Martin calls attention to the public's responsibility to engineers. As he explains, the strength of an engineer's obligation to blow the whistle is partially determined by the protections put in place by the public for those who report wrongdoing.

Chapter 5

Chapter 5 aims to deepen our understating of the fifth canon, "Avoid deceptive acts." We begin by asking several questions about the nature of honesty and deception. Is honesty just a matter of following the familiar courtroom pledge "tell the truth, the whole truth, and nothing but the truth?" Or is there something more to honesty than truth. And is honesty itself always a good thing? Or are there times when honesty could be harmful or destructive? And if telling the truth is not always the best policy, what, if anything, is the real value of honesty? Furthermore, what does it mean to fail to be honest? Is lying the opposite of honesty, or can we fail to be honest even without lying? And what is the connection between lying and deception? Might one be deceptive without telling a lie, and is one worse than the other? Finally, where do issues of honesty and deception make contact with actual engineering practice?

The moral issue of deception has a long-standing place in the history of philosophy. To help orient readers to the topic, we share insights from philosopher of language Paul Grice. Grice's work on the nature of communication makes it clear that honesty cannot be a matter of just telling the truth, and that deception cannot simply be a matter of telling lies. We follow our discussion of Grice with a presentation of Jennifer Saul's work

on the moral difference between lying and deception. We then turn our attention to exploring the issue of what makes honesty morally beneficial and deception morally detrimental. Here we consider what consequentialists, deontologists, and care ethicists have to say about the value of honesty. The historical discussion of truth-telling becomes especially interesting in the context of engineering, where "the truth" is often technically complex and easily misunderstood. In technical fields where there is often an expansive gap between expert and lay person, might there be cases in which it is in the public's best interest for an engineer to refrain from telling the truth in its entirety? The "Problem of Full Disclosure," as we call it, is one that Paul B. Thompson tackles in his article on truth-telling and the problem of risk. After a brief discussion of Thompson's article, we move on to two final issues of deception as it relates to engineers. While most of Chapter 5 focuses on honesty and deception with regard to the public, we close the chapter by drawing attention to two other forms of deception: deceiving one's self (self-deception) and deceiving one's peers (plagiarism).

Chapter 6

The final chapter of *Beyond the Code* offers a culmination of themes that began in Chapter 1. The sixth fundamental canon of the NSPE Code of Ethics challenges engineers to "Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession." Here we ask if, in addition to the obligations engineers have to themselves and to the public, they also have ethical obligations to the profession itself. If so, what is the nature and extent of the responsibility engineers have for enhancing the honor, reputation, and usefulness of the profession, and how are engineers to accomplish such a weighty task? We argue that the final directive connects issues of obligation to talk of character and, in doing so, raises questions about personal and professional excellence.

We begin by considering a number of obstacles to professional responsibility. We show how the notion of responsibility can become murky for engineers when they are embedded in complex organizational structures. In situations in which engineers lack complete control over decisions regarding their work, they might tempted to eschew responsibility altogether. On this point we look to Michael Davis, who attempts to identify what role, if any, social forces play in determining the boundaries of ethical obligation in engineering. Davis offers reasons for engineers to embrace responsibility rather than finding reasons to avoid it. After gaining some clarity on the barriers to professional responsibility, we turn to the question of how to cultivate a sense of responsibility. Here we return to the themes of virtue and excellence introduced in Chapter 2. Michael Pritchard argues that, in

thinking about professional responsibility, we have focused too much on wrongdoing and how to avoid it. This leads to a warped sense of what it means to take responsibility as an engineer. He suggests that we ought to focus on the positive aspects of engineering practice, including the development of virtuous character traits. By cultivating their character, Pritchard argues that engineers can move from merely doing the minimum to fulfill their obligations to going "above and beyond the call of duty." However, issues of character are inherently personal. Our view is that questions of morality and professionalism have deep existential import and cannot be addressed without appealing to issues of personal meaning. With this in mind, we conclude this book by returning to the work of Mike W. Martin. Martin emphasizes the connection between personal meaning and professional responsibility. He argues that morality requires that an engineer go beyond mere compliance with ethical codes and develop moral commitments that are rooted in her identity as a person and a professional.

Reading this book will not guarantee that engineer-ethicists come up with the right moral answers, but this has never been the way that moral deliberation works. Rather, the process of developing answers to ethical questions is something that starts out messy and vague and then, over an extended period of time, comes into greater and greater focus. Such deliberation should be natural for engineers—the engineering design process is an iterative practice, so that engineers continually refine their designs to best serve public needs. Answers concerning the common good are not cut-and-dry from the start; but they are, undeniably, worth pursuing.

Introduction

Background

We have two goals for this introduction. One is to provide you with the background needed to understand and evaluate the NSPE Code of Ethics. The code and its associated discussions make use of various ethical ideas and raise various ethical problems. Here we explain the ideas and problems that will be most important as background for the discussion ahead. We discuss normative ethics, applied ethics, metaethics, and philosophy of science. Our second goal is to eliminate some natural concerns one might have about the field of ethics. Some people worry that no ethical theory is plausible enough to be used as a tool to address ethical problems in the real world. Others worry that, in contrast to science, there is no truth about ethics to be found. Such concerns sometimes get in the way of doing ethics. We address them in this introduction. With the relevant background in place, and with the relevant worries addressed, the introduction will equip you to address the issues that arise in connection with the NSPE Code and its application to the engineering profession. (Note that we use "moral" and "ethical" interchangeably.)

Normative Ethics

Normative ethics is about actions. People who engage in normative ethics seek to discover principles that determine the moral status of actions. We can begin to understand normative ethics by considering some examples that bring out the strengths and weaknesses of various theories: Imagine there is a runaway trolley. If you do nothing, the trolley will kill five people who are tied to a track. But you are standing next to a lever. And if you pull the lever, the trolley will be diverted onto another track. The five will be saved. But there is one person tied to the alternate track. And if you pull the lever, that one person will die. What should you do? Call this example **Trolley**. Before reading on, take a few minutes to think about it.

Most people, when given just this example, tend to think that you should pull the lever. After all, you are trading one life for five. It is obvious that you

should pull it. But there are always a few people who resist that judgment. If you are one of the holdouts, imagine there are six people who will die unless you divert the trolley onto the alternate track. Now imagine that there are seven … imagine that there are 100 people on the other track. Keep increasing the number if you like. If you are still not convinced, imagine your mother is one of the many people who will die unless you divert the trolley. Eventually, almost everyone agrees that pulling the lever is the right thing to do.

Now consider a different example. Imagine again that there is a runaway trolley. This time, if you do nothing, the trolley will pass through a tunnel, come out the other end, and hit and kill five people tied to the track just outside the tunnel. However, you are standing on top of the tunnel, just over the entrance. In front of you is a large man. You can push the large man into the trolley just before it enters the tunnel. The impact will kill him. But he is so big that it will also stop the trolley before it exits the tunnel. And the five people tied up near the exit of the tunnel will be saved. Call this example **Large Man**. Take a moment to think about whether you should push the large man into the trolley or just let it pass through. Now compare it to what you wrote down about Trolley. If you thought should pull the lever in Trolley, consider what your reason for pulling tells you about whether you should push in Large Man.

Many people, when just given Large Man and not given Trolley, think you should not push the large man into the trolley. They think it is absolutely wrong. And you should just let the trolley go through the tunnel. But other people are holdouts. They think you should push the large man. Sometimes they just want to be consistent. They have already considered Trolley. They know that their reasoning in Trolley supports pulling the lever. And they recognize that that same reasoning will motivate pushing the large man. Other people might look at it this way. In Large Man you are trading one life for five. It is too bad that the large man has to die. But one life for five is too good a deal to pass up. If you are one of the holdouts, we ask you to consider another example. Imagine you are a doctor. Imagine you have five patients who will die if they do not get new organs. Let's suppose they each need different organs. You see a janitor pass by an elevator shaft. He is healthy, and you can push him down the elevator shaft in such a way that he will die but his healthy organs will be salvageable. So you have two options. You can let your five patients die. Or, you can push the janitor down the elevator shaft, harvest his healthy organs, and save your five patients. Call this example **Organ Harvest**.

Almost everyone agrees that harvesting the janitor's organs is wrong. And, after considering Organ Harvest, almost everyone agrees that pushing the large man in Large Man is wrong. And a natural thought is this: pushing the

large man or the janitor is wrong because killing someone is worse than letting someone die.

So there is a puzzle. In Trolley, it seems like you should pull the lever, killing the one and saving the five. And the reason seems to be that you are trading one life for five. And that seems acceptable. But that same reasoning implies that you should push in Large Man and Organ Harvest, and that seems unacceptable. On the other hand, in Large Man and Organ Harvest it seems like you shouldn't kill the one even if doing so will save the five. And that seems to be because killing is worse than letting die. But that same reasoning implies that you shouldn't pull the lever in Trolley. And that doesn't seem correct. Call this **The Trolley Problem**. The Trolley Problem is that it seems permissible to trade one life for five in Trolley but not in Large Man. And it is difficult to see how to reconcile those two judgments.

Consequentialism

One natural reaction to Trolley and Large Man is this: if we are just given Trolley we think it is OK to pull the lever; if we are just given Large Man we think it is wrong to push. But when we put them together, it seems like there really isn't a relevant difference between pulling in one and pushing in the other. The two cases should be treated alike. After all, in each case you are trading one life for five. How could it be that we should kill in one but not in the other? The consequences are all that matters. The view that consequences are all that matters to morality is **consequentialism**.

Here we will look at just one form of consequentialism—**hedonic act utilitarianism (HAU)**. The core idea behind HAU is that pleasure is all and only what is good, pain is all and only what is bad, and wright and wrong are just determined by amounts of pleasure and pain along with some simple math.

To understand HAU, we need to introduce some jargon. Actions have consequences. Some of these consequences might include pleasure. Other consequences might include pain. The **hedonic utility** of an action is the result of subtracting the total amount of pain that is a consequence of the action from the total amount of pleasure that is a consequence of that action. For example, imagine you are at a party of five people and serve everyone pizza. The pizza is delicious, everyone enjoys it, and gets 5 units of pleasure each. But it also gives everyone bad indigestion and they get 10 units of pain each. So the total amount of pleasure that is a consequence of your action is 25. And the total amount of pain that is a consequence of your action is 50. The hedonic utility of serving everyone pizza is found by subtracting the number representing the total amount of pain (50) that is a consequence

from the number representing the total amount of pleasure (25). The hedonic utility of your action is therefore −25.

Another term we need to introduce is **maximizing**. An act maximizes hedonic utility if and only if no other act has a higher hedonic utility. For example, imagine again you are at the party of five. Instead of pizza you could have served everyone hummus. While hummus isn't as tasty as pizza, and everyone would have only gotten 1 unit of pleasure from the hummus, they wouldn't have gotten indigestion and so would have received 0 units of pain. In that case, the hedonic utility of serving everyone hummus rather than pizza is 5. For simplicity, let's pretend that your only options were to serve everyone hummus (for a hedonic utility of 5) or everyone pizza (for a hedonic utility of −25). In that case, serving everyone hummus maximizes hedonic utility. Now we are in a position to understand HAU:

HAU: An act is right if and only if that act maximizes hedonic utility.

One virtue of HAU is that it seems to provide a consistent way to evaluate Trolley and Large Man. A natural thought is that you are trading one life for five in both cases. And so the two cases are morally the same. It is plausible that letting five die so that one doesn't have to kill one in these types of cases has a lower hedonic utility than killing one to save five. Thus HAU delivers the judgment that the right thing to do in both Trolley and Large Man is to pull the lever and push the large man. And so this would provide a solution to the Trolley Problem.

One problem for HAU is that it doesn't seem to get Organ Harvest right. It might very well turn out that doctors could maximize hedonic utility by killing people and harvesting their organs. But it still doesn't seem like doctors should do so. So there is room to doubt that only consequences matter. And if consequences aren't the only thing that matters, then maybe there really is a difference between what we should do in Trolley and what we should do in Large Man.

Deontology

Once we see the problems faced by HAU and other consequentialist approaches, a natural reaction is to revisit our initial thought about Trolley and Large Man. Recall, the initial thought was that in each case you are trading one life for five. So the cases should be treated in the same way. If it's OK to pull then it's OK to push. And if it's wrong to push then it's wrong to pull. We might start to think that something more than consequences matters in evaluating the morality of our actions. And this is an approach adopted by deontological theories of morality.

Here we will look at just one form of **deontology**—the **Doctrine of Double Effect (DDE)**. DDE is less ambitious than HAU. While HAU tries to explain all of good and bad and right and wrong, DDE tries to address just one question: When is it OK to do something that will lead to an evil? So DDE isn't a general theory about right and wrong and good and bad. It is a theory about one way in which it can be acceptable to do something you know will lead to an evil.

Like HAU, this theory uses some jargon. So we should say a bit to clarify it. First, the theory distinguishes between **intending and foreseeing**. Imagine you are arguing with a friend about a controversial topic. As you do so, there are certain things you intend. For example, you intend to make certain sounds needed to speak the English language. You intend to convince your friend that you are right and he is wrong. You intend to make a good case for your position. You intend to have fun. All of these are things that you are trying to make happen. But there are other things that you make happen during the course of your conversation that you to do not intend. For example, as you speak, your breath will move air particles around. And as you speak, you may have various verbal tics or hand gestures that you know you will make but don't intend to make. In these cases, you foresee that as a result of arguing with your friend such things will happen. But you don't intend for them to happen. You wouldn't bother arguing with your friend if none of the things you were trying to accomplish, like having fun or convincing them, had any chance of happening. But you would still argue with your friend if you didn't move air particles around when you talked or if you didn't have unusual verbal tics and hand gestures. That is why you intend to have fun and convince your friend. But you merely foresee that you will move air particles around and make unusual unconscious hand gestures.

Second, the theory distinguishes between **ends and means**. Imagine you have a videogame console. Imagine you walk up to it and hit the power button. If you are like us, you don't hit the power button just to hit the power button. You do so in order to play a game. In this case, you intend to hit the power button. But you do so only as a means to something else. In this case, hitting the power button is a means to playing a game. This is different from intending an end. Suppose you want to hit the power button and play a game in order to have fun. In that case, you might be playing the game or having fun as an end. So hitting the power button is intended as a means. And playing the game and having fun is intended as an end.

Third, the theory talks about having **proportionally grave reason** for permitting the evil. This just means that the good thing you intend really outweighs the bad thing that you foresee. For example, imagine again there is a runaway trolley. If you do nothing, it will hit and destroy your videogame

console that is tied to the track. But if you divert the trolley onto another track, it will hit and kill one person who is tied to the alternate track. In this case, there is no proportionally grave reason to kill the person in order to save your videogame console. As valuable as it might be to you, the videogame console doesn't outweigh the life of the person you could kill. Now we are in a position to state DDE.

> DDE: A person may permissibly perform an action that is foreseen to cause an evil if:
>
> (i) the good effect is intended,
> (ii) the evil effect is not intended (either as an end or as a means),
> (iii) there is proportionally grave reason for permitting the evil, and
> (iv) the action performed is not wrong in itself.

DDE, if true, would vindicate our initial judgments about Trolley and Large Man. The key difference between the two cases concerns condition (ii) of DDE. In Trolley, you do not pull the lever intending to kill the man on the other track. You merely foresee that he will die. If he were not on the track, you would still divert the trolley. In Large Man, you push the man intending to kill him. You are using his death as a means of saving the five. So, if DDE is true, then it is OK to pull the lever in Trolley and wrong to pull the lever in Large Man.

One problem with DDE is that there are variations of Large Man that it seems to get wrong. Imagine that it is not five people at stake if you fail to push the large man. Imagine instead that if you fail to push him all of New York, Texas, and their inhabitants will be destroyed. Everyone in the states will suffer a slow and painful death. Many people have the intuition that it is OK to push the large man in this case. But DDE implies that it is not—for you are using the large man's death as a means to save New Yorkers and Texans from horrible deaths. And DDE maintains that that is forbidden.

Applied Ethics

Sometimes the Trolley Problem, and the theories in normative ethics we have used it to motivate, are written off as merely theoretical and of no interest to those of us who care about the real world. One reason to dismiss the Trolley Problem is that Trolley-like problems rarely, if ever, happen. A reason to dismiss normative ethical theories is that they are sometimes difficult to apply, and each theory we have discovered has serious problems. The

task of applied ethics is to identify and make progress on real-world moral problems. Engineering ethics is a branch of applied ethics. And those of us who work in engineering ethics seek to identify and make progress on the real problems faced by professional engineers.

So we really do owe an explanation of how all of what we have discussed is relevant to applied ethics in general and engineering ethics in particular. We will explain by way of example. The question the Trolley Problem forces us to ask is this: When is it OK to kill someone in order to save others? Doctors really could save lives by killing people and harvesting their organs. And that seems wrong. Some people will die from being vaccinated. But more people will be saved if vaccinations are widespread. And adopting the policy of widespread vaccinations seems like the right thing to do. So adopting a policy of killing people and harvesting their organs would save lives. And so would adopting a policy of widespread vaccinations. Both policies will cause people to die. Both will save lives overall. So why is it that we are horrified by one of them but find the other acceptable?

Some philosophers and engineers have thought that reflection on the Trolley Problem can illuminate the problem about how to program the artificial intelligence (AI) that runs autonomous vehicles. Some think the Trolley Problem helps in a very direct way. There will be some cases in which autonomous vehicles face a Trolley-like problem. And in those cases we should program the autonomous vehicle to do the right thing. We are skeptical of this particular application of the Trolley Problem to the problem of autonomous vehicles. But, even so, we recognize that the Trolley Problem is relevant in a deeper and less direct way. In particular, reflection on the Trolley Problem can teach us about when it's OK to kill a few people to save a lot of people. And that question is of broad relevance to the problem of self-driving cars and many other dimensions of an engineer's work, for although they will rarely be in an exact Trolley-type scenario, their design decisions will inevitably cause some to die and others to live.

All of these issues about whether and how to apply the Trolley Problem and normative ethics to the real world are exercises in applied ethics. Applied ethics is concerned with taking the tools of theoretical ethics and using them to evaluate real-world moral problems. These include the problem of how to program autonomous vehicles and the problem of why it is permissible to adopt a policy of widespread vaccination but not organ harvesting that were just discussed. But they also include many more. What should be bought and sold? How should society be organized? Is abortion permissible? When is sex permissible? How much am I obligated to give to the poor? These and many other questions compose the field of applied ethics.

Moral Theories as Imperfect Tools

There is a natural worry one might have here. In our discussion of normative ethics, we saw that we haven't really figured out what the best normative theory is. Consequentialism and deontology each have their strengths. But they are each also problematic in various ways. It doesn't seem plausible that either sort of theory captures the whole truth about morality. One might reasonably wonder, then, how normative ethics could be useful to real-world problems.

We think this worry can be addressed by looking at how physicists use their theories. The best two theories in physics are General Relativity and Quantum Mechanics. General Relativity is good at explaining the behavior of big things like planets and stars. It has implications for the behavior of very small things like subatomic particles. But it is much less reliable in that domain. Quantum Mechanics is very good at explaining the behavior of subatomic particles. It has implications about the behavior of big things like planets and stars. But it is less reliable than it is about big things.

General Relativity and Quantum Mechanics are inconsistent with one another. They describe the universe in radically different ways. Physics uses both theories but for different purposes. No one has been able to unify them into a single theory even though they have tried. In light of such failure, physicists simply use each theory where it is strongest.

Some philosophers have suggested that we should think about moral theories in the way that physicists think about their theories. None of our moral theories are good enough to count as the One True Moral Theory. But we have consequentialist theories that are pretty good at explaining some aspects of morality. And we have deontological theories that are pretty good at explaining other aspects of morality. If we are interested in applied ethics, we should just use each theory where it is most successful. Moral theories are useful tools. But no single moral theory perfectly captures morality.

Value Conflicts in Applied Ethics

Throughout this book we will discuss various cases in which values come into conflict in engineering practice. Value conflicts occur when we try to apply the NSPE Code of Ethics to real-world situations. For example, the fifth Fundamental Canon tells us to avoid deceptive acts. But the fourth fundamental canon tells us to be faithful to our employers and clients. However, in some cases our employers and clients want us to deceive. So, depending on how we understand these canons, a conflict arises. Normative and applied ethics give us the tools to understand the canons, and, if a value conflict arises, to make progress in navigating the conflict and deciding what to do.

Let us be clear: we are not once and for all solving these dilemmas. That's not what happens in applied ethics. Failing to find a single answer to moral problems does not mean we are not making progress on the issues, and it does not mean that the problems are intractable. In some cases we may be left with more than one reasonable answer. But we will have cleared away a number of bad answers in the process.

This illustrates a standard method in applied ethics. We take on board certain moral principles and examine real-world cases in which they conflict. Then we try to figure out how best to resolve those conflicts. A standard set of such principles employed by applied ethicists is what we might call the four basic principles of applied ethics. Often employed in discussion of healthcare ethics, these principles may offer guidance to those of us in other public service professions such as engineering as well. The principles are:

1. Non-maleficence: Do not harm.
2. Beneficence: Act in such a way that the person benefits.
3. Autonomy: Honor the person's right to self-determination—to formulate and follow a life plan of her own making.
4. Justice: Distribute goods and services in a way that is fair.

In some cases, the application of these principles is unproblematic. But there are other cases in which the principles come into conflict. When such conflict occurs, engineering ethicists can look for the view that best balances these principles. For example, in some cases the principle of beneficence and the principle of autonomy come into conflict. We want to act in a way that benefits a person. We want to act in a way that respects their autonomy. But sometimes people do not choose what is best for them. When, if ever, is it acceptable to override a person's autonomy in order to secure an outcome that is best for them? In 2016 *Rust*, a multiplayer survival videogame, included an update. The update served to select the race and gender of the player. So the game would pick a race and gender for a player. And that player's account would be correlated with that race and gender for good. There was no changing it. One the one hand, this decision on the part of the game designers yielded a cost in autonomy. Players couldn't just pick whatever race or gender they wanted. On the other hand, it might be eye-opening to see the world as a character of a particular race or gender rather than whatever race or gender one wants to pick. It might make for a more interesting game in certain ways. Here the relevant issue is finding the right balance between benefiting the player and preserving the player's autonomy.

For another example, let us return to the issue of self-driving cars. Consider the following case submitted to the NSPE Board of Ethical Review (BER).

Public Health, Safety, and Welfare—Driverless/ Autonomous Vehicle

Case 16-5
Year: 2016
Facts:

Engineer A is a professional engineer working as a consultant to an automobile manufacturer that is considering the development of a driverless/autonomous vehicle operating system. Engineer A is assigned to an engineering risk assessment team whose members are being asked to make a recommendation relating to potential situations that could arise in connection with the operation of driverless/autonomous vehicles. The following scenario is among the situations that are being considered by the engineering risk assessment team: In the event of an unavoidable crash, does the vehicle's system choose the outcome that will likely result in the greatest potential for safety for the vehicle's passengers or does the vehicle's software system instead choose an option in which the least amount of potential harm is done to any of those involved in an accident, such as having the car crash into a stationary object (e.g., telephone pole, etc.) with the probability of causing some passengers serious but non-life-threatening injuries instead of striking and potentially causing a fatal injury to a pedestrian, cyclist, or motorcycle rider?

This is a case in which our values come into conflict. Whatever Engineer A's team decides, someone will be harmed. When an accident of the relevant sort occurs, either the passengers will suffer non-fatal harm *or* others involved in the accident will face the possibility of fatal harm. So both options will lead to a violation of the principle of non-maleficence. But the option that has the car crash into a stationary object does better with respect to adhering to non-maleficence than the option of having the car prioritize the safety of the passengers above all else. For in that case, although the passengers are harmed, no one is killed. As it turns out, however, most customers would prefer to purchase a car that prioritizes their safety over the safety of others. So Engineer A's team would do better with avoiding violation of the principle of autonomy for its customers by programming the car to prioritize passenger safety. For in that case, the wishes of the customers would be respected in a way that they are not if the car is programed in such a way as to prioritize the safety of all involved in a crash. In engineering ethics, we seek to find the best way to balance the relevant principles when they

come into conflict in cases like these. And these are the sort of issues that we examine in this book.

Morality and Law

When we do applied ethics, it is important to distinguish between what is moral and what is legal. For example, segregation was legal but not moral. More relevant to engineers will be cases in which there is no law, and yet there might be a moral obligation. In the Chapter 1 "Cases for Discussion" we include BER Case 18-9. In that case, an engineer is a part of a residential development project in a coastal city. There is no building code in place. So the team has a great deal of flexibility about how to proceed with the project. But the engineer has access to information and an algorithm that together make the engineer think the project should be built with a 100-year storm surge in mind. No law states that the engineer's team is required to do this. But legally, it is arguable that the engineer's team should do it. (We will return to this in Chapter 1.) Another potential point of divergence between legality and morality that is of special importance to engineers are cases of whistleblowing. Especially in the recent past, the laws in United States did not favor whistleblowers. Nonetheless, engineers still might have an obligation to blow the whistle even when doing so would be illegal. (We will return to this topic in Chapter 4.) So in these cases looking to the laws does not settle the moral questions we are interested in.

Metaethics

There is another worry one might have about the project of applied ethics. Not only might one be concerned with the fact that we haven't found the whole truth about normative ethics. And so our tools are not up to the task. One might have an even deeper worry. One might think there is no truth in morality. Or, if there is, one might think that we have no way to know what that truth is. These sorts of issues belong to the field of metaethics. We find that whenever we teach applied ethics, these sorts of issues come up. Students reasonably ask how we can know whether a moral claim is true.

One way to understand metaethics is by considering different theories about the truth and falsity of **moral statements**. Consider a list of such statements:

- Abortion is right.
- Abortion is wrong.
- Slavery is wrong.
- Mother Teresa was good.

- Hitler was good.
- Hitler was evil.
- Pleasure is good.
- Pain is bad.

Some of these statements, such as "Hitler was evil," are agreed to be true by almost everyone. Others, such as "Hitler was good," are widely thought to be false. Still other moral statements, such as the statements about abortion, are surrounded by widespread disagreement. But whatever we think of the truth or falsity of these particular moral statements, it seems that some moral statements are true and others are false. Metaethical theories may be divided according to how they answer the question: "What makes moral statements true?"

Some who doubt that morality is objective accept the **error theory**. According to this theory, no moral statements are true. All moral statements are false. Humans typically make moral statements, and in doing so think they are saying something true. But they are mistaken. When one person says "Abortion is wrong" and another person says "Abortion is right" they are both saying something false. An error theorist is like an atheist about morality. An atheist might think that both "God is loving" and "God is hateful" are false because she believes God does not exist. So there is nothing in the world to make such theological statements true. Similarly, an error theorist believes that moral statements are all false because there is nothing in the world to make them true. There is no such thing as goodness, badness, rightness, or wrongness to make such statements true.

The error theory is a very strange view. If it were true, it would mean that humans are radically mistaken about what the world is like. For this reason, one might wonder why anyone would believe such a theory. What could possibly motivate such a radical view? One important motivation for the error theory is the **argument from explanation**. According to this argument we should not believe in goodness, badness, rightness, or wrongness because they are not needed to explain any observations.

There are two premises of this argument. First, one should only believe in something if it is needed to explain what one sees and hears. Perhaps as you read this book you are studying in the school library. You look around and see other students studying. You see tables, chairs, bookshelves, and lights. Now consider a list of things you might think are in the library. You might think there are:

- Other people
- Tables
- Chairs

- Bookshelves
- Lights
- An invisible and silent leprechaun.

The first five items on the list seem like things you should believe in. But it would be absurd to believe that there is an invisible leprechaun in the library, hanging upside down from the ceiling, silently staring at you. What is the difference between the leprechaun and the other items on the list above? A natural answer is that you need people, tables, etc. to explain what you see and hear. But you don't need the leprechaun to explain anything. If there were no people, for example, you wouldn't see anyone. But if there were no invisible silent leprechaun? In that case things would appear exactly as they would if there were such a leprechaun. The leprechaun is not needed to explain what you see and hear. The other items on the list are. That is why you should believe people, tables, etc. but not the leprechaun. It would be a different story if the leprechaun became visible, hopped down from the ceiling onto your shoulder, and whispered in your ear "Don't steal my pot of gold." In that case, the leprechaun would make a difference to what you see and hear, and perhaps you should believe in it. But as long as the leprechaun remains invisible and silent, you should not believe in it. You are just tacking on something extra that you don't need to explain anything. This lends support to the first premise of the argument from explanation.

The second premise of the argument is that moral properties are not needed to explain what you see and hear. Think about something that seems obviously evil. Imagine you see an innocent child killed with a man's bat swing. What is needed to explain what you have seen and heard? You need physical things. There must be the matter that makes up the child and the man and the bat. You might need beliefs and desires to explain why the man swung the bat. But once you accept that there is the physical and there is the mental, it seems that everything about the death of the innocent child has been explained. As evil as the event seems, supposing that what happened was evil is not needed to explain what you have seen and heard. If there were no such thing as evil, the event would appear to you just as it would if there were. It is just tacking on something extra to suppose evil exists. It is just like believing in the leprechaun. And just as believing in the leprechaun is absurd, believing in goodness, evilness, rightness, and wrongness is absurd.

A challenge for anyone who wants to defend this argument concerns the first premise. The explanation for why you should not believe in the leprechaun is too demanding. There are things that we obviously get to believe, but the first premise would imply that we should not believe. We can see this by considering some of the skeptical scenarios discussed by Descartes and other philosophers later in this chapter. Go back to the story about you in

the library looking around and taking in your environment. It is true that the leprechaun is not needed to explain what you see and hear. But it is also true that other people, tables, chairs, bookshelves, and lights are not needed to explain what you see and hear. Suppose, for example, that you are a sleeping caveman dreaming about the library. All other humans have been killed. If the caveman story is true, then you would see and hear exactly what you see and hear now. But there would be no other people, no tables, etc. Imagine that only two things exist—you (a brain in a vat) and a computer hooked up to your brain with electrodes. The computer zaps your brain in one way and you see other people. It zaps your brain in another way and you hear the quiet hum of a library air conditioner. If the brain in a vat story is true, you would see and hear exactly what you see and hear now. But there would be no other people, no tables, etc.

Finally, suppose the only things that exist are you (a disembodied soul) and an omnipotent evil demon. The demon waves its demony hands in one way and it appears to you that you have a body and are in a library and that there are other people. If that were true, then you would see and hear exactly what you see and hear now. But you would have no body and no other people would exist. If you should only believe what is needed to explain what you see and hear, then you should not believe in other people or that you have a body. For stories about dreaming, and demons, and brains in vats also explain what you see and hear. That is a bit extreme. We don't have to take such wild stories seriously. But the first premise of the argument from explanation insists that we do. So the first premise is false. If we are looking for a theory about what we should believe, we need to go back to the drawing board. The challenge for the error theorist that wants to motivate her theory, then, is to come up with a better account of what we get to believe, one that makes morality come out as like the leprechaun, but not other beliefs such as the belief that other people exist or that I have a body.

Another doubt concerning the objectivity of morality stems from the thought that morality works in the way that taste is sometimes thought to work. This theory, **subjectivism**, holds that a moral statement is true for a person if and only if that person sincerely believes it. Consider the following:

- I like buffalo wings.
- I do not like buffalo wings.

If your friend says "I like buffalo wings" and you reply "No I don't, I hate buffalo wings," your reply would be based on a confusion. All you are talking about when you say you don't like buffalo wings is you. You aren't making a claim about what everyone likes. You are just making a claim about what you like. "I like buffalo wings" can be true for your friend but false for you.

To argue about whether it is true would be as silly as arguing about whether a bank is a financial institution or sloped ground along a body of water. You would just be using "bank" to talk about different things. Similarly, the subjectivist thinks that when your friend says "Abortion is wrong" and you say "Abortion is not wrong" you are just talking about different things. Your friend isn't making the claim that abortion is wrong, period, and for everybody. She is just claiming that abortion is wrong for her. It is true *for her* that abortion is wrong. But it is still true *for you* that abortion is not wrong.

It is important to note here that subjectivism and error theory are motivated in different ways. The error theorist recognizes that morality seems to exist to us. And it seems to work a certain way. She recognizes that to defend her view she needs to give us a reason to doubt how morality appears to us. Subjectivism is defended in a very different way. The error theorist tells us that our moral intuitions and appearances are mistaken, and that the argument from explanation shows that they are mistaken. Such beliefs are guilty until proven innocent. On the other hand, the subjectivist tells us that our moral intuitions and appearances are innocent until proven guilty. The reason we should believe subjectivism is because it matches the way morality seems to us. The error theorist tells us to doubt that morality is the way it appears to be. The subjectivist tells us to accept that morality is the way it appears to be. Start with the way morality seems before you were thinking about metaethics. Build your metaethical theory out of that. The subjectivist tells us that, if we do so, then we will see that subjectivism matches the way morality seems to us. And that is why we should believe it.

One challenge for subjectivism is the **argument from absent disagreement**.

Imagine you are finishing up a night of drinking in the bar district. You walk back to campus with your friends and in your dorm you start talking about abortion. Your friend says that abortion is wrong. She gives reasons and arguments for why she thinks it's wrong. You argue that abortion is not wrong. You give reasons and arguments for your position. At around 3am things get heated. Your friend yells out 'Abortion is wrong!' You yell back 'No it's not true that abortion is wrong!' Suddenly there is a knock at the door. You open the door and see a sleepy-looking subjectivist. She tells you that the two of you are confused. When your friend says 'Abortion is wrong' all she means is that abortion is wrong for her. When you say 'It's not true that abortion is wrong' all you mean is that abortion is not wrong for you. Neither of you, the subjectivist insists, is making claims about the other. You are just making claims about yourself. It can be true for your friend that abortion is wrong even if it is not true for you. It is as if the two of you are arguing about whether 'I like buffalo wings' is true or about whether a bank is a financial institution. You are just talking past each other. It is just

a confusion. In light of this, you can quiet down so the subjectivist can go back to his room and sleep.

It seems that the subjectivist is mistaken. You and your friend really do seem to be arguing. When your friend says 'Abortion is wrong!' she isn't just making a claim about what is true for her. She is claiming that abortion is wrong (period!), and for everyone. And when you say 'It's not true that abortion is wrong!' you are making a claim about everyone and not just yourself. You are really disagreeing. Think about when people yell at each other on cable news about abortion or some other issue. It seems like they really do disagree. It doesn't seem like they are just talking past one another. Finally, remember the whole reason we were supposed to accept subjectivism in the first place. The suggestion was that we should trust the way morality appears to us. The claim was that subjectivism would match that appearance. But morality papers do allow for disagreement. So subjectivism doesn't really match how morality appears to us. And so now we have no reason to accept it.

Moral objectivism is the view that some moral statements are true, some are false, and that whether they are true or false doesn't depend on what anybody believes. This view takes moral statements to work in the same way that other statements such as historical and scientific statements are supposed to work. Do you think it's true that '2 + 2 = 5'? OK. But you're wrong. Do you think it's true that 'Caesar never existed'? If so, you're wrong. Similarly, if you think it's true that 'eating babies just for fun is permissible'? Sorry. You're wrong. It isn't.

As we have seen, people sometimes doubt that morality is objective because they are attracted to the error theory and the argument from explanation. Or they are tempted to think that morality is subjective. Another doubt about moral objectivism is **the argument from widespread moral disagreement**. Humans have been arguing, for example, about abortion for a long time. It doesn't look like we'll come to a consensus about it any time soon. The lack of consensus about morality suggests that it isn't tracking anything objective.

In raising objections to skepticism about moral objectivism we do not mean to suggest that moral objectivism faces no problems. We only mean to help you see past the naïve assumption that morality is *obviously* subjective or non-existent. And, we think it is worth noting, there are skeptical problems faced by science itself.

Philosophy of Science

Consider combustion, a process that is central to many engineering processes: combustion reactions are critical for chemical transformations in

chemical engineering; combustion of fossil fuels provides energy; and the combustion engine generates mechanical power by combustion of a fuel. Combustion is so dominant in engineering that the words "engine" and "engineering" derive from the same root. Think about the last time you started a fire. Maybe you were camping during winter and wanted to make sure everyone was warm after nightfall. You lit a match, tossed it in with some kindling and some wood, and then the fire got going. This process, combustion, is so familiar that it seems unremarkable. Nevertheless, it is a source of puzzlement. While contemporary scientists agree that combustion occurs because of oxidation, long ago scientists accepted the **theory of phlogiston**. According to this theory, combustible objects contain phlogiston particles. Combustion occurs when such particles leave an object. If there really are phlogiston particles one might think that when an object is burnt it will lose weight. After all, particles have weight, burning an object causes it to lose phlogiston particles, so combustion results in weight loss. This prediction is borne out in most cases, like with the wood and kindling in your campfire. But it turns out that some metals gain weight when they are burnt. Reflection on the history and demise of the theory of phlogiston serves to illustrate a number of doubts philosophers have had about the objectivity of science.

One source of doubt is the **underdetermination problem**. We might think there is an easy argument from the story above to the falsity of phlogiston theory. The argument would be that phlogiston theory predicts that burning something causes it to lose weight. But burning certain metals causes them to gain weight. So phlogiston theory is false. Scientists at the time remained unconvinced, however. Some thought the relevant experiments simply showed that phlogiston particles have negative weight! We might laugh at this now. But what is wrong with the phlogiston theorists' reasoning here? We have an observation: some metals gain weight when burnt. The theory of oxidation predicts that observation. But so does the theory according to which phlogiston particles can have negative weight. The only good reason to believe one scientific theory rather than another is a difference in their ability to successfully predict observations. So it provides no reason to believe one theory rather than the other. Some philosophers of science believe that what is true of oxidation theory, phlogiston theory, and the observation that some metals gain weight when burnt is true of *all* scientific theories and *any* set of observations. In particular, for any scientific theory that correctly predicts any set of observations, there are an infinite number of other, incompatible, scientific theories that also correctly predict those observations. Successful prediction of observations is the only reason to prefer one scientific theory over another. So we have no reason to believe any scientific theory at all.

One way to try to address the underdetermination problem is by denying that consistency with observations is the only good reason to believe a scientific theory. Perhaps there are theoretical virtues, such as simplicity, that can be used, along with observational adequacy, to rule out theories. And perhaps that will allow us to settle on some scientific theories. A challenge for this sort of view is to explain why we should think theoretical virtues such as simplicity track the truth, and whether such virtues are really sufficient to narrow down the number of incompatible scientific theories enough to support objectivism about science.

Another source of doubt about the objectivity of science is **pessimistic induction**. Eventually phlogiston theory gave way to oxidation theory. The two theories posited different unobservable entities. Oxidation theory, we are supposing, was a better theory. So scientists eventually went with it and the unobservables it posited. But notice that the history of science is littered with stories like this. We've got a theory that posits certain unobservable entities that is pretty good at predicting observations. Then we get a theory that is even better at predicting observations but that posits completely different unobservable entities. Every scientific theory before our current ones gave way to a better scientific theory that posited completely different unobservable entities. So our current scientific theories will probably suffer the same fate. And therefore, we have no good reason to believe in the unobservable entities posited by our current and best scientific theories. All the stuff scientists are telling us about quantum entities? Don't believe it. Eventually we'll get an even better theory that tells us that something completely different exists.

One way to try to deal with pessimistic induction is to appeal to the idea of approximate truth. It is true that all previous scientific theories have been replaced by better ones. And it is true that our current scientific theories will be replaced by still better ones. Nevertheless, earlier theories were approximately true. And current scientific theories are even closer to the truth. And future theories will be still closer to the truth. That is enough to support objectivism about science. A challenge for anyone holding this view is to address the worry that previous theories were not even approximately true. Phlogiston theory, for example, posited entities which simply don't exist at all. It made predictions about combustion that were approximately true. But the entities it posited were nowhere near the truth. In the same way, when our current theories are replaced by better theories, it will remain the case that our theories make approximately true predictions about some phenomenon. But the entities that our best scientific theories posit will be shown to be completely non-existent and replaced with totally alien entities.

Another source of doubt about the objectivity of science is **descriptivist relativism**. You might think that if two people associate different descriptions with a word, then they are talking about different things when they use that

word. Imagine you are at a financial institution withdrawing some money. You associate the word "bank" with financial institution. Imagine your friend is near the ocean standing on land that borders the water with sloped ground. He associates "bank" with sloped ground along a body of water. Since you associate "bank" with different descriptions, you are talking about different things when you talk about banks. This natural thought has led some to think that supporters of distinct scientific theories are talking about different things. Oxidation theorists, for example, associate one description with "burning." Phlogiston theorists associate a different description with "burning." So they must be talking about different things when they talk about burning. And, just as you inhabit one world and your friend next to the ocean inhabits another world, so too do the proponents of phlogiston theory inhabit a different world than the proponents of oxidation theory.

One problem for descriptivist relativism is that it is unclear why the fact that people talk about different things would imply that they inhabit different worlds. Why isn't it just that they exist in the same world in which the same stuff exists but that one, the oxygen theorist, is talking about something that exists and another, the phlogiston theorist, is talking about something that doesn't exist? Another problem is that it is unclear why associating different descriptions with a phenomenon is sufficient, by itself, to make us talk about different things. Why isn't it just that phlogiston theorists and oxygen theorists are talking about the same thing but simply have radically different theories about that thing? Maybe what it takes to talk about something isn't to correctly describe it, but to instead have the right sort of causal connection to it. Surely, before the development of chemical theory, people were able to talk about water even if they had no idea that it was composed of H_2O and even if they had no theory about it whatsoever. Similarly, it seems that phlogiston theorists were talking about burning. It's just that they had a mistaken theory about what burning consists of.

It is important to recognize some differences between the underdetermination and pessimism problems, on the one hand, and the argument from descriptivist relativism on the other. Even if they are correct, the underdetermination and pessimism problems do not show that there is no objective scientific truth. At most they just show that we are too dumb to figure out what the objective scientific truth is. On the other hand, descriptivist relativism, if correct, would show that scientific truths are not objective. This should provide some comfort for the objectivist. The underdetermination and pessimism problems have at least *some* plausibility. But we think descriptivist relativism, though historically important, doesn't really have much going for it for the reasons discussed above. So, at best, the arguments of this section show that we are just too dumb to know what the objective scientific truths are.

Another important thing to note is that there are still some objective scientific truths we can know even if the underdetermination and pessimism problems turn out to be sound. In particular, such problems do not threaten the idea that we can rule out a bunch of scientific theories because they conflict with observation. And we can know which of the theories match observation and which don't. Maybe that is not all that the objectivist about science would hope for. But it is not trivial either.

In presenting some doubts about the possibility of knowledge of scientific truths, we are not suggesting that such doubts are in the end well-founded. We just want to help you see past the naïve, knee jerk idea that science is the ONE TRUE OBJECTIVE THING and that there are no important challenges to scientific objectivism. Life is puzzling. Just as philosophers have found puzzling things about every other area of life, they have found puzzling things about science. Such puzzles are not exclusive to morality.

Why Metaethics and Philosophy of Science?

If we're interested in the applied problems faced by professional engineers, why bother with metaethics and philosophy of science? We find that unless we address these issues at the beginning of class, students wonder how we could have any moral knowledge. And, without such knowledge, they sometimes think it is pointless to discuss applied ethics. So, in addressing moral epistemology, and in identifying some common problems about moral knowledge and scientific knowledge, we can then move on to more applied issues.

Introduction Key Terms and Concepts

Trolley
Large Man
Organ Harvest
The Trolley Problem
Consequentialism
Hedonic Act Utilitarianism (HAU)
Hedonic Utility
Maximizing
Deontology
Doctrine of Double Effect (DDE)
Intending and Foreseeing
Ends and Means
Proportionally Grave Reason
Moral Statements
Error Theory
The Argument from Explanation
Subjectivism
The Argument from Absent Disagreement
Moral Objectivism
The Argument from Widespread Moral Disagreement
The Theory of Phlogiston
Underdetermination Problem
Pessimistic Induction
Descriptivist Relativism

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Further Reading I.3: 'Metaethics in context of engineering ethical and moral systems' by Lily Frank and Michał Klincewicz

Tip: If you can't use the QR codes, use the hyperlinks found on the book's webpage instead: www.routledge.com/9781138183865.

Guided Core Reading

Core Reading I.1: 'An ethical framework for evaluating experimental technology' by Ibo van de Poel (excerpts)

Preparing to Read

In this reading van de Poel addresses the control problem for experimental technologies. On the one hand, it is difficult or impossible to predict the consequences of introducing experimental technologies to society. On the other hand, once an experimental technology has been introduced, it is difficult to take it back. Van de Poel suggests dealing with this problem by adopting an experimental incremental approach to introducing new technology to society. Drawing on ideas from bioethicists, van de Poel appeals to principles of non-maleficence, beneficence, respect for autonomy, and justice to construct an ethical framework to guide societal experimentation with new technologies.

Excerpted from: Van de Poel, I. (2016). An ethical framework for evaluating experimental technology. *Science and Engineering Ethics*, 22, 667–686. doi.org/10.1007/s11948-015-9724-3. Internal references generally omitted.

Introduction

Swarm robots. Human enhancement. Algae based on synthetic biology. Automated driving vehicles. What these new technological possibilities have in common is that they may seriously impact society. What they also have in common is that the exact impacts on society are currently largely unknown and are very hard to predict beforehand.

…

The difficulties in dealing with experimental technologies go back to the control dilemma formulated by Collingridge …. This says that in early phases of new technology, when a technology and its social embedding are still malleable, there is uncertainty about the social effects of that technology. In later phases, social effects may be clear but then often the technology has become so well entrenched in society that it is hard to overcome negative effects.

…

New Technologies as Social Experiments

One way to conceptualize the introduction of technology is to conceive of the introduction as a social experiment. A 2007 report by the *European Expert Group on Science and Governance* stressed the importance of the notion. They noted, "we are in an unavoidably experimental state. Yet this is usually deleted from public view and public negotiation" (Felt et al. 2007: 68) And they continue: "If citizens are routinely being enrolled without negotiation as experimental subjects, in experiments which are not called by name, then some serious ethical and social issues would have to be addressed" (Felt et al. 2007: 68).

Towards an Ethical Framework for Experimental Technology: Informed consent

When a technology is introduced it amounts to a social experiment because even if all reasonable efforts to anticipate consequences haven been undertaken, there will be unanticipated consequences. This can be turned into a more deliberate and responsible experimentation by following Popper's idea of piecemeal social experiments.

Martin and Schinzinger … have proposed *informed consent* to judge the acceptability of social experiments with new technology. The application of this principle is problematic. It may be hard to identify individuals potentially affected by the introduction of technology. To deal with this, Martin and Schinzinger propose the following specification of informed consent for situations in which individuals cannot be readily identified:

> Information that a rational person would need, stated in understandable form, has been widely disseminated. The subject's consent was offered in a proxy by a group that collectively represents many subjects of like interests, concerns, and exposure to risk (Martin and Schinzinger 1996: 87).

It remains unclear whether they understand the second condition to require unanimous consent by the representative group or only a majority decision. In the first case, the requirement of informed consent might be too strict. In the second case, it may be doubted whether what they propose is still a form of informed consent. Also, the first condition is problematic. Risks and benefits of experimental technologies may not only be hard to estimate, sometimes they are unknown.

Table 3 An ethical framework for experimental technology

1	Absence of other reasonable means for gaining knowledge about risks and benefits
2	Monitoring of data and risks while addressing privacy concerns
3	Possibility and willingness to adapt or stop the experiment
4	Containment of risks as far as reasonably possible
5	Consciously scaling up to avoid large-scale harm and to improve learning
6	Flexible set-up of the experiment and avoidance of lock-in of the technology
7	Avoid experiments that undermine resilience
8	Reasonable to expect social benefits from the experiment
9	Clear distribution of responsibilities for setting up, carrying out, monitoring, evaluating, adapting, and stopping of the experiment
10	Experimental subjects are informed
11	The experiment is approved by democratically legitimized bodies
12	Experimental subjects can influence the setting up, carrying out, monitoring, evaluating, adapting, and stopping of the experiment
13	Experimental subjects can withdraw from the experiment
14	Vulnerable experimental subjects are either not subject to the experiment or are additionally protected or particularly profit from the experimental technology (or a combination)
15	A fair distribution of potential hazards and benefits
16	Reversibility of harm or, if impossible, compensation of harm

Developing an Ethical Framework

I propose to start from the broader and more general set of ethical principles that have been articulated in bioethics: non-maleficence, beneficence, respect for autonomy, and justice (Beauchamp and Childress 2013). Table 3

Conditions for Responsible Experimentation in the Context of Experimental Technology

Non-maleficence

One ought not to (intentionally) inflict harm (Beauchamp and Childress 2013). Conditions 1 through 7 in Table 3 can be seen as a specification of the principle of non-maleficence for social experiments with technology. Condition 1 requires that before a technology is introduced, other reasonable means to gain knowledge about risks, like lab tests or field tests, have been exhausted. Conditions 2 and 3 require that that if harm occurs the experiment be stopped or can be adapted to avoid harm. Condition 4 states that harm should be contained. For reasons explained above, a complete avoidance of harm is usually not possible for experimental technologies. Conditions 5 through 7 all aim at achieving non-maleficence through the strategy of incrementalism (rather than anticipation) that was explained above. Condition 5 follows from Popper's (1945) idea of piecemeal social

experiments and is intended to avoid large-scale harm and to increase what is learned from the experiment. Condition 6 is based on the idea of Collingridge … that incrementalism requires flexibility. Condition 7 follows Wildavsky's … idea that in order to deal with the risks of new technology we should not solely depend on containment of expected risks, but also on resilience in order to be able to deal with unexpected risks.

Beneficence

We should not only avoid harm but also do good. Introducing possible but unknown harm would only be permissible if it is reasonable to expect at least some benefits from the experiment. This is what is expressed in condition 8. For experimental technologies, we often do not know the potential benefits and drawbacks well enough to list all possible effects. Therefore condition 8 is formulated in terms of whether it is reasonable to expect social benefits from the experiment. Balancing risks and benefits requires accurate knowledge of risks and benefits and the point of experimental technology is that such knowledge is usually lacking. It seems better to use a criterion that requires less anticipatory knowledge of social impacts. Condition 9 was developed as an alternative specification that something is learned from the experiment that benefits society. The learning is not scientific learning but rather trial-and-error learning about an on-going intervention through the experimental introduction of a technology into society. This learning is enabled by some of the already mentioned conditions like condition 2 (monitoring) and condition 5 (gradually scaling up to enable learning).

Respect for Autonomy and Justice

Conditions 10 through 13 are intended to safeguard the moral principle respect for autonomy. Condition 10 covers the 'informed' part of informed consent. But rather than requiring individual consent, condition 11 requires a form of collective consent by approval by a democratically legitimized body. A potential problem of such collective consent is that it may lead to a tyranny of the majority, requiring unacceptable sacrifices from individuals for the collective good. Conditions 12 and 13 and the conditions 14 through 16, which address the moral principle of justice, can be seen as a way to avoid such exploitation. They guarantee that experimental subjects have a say in the set-up of the experiment (condition 12), and are able to withdraw from the experiment (condition 13). They also guarantee that vulnerable people are either additionally protected or are not subjected to the experiment (condition 14) and risks and benefits are fairly distributed (condition 15). The last two conditions are especially important in the light

of the moral principle of justice. In the case of clinical experiments usually three main groups can be distinguished: the experimental group undergoing the intervention, the control group (undergoing another intervention or no intervention), and the larger population that might profit from the results (including vulnerable groups within this larger population). In the case of technologies, risks and benefits may be distribution over a larger number of groups and distribution effects may be more complicated. While in medicine the main effects are health effects for individuals, some technologies may also shift the power relations between groups and so have complicated distribution effects. Condition 16 that states that irreversible harm should be avoided, which can be seen as a specification of non-maleficence and when irreversible harm nevertheless occurs, compensation should be offered.

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Guided Reading Questions

1. What is the control problem? What examples from your own exposure to engineering illustrate this problem?
2. In what ways does van de Poel think anticipation-based solutions to the control problem are deficient? Do you think he is right about this? Or do you think his criticisms are exaggerated? Why?
3. What is the incremental and experimental approach that van de Poel proposes? Do you think that it is a viable solution to the problem? Does it do a better job than the anticipation-based solutions? If so, why? If not, why not?
4. What is the informed consent principle for introducing experimental technology? What, according to van Poel, are its problems?
5. What are the four general moral principles for experimental technology? How do they give rise to the conditions of van de Poel's framework? Do you think his principles are helpful?

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Core Reading I.2: 'Why ethics matters for autonomous cars' by Patrick Lin (excerpt)

Preparing to Read

If motor vehicles are to be truly autonomous and able to operate responsibly on our roads, they will need to replicate—or do better than—the human decision-making process. But some decisions are more than just a mechanical application of traffic laws and plotting a safe path. They seem to require a sense of ethics, and this is a notoriously difficult capability to reduce to algorithms for a computer to follow.

Excerpted from: Lin, P. (2016). Why ethics matters for autonomous cars. In M. Maurer, J. Gerdes, B. Lenz, & H. Winner (Eds.), *Autonomous Driving*. Berlin and Heidelberg: Springer. doi.org/10.1007/978-3-662-45854-9_4.

4.1 Why Ethics Matters

To start, let me offer a simple scenario that illustrates the need for ethics in autonomous cars. Imagine in some distant future, your autonomous car

encounters this terrible choice: it must either swerve left and strike an eight-year old girl, or swerve right and strike an 80-year old grandmother …. Given the car's velocity, either victim would surely be killed on impact. If you do not swerve, both victims will be struck and killed; so there is good reason to think that you ought to swerve one way or another. But what would be the ethically correct decision? If you were programming the self-driving car, how would you instruct it to behave if it ever encountered such a case, as rare as it may be?

Striking the grandmother could be the lesser evil, at least to some eyes. The thinking is that the girl still has her entire life in front of her—a first love, a family of her own, a career, and other adventures and happiness—while the grandmother has already had a full life and her fair share of experiences. Further, the little girl is a moral innocent, more so than just about any adult. We might agree that the grandmother has a right to life and as valuable a life as the little girl's; but nevertheless, there are reasons that seem to weigh in favor of saving the little girl over the grandmother, if an accident is unavoidable. Even the grandmother may insist on her own sacrifice, if she were given the chance to choose.

But either choice is ethically incorrect, at least according to the relevant professional codes of ethics. Among its many pledges, the Institute of Electrical and Electronics Engineers (IEEE), for instance, commits itself and its 430,000+ members "to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression" …. Therefore, to treat individuals differently on the basis of their age, when age is not a relevant factor, seems to be exactly the kind of discrimination the IEEE prohibits ….

Age does not appear to be a relevant factor in our scenario as it might be in, say, casting a young actor to play a child's character in a movie. In that movie scenario, it would be appropriate to reject adult actors for the role. Anyway, a reason to discriminate does not necessarily justify that discrimination, since some reasons may be illegitimate. Even if we point to the disparity of life experiences between the old and the young, that difference isn't automatically an appropriate basis for different treatment.

Discriminating on the basis of age in our crash scenario would seem to be the same evil as discriminating on the basis of race, religion, gender, disability, national origin, and so on, even if we can invent reasons to prefer one such group over another. In Germany—home to many influential automotive companies that are working to develop self-driving technologies—the right to life and human dignity is basic and set forth in the first two articles of the very first chapter in the nation's constitution …. So it is difficult to see how German law could even allow a company to create a product that is capable

to making such a horrific and apparently illegal choice. The United States similarly strives to offer equal protection to all persons, such as stipulated in the fourteenth amendment of its constitution.

If we cannot ethically choose a path forward, then what ought to be done? One solution is to refuse to make a swerve decision, allowing both victims to be struck; but this seems much worse than having only one victim die, even if we are prejudiced against her. Anyway, we can force a decision by modifying the scenario: assume that 10 or 100 other pedestrians would die, if the car continued forward; and swerving would again result in only a single death.

Another solution could be to arbitrarily and unpredictably choose a path, without prejudice to either person …. But this too seems ethically troubling, in that we are choosing between lives without any deliberation at all—to leave it to chance, when there are potentially some reasons to prefer one over the other, as distasteful and uncomfortable as those reasons may be. This is a dilemma that is not easily solvable and therefore points to a need for ethics in developing autonomous cars.

4.1.1 Beyond Crash-Avoidance

Many readers may object right away that the dilemma above, as well as others that follow, will never occur with autonomous cars. It may be suggested that future cars need not confront hard ethical choices, that simply stopping the car or handing control back to the human operator is the easy path around ethics. But I will contend here that braking and relinquishing control will not always be enough. Those solutions may be the best we have today, but if automated cars are to ever operate more broadly outside of limited highway environments, they will need more response-options.

Current research already makes this case as a matter of physics …, but we can also make a case from commonsense. Many ordinary scenarios exist today in which braking is not the best or safest move, whether by human or self-driving car. A wet road or a tailgater, for instance, may make it dangerous to slam the brakes, as opposed to some other action such as steering around the obstacle or simply through it, if it is a small object. Today, the most advanced self-driving cars cannot detect small objects such as squirrels …; therefore, they presumably cannot also detect squirrel-sized rocks, potholes, kittens, and other small but consequential hazards can cause equipment failure, such as tire blowouts or sensor errors, or deviations from a safe path.

In these and many other cases, there may not be enough time to hand control back to the driver. Some simulation experiments suggest that human drivers need up to 40 s to regain situation awareness, depending on the distracting activity, e.g., reading or napping—far longer than the 1–2 s of

reaction time required for typical accident scenarios …. This means that the car must be responsible for making decisions when it is unreasonable to expect a timely transfer of control back to the human, and again braking might not be the most responsible action.

One possible reply is that, while imperfect, braking could successfully avoid the majority of emergency situations a robot car may find itself it, even if it regrettably makes things worse in a small number of cases. The benefits far outweigh the risks, presumably, and the numbers speak for themselves. Or do they? I will discuss the dangers of morality by math throughout this chapter.

Braking and other responses in the service of crash-avoidance won't be enough, because crash-avoidance is not enough. Some accidents are unavoidable—such as when an animal or pedestrian darts out in front of your moving car—and therefore autonomous cars will need to engage in crash-optimization as well. Optimizing crashes means to choose the course of action that will likely lead to the least amount of harm, and this could mean a forced choice between two evils, for instance, choosing to strike either the eight-year old girl or the 80-year old grandmother in my first scenario above.

4.1.2 Crash-Optimization Means Targeting

There may be reasons, by the way, to prefer choosing to run over the eight-year old girl that I have not yet mentioned. If the autonomous car were most interested in protecting its own occupants, then it would make sense to choose a collision with the lightest object possible (the girl). If the choice were between two vehicles, then the car should be programmed to prefer striking a lighter vehicle (such as a Mini Cooper or motorcycle) than a heavier one (such as a sports utility vehicle (SUV) or truck) in an adjacent lane ….

On the other hand, if the car were charged with protecting other drivers and pedestrians over its own occupants—not an unreasonable imperative—then it should be programmed to prefer a collision with the heavier vehicle than the lighter one. If vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications are rolled out (or V2X to refer to both), or if an autonomous car can identify the specific models of other cars on the road, then it seems to make sense to collide with a safer vehicle (such as a Volvo SUV that has a reputation for safety) over a car not known for crash-safety (such as a Ford Pinto that's prone to exploding upon impact).

This strategy may be both legally and ethically better than the previous one of jealously protecting the car's own occupants. It could minimize lawsuits, because any injury to others would be less severe. Also, because the

driver is the one who introduced the risk to society—operating an autonomous vehicle on public roads—the driver may be legally obligated, or at least morally obligated, to absorb the brunt of any harm, at least when squared off against pedestrians, bicycles, and perhaps lighter vehicles.

The ethical point here, however, is that no matter which strategy is adopted by an original equipment manufacturer (OEM), i.e., auto manufacturer, programming a car to choose a collision with any particular kind of object over another very much resembles a targeting algorithm …. Somewhat related to the military sense of selecting targets, crash-optimization algorithms may involve the deliberate and systematic discrimination of, say, large vehicles or Volvos to collide into. The owners or operators of these targeted vehicles bear this burden through no fault of their own, other than perhaps that they care about safety or need an SUV to transport a large family.

4.1.3 Beyond Harm

The problem is starkly highlighted by the following scenario …: Again, imagine that an autonomous car is facing an imminent crash, but it could select one of two targets in adjacent lanes to swerve into: either a motorcyclist who is wearing a helmet, or a motorcyclist who is not. It probably doesn't matter much to the safety of the car itself or its occupants whether the motorcyclist is wearing a helmet; the impact of a helmet into a car window doesn't introduce that much more risk that the autonomous car should want to avoid it over anything else. But it matters a lot to the motorcyclist whether s/he is wearing a helmet: the one without a helmet would probably not survive such a collision. Therefore, in this dreadful scenario, it seems reasonable to program a good autonomous car to swerve into the motorcyclist with the helmet.

But how well is justice and public policy served by this crash-optimization design? Motorcyclists who wear helmets are essentially being penalized and discriminated against for their responsible decision to wear a helmet. This may encourage some motorcyclists to not wear helmets, in order to avoid targeting by autonomous cars. Likewise, in the previous scenario, sales may decline for automotive brands known for safety, such as Volvo and Mercedes Benz, insofar as customers want to avoid being the preferred targets of crash-optimization systems.

Some readers may want to argue that the motorcyclist without a helmet ought to be targeted, for instance, because he has acted recklessly and therefore is more deserving of harm. Even if that's the correct design, notice that we are again moving beyond harm in making crash-optimization decisions. We're still talking about justice and other such ethical considerations, and that's the point: it's not just a numbers game.

Programmers in such scenarios, as rare as they may be, would need to design cost-functions—algorithms that assign and calculate the expected costs of various possible options, selecting the one with the lowest costs—that potentially determine who gets to live and who gets to die. And this is fundamentally an ethics problem, one that demands much more care and transparency in reasoning than seems currently offered. Indeed, it is difficult to imagine a weightier and more profoundly serious decision a programmer would ever have to make. Yet, there is little discussion about this core issue to date.

Guided Reading Questions

1. Lin considers a case in which your autonomous vehicle must either kill an elderly woman or a little girl. He considers reasons why it should target the elderly woman and reasons why it should not. Where do you stand on this? Do you think the right thing to do is to kill the elderly woman? The little girl? Both? Or randomly pick which one dies? Why?
2. Some people complain that automated cars will never be, or at least need not be, in the kind of situation discussed in question 1. Lin has a response to this. What is his response? Do you agree with it? Or do you side with the view that this problem need not arise?
3. Lin considers the idea that maybe the autonomous vehicle should run over the young girl. The idea is that an autonomous car should protect its occupants first and foremost. And they are less likely to be hurt if they hit the little girl than they are if they hit the elderly woman. What do you think of this? Should the car target the girl? What do you think of the more general point that maybe a car should be programmed to prioritize the safety of its occupants?
4. What do you think about Lin's helmet example? Should the car be programed to swerve into the motorcyclist wearing a helmet? What problems might such programming cause? Can you think of any other puzzling examples in light of Lin's points?

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Guided Further Reading

Further Reading I.1: 'Thinking like an engineer: The place of a code of ethics in the practice of a profession' by Michael Davis

Find the Article

Davis, M. (1991). Thinking like an engineer: The place of a code of ethics in the practice of a profession. *Philosophy and Public Affairs*, 20(2), 150–167. www.jstor.org/stable/2265293.

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Preparing to Read

Beyond the Code is premised in part upon the idea that, on their own, engineering codes of conduct are not enough to ensure engineers understand how to fulfill their obligations. We, the authors have argued, that engineers must "go beyond" the code in the sense that they must understand the various moral complexities that arise when trying to apply the code in real life. However, this is not to say that engineering codes of ethics—the NSPE Code of Ethics in particular—are not invaluable resources for engineering ethics. For this reason, before we go "beyond the code" it is worthwhile taking a moment, as Michael Davis does in this article, to examine the role of professional codes of ethics in engineering.

Guided Reading Questions

1. What was the decision Lund made? What was your initial reaction upon learning of it? Was Lund wrong? Was what he did permissible? Do you think it can be permissible for an engineer to think like a manager?
2. Davis considers two ways in which we might understand the contrast between 'thinking like an engineer" and "thinking like a manager." One way concerns expert knowledge and skill. The manager deals with people and understands problems in terms of people. The engineer deals with things and understands problems in terms of them. What was Davis's criticism of this way of understanding what Lund was asked to do? Do you agree with Davis about this? Why or why not?
3. Davis argues that a professional code has advantages over personal conscience. Part of his argument involves a comparison of a professional code with the rules of a game like baseball. Among other things, a code allows an engineer to know what to expect of other engineers. Do you think the analogy is apt? Even if it is apt, do you think that it is enough to support the use of a code? Can you think of ways engineers could know what to expect of one another without a code?
4. According to Davis, engineers should follow their code of ethics because its content makes it worthy of being followed. He considers a hypothetical example in which there is no code that is

widely followed by engineers. He argues that it would be too easy to fire a particular engineer for taking a moral stand in such a case. Do you buy this argument? Do you agree that a code helps protect individual engineers from getting fired for doing the right thing? If you do, why? If not, why not? Davis thinks this also provides an explanation for how Lund could reject the exhortation to "think like a manager rather than an engineer." Do you think Davis is right about that? Or is he mistaken?

5. Davis argues that the code, if Lund had followed it, would have prevented him from thinking like a manager. Do you think he is right about this?

Further Reading I.2: '"Things that went well—no serious injuries or deaths": Ethical reasoning in a normal engineering design process' by Peter Lloyd and Jerry Busby

Find the Article

Lloyd, P., & Busby, J. (2003). 'Things that went well—no serious injuries or deaths': Ethical reasoning in a normal engineering design process. *Science and Engineering Ethics*, 9, 503–516. doi.org/10.1007/s11948-003-0047-4.

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https://link.springer.com/article/10.1007/s11948-003-0047-4

Preparing to Read

At the beginning of this chapter, we briefly introduced the reader to the role of ethical theories in the study of ethics. In the following chapters, however, we will not make direct use of these theories in our exploration of the ethical complexities behind the fundamental canons of the NSPE Code of Ethics. Likewise, with the exception of Chapter 2 (when we discuss virtue ethics), we will not usually appeal to a particular ethical theory when offering suggestions for how to approach these complexities. However, it is important to note that many of those working in engineering ethics do make explicit use of ethical theories such as deontology, consequentialism, and virtue ethics, both as a framework for understanding ethical issue in engineering and as a basis for addressing moral issues in engineering. For this reason, we have included this article by Peter Lloyd and Jerry Busby, which makes explicit use of ethical theory in discussing ethical reasoning in the engineering design process.

Guided Reading Questions

1. Lloyd and Busby consider the practice of treating engineering ethics as a sub-problem of engineering design. One concern they have about this approach is that it leads to individualized specialization on very specific moral problems. Do you agree that this is a problem for the approach? Why would such focus and specificity be problematic?
2. Lloyd and Busby give three reasons for thinking that engineering ethics should be consequentialist rather than deontological. First, engineering ethics is based on the outcome of processes. Second, engineering as a profession aims to change the world. Third, engineering ethics has a link between decisions and outcomes. Do you agree with this? Based on what we learned about deontology earlier in this chapter, do you think that being concerned with outcomes or linking decisions to outcomes should suggest that only outcomes matter? If you agree, why? If you disagree, why?
3. Consider two questions: First, how do engineers reason about morality? Second, how should engineers reason about morality? Lloyd and Busby are primarily concerned with the first question. Do you think providing an answer to the first question can help us

find an answer to the second? Or do you think the two questions are largely independent?

4. One issue that comes up in Lloyd and Busby's paper is the value of simplicity. It seems that many engineers think a simple design is more beautiful, and for that reason to be preferred to an unduly complicated design. Do you agree that there is a connection between beauty and simplicity? When can the value of simplicity be overridden in design? Can simplicity ever make something ugly?

Further Reading I.3: 'Metaethics in context of engineering ethical and moral systems' by Lily Frank and Michał Klincewicz

Find the Article

Frank, L, & Klincewicz, M. (2016). Metaethics in context of engineering ethical and moral systems. Association for the Advancement of Artificial Intelligence (AAAI) Spring Symposium Series.

Read the article online by scanning the QR code or following the link below. Select the title from the contents—*no subscription or login is required*.

www.aaai.org/Library/Symposia/Spring/ss16-04.php

Preparing to Read

As a branch of applied ethics concerned with the concrete and practical side of ethics, engineering ethics seldom concerns itself with the more abstract topics of metaethics. Lily Frank and Michał Klincewicz,

however, argue that when it comes to certain applied topics—in particular the issue of moral development in AI—our metaethical issues are relevant to applied projects.

Guided Reading Questions

1. Frank and Klincewicz contrast a moral microscope AI with a simulation AI. They think the moral microscope is plausible only if moral realism is true. But the simulation AI could be made whether moral realism or anti-realism is true. Do you agree with this? In particular, they hold that a moral microscope AI could detect things we are insensitive to and be free of cognitive distortions. Do you think these things would be helpful and possible even if moral anti-realism is true? Or do you think the authors are correct in holding that they are helpful only if moral realism is true.
2. Frank and Klincewicz distinguish between strong and weak ambitions for moral AI. There is disagreement, they think, about what humans do when they make moral judgments. Depending on which metaethical theory is true, and depending on whether AI can be conscious, AI may not even be able to make moral judgments. And so engineering or modeling human moral judgments must be preceded by settling the relevant philosophical questions. Do you agree with this? Contrast this with judgments of taste. For example, can AI usefully model human judgments about what is tasty even if it is unable to make such judgments itself? If so, what might this reveal about whether AI can model human judgments about morality if anti-realism is true? If not, why not?
3. What is the distinction between motivational internalism and motivational externalism? Which of the two views do you think is right? What implications would this have for building moral AI?
4. Frank and Klincewicz compare the project of building conscious AI with the project of building AI that makes moral judgments. They claim that the two projects are not that different. Do you agree with them about this? Or do you think the two projects are very different?
5. The authors suggest building moral AI in such a way that assumes the least demanding metaethical theory. What do they mean by demandingness? What do you think about this strategy for building moral AI? Is it really the best strategy? Or can you think of a better one?

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