

An Introduction to Values and Science

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Abstract

This chapter introduces readers to the area of inquiry commonly known as values and science. The chapter is organized in two sections. First, it provides a brief overview of the current philosophical literature on this topic, including the nature of values, arguments against the "value-free ideal" (VFI) for science, strategies for managing values in science, and important emerging issues. Second, it lays out the organization of the book's six parts: Theoretical Background on Values and Science; Managing Values in Science; Values, Science, and Democracy; Values, Science, Institutions, and Organizations; Values in Scientific Activities; and Values in Specific Sciences.

Introduction

At first glance, there appears to be little in common between science and values. Science is supposed to be about *facts*, which are true no matter what we hope or prefer to be the case. In contrast, values are supposed to be about what we *desire* or *prefer*. To put it simply, science appears to be about the way the world *is*, whereas values appear to be about what we *want* the world to be. Especially in today's era of misinformation, polarization, and "fake news," it might seem essential to keep these two realms as distinct from each other as possible. Only by keeping scientists focused on facts alone can we maintain the reliability and authority of science, so the thinking might go.

But a moment's reflection reveals that this distinction is too simple. We correctly applaud the researcher who studies cancer because they want to save lives. Notice that this desire to prevent human deaths reflects how they *want* the world to be, not how the world *is*. Thus, we can see that it is appropriate and even advisable for scientists to consider values when deciding what topics to study and how to study those topics. Upon further reflection, it also becomes clear that values have a crucial role to play when using science to inform decision making. For example, scientists can predict how likely it is for a nuclear power plant to malfunction, but values are important when deciding whether it is appropriate to accept that risk and build the plant. Even when scientists are considering how to communicate their findings, values are clearly relevant. Consider again the case of the nuclear power plant. When scientists predict the likelihood that it will malfunction, they have to draw on enormous amounts of data and make a wide variety of assumptions. Under such conditions, different experts are likely to come to different conclusions. Deciding how to present all those different conclusions in a responsible manner requires value-laden choices about how much to prioritize completeness as opposed to making information easy to understand.

The more one reflects on these situations, the more complex they get. Consider once again the scientists trying to predict the likelihood that a nuclear power plant will malfunction. As they formulate their predictions, they face a wide variety of questions. Which data should they include

in their analyses? Should they include safety data about all existing nuclear power plants, or only power plants that are sufficiently similar to the one under consideration? And how should they extrapolate from the existing data into the future? What if they suspect that conditions in the future might be different from those in the past? Depending on how the scientists answer these questions, they might overestimate or underestimate the likelihood of a malfunction. Which is a more tolerable error to make? Once again, it seems like responsible scientists need to consider values in order to handle this decision. In other words, they need to reflect on how different errors could affect society, which is a decision about how they *want* the world to be, not about the way the world *is*.

One might argue that scientists could avoid considering values if they either refrained from making a prediction or if they just described a wide range of possible outcomes. This seems, however, unlikely to solve the problem. The scientists would still have to make value-laden decisions about when to withhold their judgment, what range of possibilities to describe, and/or how to describe the plausibility of different options. So we are left with difficult questions about how scientists can navigate all these roles for values in a responsible fashion that maintains scientific integrity.

Interest in these sorts of questions has exploded in recent decades among philosophers of science. This topic—frequently labeled “values and science”—has taken on even more significance because of contemporary concerns about misinformation (O’Connor and Weatherall 2018), corporate manipulation of science (Oreskes and Conway 2010), and problems with scientific reproducibility (Harris 2017). The COVID pandemic brought even more attention to the relationship between values and science, as calls to “follow the science” often overlooked the important ways that values shaped scientific models and policy recommendations (Harvard et al. 2021; Macedo and Lee 2025). This volume provides an introduction to the contemporary literature on values and science and can serve as a resource both for those new to the debates and for those who have already been participating in them.

Contemporary work on values and science draws on several previous areas of research. First, the famous historian and philosopher of science Thomas Kuhn (1977) argued that reasonable scientists could legitimately disagree about how to weigh multiple values (e.g., explanatory power, predictive accuracy, and simplicity) when choosing among multiple scientific theories, such as Copernican vs Ptolemaic accounts of the solar system. His work launched subsequent discussions about whether it was possible to distinguish “epistemic” values, which provided evidence for a theory’s truth, from “non-epistemic values,” which failed to be truth-conducive (see e.g., McMullin 1982). Second, feminist scholarship drew attention to the role that social, political, and ethical values could play in developing scientific theories and shaping scientists’ assumptions. As Kristen Intemann discusses in her chapter for this *Handbook*, the work of these feminist scholars raised questions about whether value influences in science were inherently problematic or whether incorporating feminist values in science could sometimes generate better, more objective science (Intemann XXX: see also Kourany 2010). Helen Longino (1990; 2001) famously argued that scientists invariably rely on value-laden background assumptions when drawing conclusions, so it is better for them to subject these background assumptions and values to “transformative criticism” from diverse perspectives rather than pretending to be able to draw value-free conclusions. Third, Heather Douglas (2000; 2009) developed the “argument from

inductive risk” (see Elliott XXX, in this *Handbook*), which brought renewed attention to mid-twentieth-century philosophical discussions about the risks involved in making inductive inferences. Douglas argued that scientists have ethical responsibilities to consider the potential social consequences of drawing erroneous conclusions. On this basis, she concluded that the “value-free ideal” (VFI) for science, which had been prominent in previous philosophical thinking (e.g., McMullin 1982), should be rejected as a bad ideal.

Our aim in this handbook is to provide an accessible overview of the vibrant body of literature that has developed from these starting points. It would be unrealistic to try to represent this literature in a comprehensive fashion. Instead, we have sought to focus on promising new directions in which the field is headed while also providing readers with an introduction to the most important existing debates. This introductory chapter provides an orientation to key conceptual issues, clarifies how the various parts of the book fit together, and highlights important opportunities for further scholarship.

The nature of values and the value-free ideal

Values are generally thought to be concepts that reflect our ideals, preferences, or goals (see Elliott and Korf 2024 for further clarification). Values, as such, need not be fully conscious, and can range over many kinds, whether epistemic, aesthetic, political, social, personal, or ethical. Matt Brown has emphasized the distinction between values—which can be held without reflection—and value judgments—which are choices or conclusions that result from careful inquiry regarding which values we should hold, pursue, and prioritize (Brown 2020). Regardless of whether we are discussing values or value judgments, one key question concerns whether and how values should play a role in science.

During the latter part of the twentieth-century, one influential view was that some kinds of values could influence science without causing problems, whereas other kinds of values needed to be carefully limited. For example, Ernan McMullin (1982) argued that “epistemic” values, which provided evidence that a theory was true, could appropriately influence scientific reasoning. In contrast, other values, the “non-epistemic” ones, did not provide evidence that a theory was true, and therefore they should not influence scientific reasoning. Scholars have since added further nuance to this distinction. Laudan (2004) and Douglas (2013) argued that the category of “epistemic” values failed to distinguish between values that were genuinely truth indicative and those that were valued by scientists for other cognitive reasons, such as being pragmatically useful. Steel argued further that epistemic values could be distinguished into those that are intrinsic, meaning that exemplifying them “either constitutes an attainment of truth or is a necessary condition for a statement to be true,” as opposed to those that are extrinsic, meaning that they “promote the attainment of truth without themselves being indicators or requirements of truth” (2010, 18).

Although the epistemic/non-epistemic distinction continues to be widely used, serious challenges have been leveled against the possibility of drawing a strict distinction of this sort (Rooney 1992, Longino 1996). Part of the problem is that values that normally seem indicative of a theory’s reliability (e.g., its coherence with other established theories) might not always be genuine indicators of its reliability, and values that do not normally seem like genuine indicators of a

theory's reliability (e.g., its coherence with our considered ethical judgments) could sometimes help us arrive at more reliable theories. Another challenge is that so-called epistemic values typically need to be weighed and interpreted, and it is plausible that non-epistemic values typically play a role in that process. One response to this problem is to assert that there may be some cases in which values can be classified relatively cleanly as epistemic or non-epistemic, but there are other cases where values occupy a messy "borderlands" between the two (Rooney 2017). We have included a chapter on aesthetic values in the *Handbook* (see Ivanova XXX), which illustrates the interesting philosophical work that can be done by studying values that occupy the borderlands between the epistemic and the non-epistemic.

In recent years, philosophers studying the role of values in science have argued that even "non-epistemic" values have legitimate roles to play in scientific reasoning. These philosophers typically claim to be rejecting a "value-free ideal" (VFI) that dominated late-twentieth-century philosophy of science. Based on her historical analysis of this time period, Douglas (2009) characterizes the VFI as the view that "the value judgments internal to science, involving the evaluation and acceptance of scientific results at the heart of the research process, are to be as free as humanly possible of all social and ethical values" (2009, 45). It is important to recognize, however, that this VFI does not completely exclude values from science. It makes a distinction between the "internal" aspects of science, which involve the core processes of scientific reasoning, and the "external" aspects of science, such as choosing research topics and making use of science for policy making. This VFI allows non-epistemic values to influence the external aspects of science, and it allows epistemic values to influence the internal aspects of science. Thus, Douglas notes that the VFI is actually a "somewhat inaccurate label" for what is really an "epistemic-values-only-in-scientific-inference" ideal (2016, 3).

It is crucial to remember that even if one were to accept this VFI, one could still allow non-epistemic values to play very significant roles in science—e.g., guiding the directions of scientific inquiry, promoting inclusive and ethical scientific practices, and steering the communication of findings—which many of the chapters in this *Handbook* discuss (see e.g., Beck et al XXX, Biddle XXX, Bluhm XXX, Douglas XXX, Elabbar XXX, Gutiérrez Valderrama XXX, Goldenberg XXX, Nieves Delgado XXX, Resnik XXX, and Steel XXX). In fact, philosophers have increasingly been arguing that the internal/external distinction does not hold up well under scrutiny and that value influences on the external aspects of science can end up influencing the internal aspects as well (see e.g., Holman and Bruner 2017 and Elliott XXX). Even though the VFI already allows for significant roles of values in science, Douglas (2000; 2009; 2022) famously argued that it was still ethically problematic. She noted that scientists, like all moral agents, have ethical responsibilities to avoid negligently or recklessly causing harm to others. On this basis, she argued that scientists ought to take into account the potential harmful effects of mistakes when making inductive inferences or engaging in other scientific activities (such as characterizing or interpreting data) that contribute to inductive inferences (Douglas 2003). For example, if scientists were studying a potentially deadly chemical, they would be morally required to consider the consequences of predicting the deadliness of the chemical incorrectly. If they concluded the chemical was deadly and it wasn't, then economically burdensome (and needless) regulations would occur based on their conclusion; if they concluded the chemical was not deadly and it was, then there would be (preventable) human deaths. Social

and ethical values are important for balancing these consequences to the economy and public health.

While Douglas’s “argument from inductive risk” became the main fulcrum for overturning the VFI, a number of scholars formulated additional arguments against it (see Elliott XXX). For example, another challenge to the VFI is based on the idea that science incorporates multiple aims, including non-epistemic ones—e.g., promoting environmental sustainability or protecting public health (see Lusk and Elliott 2024). Therefore, when scientists are determining how to model phenomena or assess hypotheses, they need to take non-epistemic values into account (see e.g., Elliott and McKaughan 2014; Fernández Pinto and Hicks 2019). For example, Kristen Intemann (2015) has emphasized that when climate models are optimized to predict one kind of phenomenon (e.g., global temperature changes), they may not be as good at predicting other phenomena (e.g., local changes in precipitation), so scientists need to consider the non-epistemic aims of society when assessing these climate models. Another important challenge to the VFI is based on the notion that scientists employ concepts that incorporate both epistemic and non-epistemic elements (e.g., Dupré 2007). For example, Anna Alexandrova (2018) argues that a concept like “well-being” has this sort of “mixed” character, meaning that scientists need to take non-epistemic values into account when deciding how to define it in an appropriate manner (see also the chapters by Anderson XXX, Elabbar XXX, and Larroulet Philippi XXX in this *Handbook*). In some respects, these arguments based on non-epistemic aims and concepts provide deeper critiques of the VFI than the AIR because they are not based on the presence of scientific uncertainty (de Melo-Martín and Intemann 2016). In contrast, the importance of values under the AIR diminishes as scientific uncertainty decreases because the potential for error also decreases (Douglas 2000, 577; 2009, 96).

Based on these arguments, it is now widely accepted that the VFI is untenable (see e.g., Biddle 2013; Brown 2020; Douglas 2009; 2016; Elliott 2022b; Intemann 2015; Kitcher 2011; Wilholt 2009; Winsberg 2025). For example, Douglas’s AIR has been shown to be valid and defended as sound (Brown 2024; Brown and Stegenga 2023; Havstad 2022). Some authors, however, have resisted this conclusion (e.g., Betz 2013; Lacey 2017; Hudson 2021), and a number of philosophers have attempted to resurrect some form of the VFI (see e.g., Levy 2025; Menon and Stegenga 2023; Parker 2024; Sheykh-Rezaee and Bikaraan-Behesht 2023; Sikorski 2024; Stamenkovic 2024). Perhaps surprisingly, this scholarship itself appears to be motivated by a mixture of epistemic and non-epistemic considerations. For example, some of those seeking to limit the influences of non-epistemic values on scientific reasoning appeal to social concerns, such as the importance of maintaining science as a trustworthy source of information on which all members of society can rely (see e.g., Betz 2013; Bright 2018; John 2015; Menon and Stegenga XXX). Yet, no matter how reasonable these motivations may appear, it has been argued that none of the current approaches to saving the VFI are successful (Brown 2024; Brown XXX).

Nevertheless, these debates over the VFI are providing opportunities to sharpen our conceptual understanding of it (Elliott 2025). To assess the cogency of efforts to salvage some form of the VFI, it is important to develop clear notions of what values are (Elliott and Korf 2024; Hillgardt 2022; Winsberg 2024), what it is for scientific reasoning to be free of values (Ward 2021; Ward XXX), and what is involved in holding onto an ideal (Intemann and de Melo-Martín 2016; Lusk

2025; Menon and Stegenga 2023). When debating formulations of the VFI, it is especially important to recognize that a scientific choice can be “value-laden” in at least four different ways: values could serve as *motivating reasons* for the choice, they could serve as *justifying reasons* for the choice, they could play a *causal role* influencing the choice, or they could be *affected* by the choice (Ward 2021). Without clarifying these distinctions, it is easy for proponents and opponents of the VFI to talk past each other. For example, a proponent of the VFI might insist that it is possible for scientists to avoid consciously appealing to non-epistemic values (thereby excluding values as *motivating reasons*), whereas an opponent of the VFI might insist that non-epistemic values still ought to be taken into account (thereby including values as *justifying reasons*; see Ward 2021 and Ward XXX in this *Handbook*).

Managing values

Whatever one concludes about these debates regarding the VFI, it is clear that steps need to be taken to manage values in science appropriately. On one hand, the critics of the VFI need to show that non-epistemic values can be incorporated responsibly in scientific reasoning without threatening the integrity of science (Resnik and Elliott 2019). On the other hand, the defenders of the VFI are essentially proposing a particularly stringent form of value management—namely, excluding non-epistemic values completely (or at least *striving* to exclude non-epistemic values) from some aspects of scientific reasoning. Partly for this reason, figures like Brown (2024 and XXX in this *Handbook*) and Lusk (2025) argue that it would be more productive to stop talking about the VFI and simply focus on discussing the best ways to manage values in science.

In fact, value management is an important issue no matter what kinds of values are at play. Historically, discussions of value management have typically focused on managing non-epistemic values, thereby implicitly suggesting that epistemic values do not require management. But this is a problematic assumption. As long as scientists need to make debated judgments about how to interpret and weigh values relative to one another (whether those values are classified as epistemic or non-epistemic), it raises the potential for reasonable and legitimate scientific disagreement. This, in turn, calls into question science’s character as a universal, authoritative source of neutral information on which everyone can rely (Betz 2013; Holman and Wilholt 2022; Lusk 2021). Therefore, steps need to be taken to manage these value-based scientific disagreements in socially responsible ways. For example, suppose a number of prominent climate scientists disagree about which climate models will generate more reliable predictions. Perhaps some scientists recommend one model because of its consistency with earlier models and because of its simplicity. Perhaps other scientists recommend a different model because they think it more accurately represents underlying features of the physical climate system. Even if all the scientists involved in the dispute think that they are appealing solely to epistemic values, they still need to find ways to manage these value-based disagreements responsibly when they are making claims that could have a significant impact on society.

Value management, then, is one of the most important topics in the current literature on values and science. When Douglas (2009) first challenged the VFI, she suggested a management approach that distinguished between direct and indirect roles that values could play in the internal stages of scientific reasoning. She argued that values should not play a *direct* role in

these stages (meaning they should not be treated as a form of evidence); rather, values should be limited to an *indirect* role (meaning that they should be used to assess whether the available evidence is sufficient to draw a conclusion). Some figures have questioned the cogency of this distinction (e.g., Elliott 2013; Steel and Whyte 2012), but it still captures a common intuition that values are different from evidence. Nevertheless, Brown (2020) has argued that this intuition rests on the problematic assumption that values do not have cognitive status. He challenges this assumption and argues that values can act as evidence under some circumstances as long as they do not predetermine the outcome of inquiry (see also Anderson 2004).

Holman and Wilholt (2022) recently divided the current approaches to value management into five main categories (see also Elliott 2022b), and they characterized questions about how to manage values in science as a “new demarcation problem.” In contrast to the old demarcation problem, which attempted to distinguish science from pseudoscience, the new demarcation problem attempts to distinguish legitimate and illegitimate influences of values in science. An important theoretical question to consider moving forward is how to choose between these management approaches. Are there a priori reasons to think that one approach is typically better than the others? Or do different value management approaches work better in different situations? Some authors have even argued that the elements of multiple value management approaches can be integrated together (Resnik and Elliott 2023; Rolin and Koskinen 2022). Holman and Branch (XXX) in this *Handbook* survey attempts at addressing the new demarcation problem.

One of the most important developments in the recent literature on managing values in science has been the turn toward a more “political” philosophy of science (see e.g., Badano 2025; Hillgardt 2024; Lusk 2021; Scherz and García-Portela 2025; Schroeder 2021; Ward and Creel 2024). This scholarship builds on previous work by scholars from a number of different fields who have been striving to make science more responsive to public values (see e.g., Brown 2009; Hess 2016; Jasanoff 2017; Sarewitz 2010; Wynne 1996). Within the philosophy of science, Philip Kitcher (2001; 2011) famously argued that science should be “well-ordered,” meaning that it should be directed in accordance with what an idealized group of deliberators would choose if they were informed both about relevant scientific facts and about the perspectives of all affected parties. In general, this kind of effort to integrate perspectives from political philosophy into value management is designed to address the worry that value-laden science cannot play a legitimate role in social decision making in a diverse society where people hold very different values. Proponents of a political philosophy of science contend that value-laden science can still have political legitimacy if the values underlying it are generated through appropriate political structures or processes, although this depends on broader normative judgments about what counts as a legitimate political process. Greater collaboration from political philosophers, who have not always taken the complexity of value-laden science into account (Hamilton 2024), could help move this scholarship forward. The chapters in Part 3 explore these issues in more detail.

Emerging issues

Studies of values and science have clearly made significant progress in clarifying the conceptual terrain and exploring how to manage value influences in science. These conceptual issues will

likely continue to be important moving forward. One important area of contemporary scholarship is the effort to distinguish different kinds of “epistemic risks” in addition to inductive risk (Biddle and Kukla 2017). For example, Stephanie Harvard and Eric Winsberg argue that scientists have to make value-laden decisions about how to handle the “representational risk” of adopting models that are inadequate to the purposes for which they were developed (see e.g., Harvard and Winsberg 2022; Harvard and Winsberg XXX in this *Handbook*). Some scholars are also starting to discuss the “ontic risk” involved in drawing scientific conclusions that could affect the very phenomena under investigation (Ortmann 2025; Witteveen under review). For example, consistently claiming that the climate crisis is a tragedy of the commons could make it even more likely to play out as a tragedy of the commons, whereas framing it in other ways could make it less likely to play out in this fashion (Ortmann and Veit 2023; Steel XXX in this *Handbook*).

Another important question is how to integrate an institutional and organizational perspective into the literature on values and science. When thinking about the topic of values and science, it can be tempting to focus on individual scientists and the values they bring to their work. This turns out to be a highly impoverished perspective (see Elabbar XXX in this *Handbook*). As discussed above, Zina Ward (2021) has emphasized that choices in science can be value-laden not only in the sense that scientists are consciously motivated by values but also in the sense that values are affected by the choices or cause the choices to be made in a particular way. This opens up the opportunity to think about how institutions—the rules and norms that structure scientific practice (Jupille and Caporaso 2022)—influence scientific choices in ways that support some values and detract from other values (see Part 4 of the *Handbook*).

These rules and norms are often generated and enforced by organizations, such as universities, scholarly societies, companies, contract research organizations, and standard-setting bodies. These organizations can exert powerful influences on research. For example, a wide-ranging interdisciplinary body of literature has recently documented the ways in which corporations have suppressed science that conflicts with their interests, funded questionable studies designed to produce desired results, and harassed scientists who present opposing perspectives (Holman and Elliott 2018; Michaels 2008; Oreskes and Conway 2010; White and Bero 2010; see also Fernández Pinto and Leuschner XXX in this *Handbook*). Some of these activities are obviously problematic, but in other cases industry exerts subtler value influences that deserve more nuanced analyses (Elliott 2014; Wilholt 2006; see also Bravo XXX in this *Handbook*). Comparing the characteristics of science produced by industry, academia, and nongovernmental organizations is likely to uncover important ways in which the organizational contexts in which science is produced—together with the explicit and implicit rules, guidelines, and standards associated with those contexts—serve particular values over others (Bravo and Elliott 2025).

Another important direction for future work is to explore the nuances of how value-laden choices permeate particular scientific activities or fields (see Parts 5 and 6 of the *Handbook*). For example, there has been increasing attention to the role of values in specific aspects of science, such as modeling (e.g., Biddle and Winsberg 2010; Intemann 2015; Harvard and Winsberg 2022), measurement (e.g., Ohnesorge 2024; Larroulet Philippi XXX in this *Handbook*), classification (Brigandt 2022; Elliott 2009; Ludwig 2016; Katikireddi and Valles 2015), and communication (Franco 2019; John 2019; Kovaka 2021). Philosophers are also beginning to pay

more attention to the relationships between different knowledge systems, including the roles that values play in those relationships (Kendig 2020; Ludwig and El-Hani 2020; Parke and Hikuroa 2024). In addition, there is growing recognition that scientific assessments designed to guide policy making on topics like climate change are value-laden in numerous ways and worthy of detailed scrutiny (see Elabbar XXX and Whyte and Sherpa XXX in this *Handbook*). Virtually any scientific field incorporates subtle value judgments that merit further investigation (see Part 6 of the *Handbook*).

Finally, as society struggles to deal with rampant misinformation and skepticism about science, a crucial role for philosophers will be to clarify how attention to values can help to address these problems. One avenue, as discussed earlier, is to clarify obvious abuses of science by those who operate in bad faith (see e.g., McGarity and Wagner 2008; Michaels 2008; Oreskes and Conway 2010). Scholars working on values and science can collaborate with those working in social epistemology and network epistemology to explore how misinformation spreads (see Korf and O'Connor XXX in this *Handbook*). In other cases, there are more subtle value differences that contribute to scientific disagreement and dissent against prevailing scientific views. In those cases, it can be helpful to clarify those value differences and explore whether or not they can be justified (Biddle and Leuschner 2015; de Melo-Martín and Intemann 2018; Elliott 2023; Miller 2021; see also Goldenberg XXX in this *Handbook*). In the face of these sorts of controversies, the values and science literature can also help to identify better approaches for science communication (see e.g., Branch XXX in this *Handbook*; Halpern and Elliott 2022) and more sophisticated perspectives on how to make science worthy of public trust (see e.g., Contessa 2023; de Melo-Martín and Intemann 2018; Intemann 2024; Irzik and Kurtulmus 2019; Wilholt 2013).

The six parts of the handbook are designed to provide a survey of this widespread literature. Some chapters focus on the theoretical background for contemporary debates about values and science, while others investigate the practical applications of this work. Some chapters provide reviews of existing literature, while others explore new and emerging issues. Many of the chapters draw connections to other areas of scholarship, such as political philosophy, science and technology studies, and research ethics. Together, the handbook's chapters illustrate the wide breadth and relevance of this research area.

Organization of the Handbook

Part 1: Theoretical Background on Values and Science

Part 1 explores the theoretical ideas that structure the field of values and science. It begins with some of the key historical ideas that provided a starting point for subsequent work. Intemann's chapter describes some of the major feminist critiques that began to challenge the notion that science is or should be value free, and Kristina Rolin delves more deeply into one of those feminist approaches, namely, standpoint theory. One of the key issues raised by this feminist scholarship is the concept of objectivity and the extent to which objective science must be value-free, which Inkeri Koskinen considers in her chapter. Building on this historical background, Kevin Elliott's chapter describes six major arguments that have been developed against the VFI.

In a complementary chapter, Matthew Brown evaluates a number of arguments for maintaining the VFI and concludes that they are unconvincing.

The remainder of Part 1 explores conceptual issues that continue to be important for thinking about values and science. Ivanova's chapter examines the role of aesthetic values in science, which (as noted previously) is an important topic both because aesthetic values have received very limited serious attention in the existing literature and because aesthetic values open up new layers of complexity in the relationship between epistemic and non-epistemic values. Zina Ward discusses the concept of value-ladenness, which, as noted above, is crucial for promoting precise discussions about the VFI and about the roles of values in science more broadly. Finally, Stephanie Harvard and Eric Winsberg's chapter makes the case for distinguishing different kinds of "epistemic risks" in science in addition to inductive risk. In particular, they introduce the concept of "representational risk," which involves mistakes in building models rather than mistakes in making inductive inferences (see also Biddle and Kukla 2017; Harvard and Winsberg 2022).

Part 2: Managing Values in Science

Part 2 turns to the question of how to manage values in science appropriately. As mentioned previously, Holman and Wilholt (2022) argued in an influential article that the issue of value management should be framed as a "new demarcation problem" (NDP). Bennett Holman and T.Y. Branch's contribution to the handbook introduces the contemporary literature on value management by reviewing the concept of the NDP and the recent literature on it.

One approach to managing values in science is to harken back to the ban on values that was central to the traditional VFI. In response to the arguments against the traditional VFI, proponents of these neo-VFIs utilize varying types of value prohibitions. The chapters by Wendy Parker and Tarun Menon and Jacob Stegenga provide two examples of this approach. Parker acknowledges that non-epistemic values are often relevant to scientific reasoning, but she suggests using an "epistemic projection" approach to value management that shifts value-laden decisions into the "problem selection" stage of scientific inquiry. For their part, Menon and Stegenga acknowledge that it might not be appropriate to completely remove non-epistemic values from scientific reasoning, but they argue that the VFI is still tenable as an action-guiding principle that calls for scientists to remove the influences of values on their inferences to the greatest extent possible.

Another particularly prominent approach to managing values in science is what Holman and Wilholt (2022) called the "systemic" approach. Systemic strategies for managing values in science focus on creating an appropriate social structure that can critically assess value influences on science. Helen Longino's critical contextual empiricism (CCE) is arguably the most influential version of a systemic approach. Kirstin Borgerson provides an overview of CCE in her chapter and considers major critiques of it. As Borgerson emphasizes, CCE calls for critical discussion of values and background assumptions in science from a variety of different perspectives. A critical question for this sort of systemic approach, however, is what range of different perspectives are necessary and appropriate in order to foster objectivity in science. In her contribution, Juliana Gutiérrez Valderama argues that geographical diversity has received

inadequate attention, and this has resulted in a global scientific endeavor that prioritizes the values of privileged geographical locations. In their chapter, Abigail Nieves Delgado and her colleagues clarify that the pursuit of diversity, especially data diversity, can also have costs, including stereotyping and extractive practices (see also Bluhm XXX in this *Handbook*). Therefore, they argue that it is often better for scientists to aim for local, rather than global, forms of diversity.

An additional approach to value management is to foster transparency or openness about values so that people can make their own decisions about whether to accept the science or reject it as problematic (see e.g., Douglas 2008; Elliott 2021; Elliott 2022a). This approach resonates with current trends in science, such as the promotion of open science initiatives (see e.g., Leonelli 2023). Nevertheless, transparency has limitations. In his chapter, Stephen John examines the strengths and weaknesses of transparency as a response to the value-ladenness of science. He argues that transparency initiatives can have costs for public audiences (e.g., promoting unwarranted distrust of science) and for the quality of research itself (e.g., incentivizing researchers to adopt sub-optimal research practices).

Part 3: Values, Science, and Democracy

As discussed above, one of the most widely discussed approaches to managing values in science is to lean upon democratic principles and practices. The idea is that value-laden science can still play a legitimate role in the political sphere as long as the values underlying the science are democratically legitimate. This is such an influential idea, with so many issues and complexities to explore, that we have assigned a separate part of the handbook to this topic.

As discussed earlier, the democratization of science is not a new idea (see e.g., Jasanoff 2017; Kitcher 2001; Wynne 1996), but Andrew Schroeder's work on this topic has been particularly influential in the recent values and science literature (e.g., Schroeder 2019; Schroeder 2021; see also Lusk 2021). In his chapter for the handbook, Schroeder provides an overview of the key reasons for thinking that science should be responsive to the public, and he then highlights some of the important complications that need to be addressed if this goal is to be pursued in a serious fashion. Karen Kovaka and Inmaculada de Melo-Martín probe even further into these challenges in their chapters. Kovaka argues that it is very difficult to measure the public's values in a manner that is both truly representative of their diversity and can meaningfully guide the wide array of value judgments that permeate scientific research. De Melo-Martín explores how different stakeholders who are impacted by a particular area of science, such as pharmaceutical development and regulation under the auspices of the FDA, often have conflicting values.

Given these complexities of achieving democratized science, philosophers of science are increasingly turning to political theory in an effort to develop more sophisticated perspectives about how to relate values and science. In their chapter, Hannah Hillgardt and Torsten Wilholt use both ideal and non-ideal political theory to explore how science ought to be organized in order to fulfill the distinctive roles that it plays in democratic societies. Yiftach Fehige uses political theory to explore the additional question of how religious values should factor into decisions about science in democratic societies. This is an important contribution because religious values have received very little discussion in the recent values and science literature.

Another topic that has received very little previous attention in values and science is how to think about science in *nondemocratic* contexts. Karoliina Pulkkinen provides a much-needed opportunity to reflect on this neglected topic in her chapter for the handbook. She problematizes the assumption that value influences flow in a simple top-down fashion in nondemocratic contexts, she examines the nature of ideology and the moral ambiguity around “wishful speaking” as a way to navigate ideology, and she raises the question of whether value influences in science could be legitimized in ways other than through some form of democratic endorsement.

Finally, Heather Douglas’s and Alexander Tolbert’s chapters conclude the discussion of value management approaches that runs through Parts 2 and 3 of the handbook. Noting that science is a source of power in modern society, Douglas argues that proper value management in science should also include considerations of social justice. She considers how justice can be promoted or jeopardized through four aspects of research: (1) participation in science; (2) the treatment of human subjects in science; (3) interaction and engagement with social communities through research; and (4) agenda-setting for science. Alexander Tolbert then provides a detailed analysis of injustice in a particular area of science, namely, machine learning. He argues that the current literature on algorithmic fairness in machine learning reproduces racial disparities in society because it treats fairness as a technical problem and fails to grapple with background conditions of social injustice. Ultimately, Douglas’s and Tolbert’s chapters show that if social justice is to be achieved, it will stem not only from individual efforts by scientists but also through the creation of policies that guide scientific research toward the promotion of justice. Building on this point, the next part of the handbook explores the wide variety of institutions that influence how science impacts society.

Part 4: Values, Science, Institutions, and Organizations

Philosophers of science have been arguing for years that more attention should be paid to the institutions and organizations that guide the practices of science in ways that support some values and challenges others (Biddle 2024; Douglas 2018; Elliott 2017; Fernández-Pinto 2023). Nevertheless, there has still been a tendency in the literature to focus on the values that individual scientists or research groups bring to their work rather than to the institutions and organizations in which scientists operate. The chapters in this part of the handbook examine the important relationships between values and scientific institutions and open up a number of important questions for future work.

The first group of chapters focus broadly on the organizations that fund and perform research. Jamie Shaw begins by focusing explicitly on an analysis of the values that public, private, and philanthropic funders bring to science. Pedro Bravo then provides an overview of the wide variety of ways that industry funding can influence scientific research. This description is valuable because industry funding provides one of the few examples of an institutional or organizational context that has received sustained attention by those working on values and science (for an overview, see Holman and Elliott 2018). Manuela Fernández Pinto and Anna Leuschner build on Bravo’s analysis by focusing specifically on the ways that companies (as well as other actors) harass scientists in order to discourage them from communicating unwanted

messages. This phenomenon of epistemic intimidation, and its effects on scientific practice, is a crucial emerging topic that merits significant attention. Rebecca Korf and Cailin O'Connor extend the discussion in the previous two chapters by showing how network modeling can provide a richer understanding not only of industry influences on science but also of a wide array of other ways in which values influence the communal generation and communication of scientific knowledge. Finally, Rachel Ankeny and Emily Buddle problematize simple distinctions between the values of industry and the values of academia in their analysis of agricultural genomics research collaborations in Australia. Furthermore, they call for those working in values and science to adopt approaches that are more empirical and that consider a richer array of institutional factors beyond funding sources (e.g., standards, infrastructures, funders, and intellectual property regimes; see also Ankeny and Leonelli 2016).

In addition to the organizations that fund and perform research, some of the most important organizations that influence science are regulatory and policy-making bodies. One important question in this arena is how values influence the information that scientists provide to these organizations. This question is considered in two chapters that explore the values involved in formulating environmental assessment reports. Ahmad Elabbar examines how the assessment reports produced by the IPCC incorporate values through inductive risk considerations, visualizations, and procedures for information curation and synthesis. Kyle Whyte and Pasang Sherpa inquire into how the development of Indigenous-led assessment reports could generate scientific assessments that highlight different values. Another important question about policy-making bodies is how their science-related claims and recommendations are received by the public. Maya Goldenberg's chapter explores this question. She examines conflicts over vaccine policy and highlights how these debates, which are often framed as a conflict between science and politics, actually reflect a much more complex array of values. Finally, in the concluding chapter of this part, David Resnik explores a third relationship between science and policy-making bodies, namely, the ways in which they regulate the practice of science. Specifically, he examines the institutional structures that regulate dual-use biomedical research, which has become particularly pressing in the wake of the COVID-19 pandemic.

Part 5: Values in Scientific Activities

Part 5 turns to an analysis of values in specific scientific activities. This part does not provide a comprehensive analysis of all the ways values arise in the practices of science; rather, it provides a sampling of different practices and the ways values are intertwined with them.

The first two chapters explore how values are involved in the nitty-gritty details of scientific data collection and analysis. Cristian Larroulet Philippi examines value considerations in the process of measurement. Perhaps because measurement appears so straightforward and factual, there has been comparatively little attention paid to measurement in the values and science literature. Larroulet Philippi, however, shows that this is a complex topic that merits more attention (see also Ohnesorge 2025). Zinhle Mncube explores value considerations in deciding whether to include race as a predictor in medical guidelines and algorithms. Mncube argues that one can clarify the debate between proponents and opponents of using race as a predictor by attending to their differing approaches to inductive risk (i.e., the potential to make false positive or false negative errors) and the values underlying those approaches.

The final four chapters of this part explore a broader array of scientific practices that are bound up with values. Charbel El-Hani and David Ludwig turn to the question of how different knowledge systems (e.g., academic, Indigenous, local) relate to each other. El-Hani and Ludwig highlight the dangers of oversimplifying either the similarities or the differences between knowledge systems, and they argue that one can avoid many of these dangers by focusing on the partial overlaps between different systems. Daniel Steel focuses on the role of values in framing issues at the intersection of science and policy. He uses climate change as a case study and explores the implications of framing it as a tragedy of the commons as opposed to an energy transition. T.Y. Branch discusses how different models for science communication reflect and reinforce different normative assumptions about the roles for values in science. Finally, Kristina Rolin examines research ethics education and considers how it can be enhanced by incorporating themes from the literature on science and values. In particular, she argues that scientists can better appreciate the importance of ethical norms and guidelines in science when they understand how those norms and guidelines support not only ethical and social goals but also epistemic goals.

Part 6: Values in Specific Sciences

Part 6 concludes the handbook by considering how values are incorporated in the practice of specific sciences. Robyn Bluhm explores the tensions involved in trying to overcome the influences of androcentric values in the biomedical sciences. She shows that efforts to overcome androcentric values by incorporating more female animals in preclinical research can actually backfire and reinforce sex essentialism. Yasmin Haddad and Celso Neto focus on human genomics, arguing that there are good reasons to incorporate non-epistemic values in this area of research in order to lessen potential harms, respond to underdetermination and inductive risk, and guide the direction of research. Turning to the environmental sciences, Greg Lusk explores the many ways that values are embedded in climate modeling and also discusses how those value influences can be managed. Meanwhile, Jacalyn Beck and her colleagues provide their perspective as practicing conservation biologists about how value-laden frames and narratives shape the ways they study and communicate about complex biological systems. Turning to the social sciences, Elizabeth Anderson looks at value debates in classical economics in order to draw lessons for critiquing contemporary economics, especially with respect to its assumptions about how to measure human welfare. Finally, Justin Biddle considers the role of values in artificial intelligence research and governance, highlighting the importance of values for problem framing and operationalization, data, modeling and validation, and deployment.

Our goal in this part, as in previous parts of the handbook, is obviously not to provide a comprehensive examination of values in all areas of science. Rather, we aim to consider enough different sciences to illustrate how value-laden dimensions can be uncovered in many different fields. Many of the chapters in other parts of the handbook provide additional illustrations of value dimensions in other areas of science (see, e.g., Ankeny and Buddle XXX; Mncube XXX; Nieves Delgado et al. XXX).

Some readers will notice that our examples in this part do not come from theoretical areas of chemistry or physics. More work is needed to probe the roles of values in these areas of science,

but it is important to note that many of the arguments found throughout the handbook apply to these areas of science as well. For example, Ivanova's chapter on aesthetic values includes a wide array of examples from the physical sciences. Values associated with who participates in science and what research agendas get funded are also highly relevant to these fields (see Douglas's and Shaw's chapters). In fact, because the potential social benefits of these areas of science are not as obvious as in other areas of science, researchers in these fields have to make particularly significant value-laden decisions about how to responsibly communicate their work in order to motivate funding and generate public interest without succumbing to inappropriate hype (Intemann 2022; see also the chapters by Branch and Steel). Along these lines, Kent Staley (2017) has pointed out that considerations of inductive risk are relevant even in a field like physics because researchers have to decide how much evidence to demand before announcing high-profile discoveries to the public.

Conclusion

The chapters in this handbook provide an accessible, forward-looking orientation to the literature on values and science. Besides providing background on some of the classic theoretical debates that have animated the field, the chapters illustrate the breadth of this topic and its intersections with other fields. Much insight has been gained by engaging with work in research ethics, biomedical ethics, science and technology studies, and political philosophy. Scholarship on concepts that integrate epistemology and ethics, such as epistemic injustice (Elliott forthcoming; Grasswick 2017; Gagné-Julien 2021), pragmatic encroachment (Kim 2017; Miller 2014), coupled epistemic-ethical issues (Tuana 2013; Katikireddi and Valles 2015), and performativity in scientific modeling (Ortmann 2025; van Basshuysen et al. 2021), are likely to generate promising insights for values and science as well. In order to make this scholarship as impactful as possible, we encourage continuing collaborations between philosophers working in this area and practicing scientists, policy makers, and activist groups (see Ludwig and El-Hani 2025; Plaisance and Elliott 2021; Toomey 2024). We hope this handbook inspires a wide range of future scholarship on the ways in which ethics, values, and social considerations are embedded in the reasoning practices and the content of the sciences. In our view, these deep connections between the ethical and the epistemic, between the social context of science and the content of scientific claims, are what make the field of values and science so distinctive, exciting, and socially important.

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