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Direct and Indirect Roles for Values in Science*

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Although many philosophers have employed the distinction between "direct" and "indirect" roles for values in science, I argue that it merits further clarification. The distinction can be formulated in several ways: as a logical point, as a distinction between epistemic attitudes, or as a clarification of different consequences associated with accepting scientific claims. Moreover, it can serve either as part of a normative ideal or as a tool for policing how values influence science. While various formulations of the distinction may (with further clarification) contribute to a normative ideal, they have limited effectiveness for regulating how values influence science.

1. Introduction. Philosophers of science have recently focused a good deal of attention on the roles that various sorts of values ought to play in scientific practice (e.g., Machamer and Wolters 2004; Kincaid, Dupre, and Wylie 2007). It is now widely accepted that "epistemic" values (e.g., predictive accuracy, explanatory power, and consistency) have a legitimate role to play throughout all aspects of scientific reasoning (Kuhn 1977; McMullin 1983).[1] Moreover, most scholars agree that "nonepistemic" values (e.g., ethical, political, or religious concerns) can appropriately influence many aspects of science, including choices about what projects

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1. Throughout this article, I will employ the distinction between epistemic and nonepistemic values as it is propounded by McMullin (1983). Some of the values that McMullin would consider to be epistemic, such as explanatory power and fertility, would be classified differently by other authors (see, e.g., Douglas 2009). Such details do not affect the major arguments of this article.

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to pursue and what ethical constraints to place on scientific methodologies (Longino 1990; Machamer and Wolters 2004; Elliott 2011). Current debates revolve primarily around the question of whether nonepistemic values also have a legitimate role to play in activities at the very heart of scientific reasoning, such as the evaluation and justification of scientific claims.

There are numerous strategies for arguing that even nonepistemic values should be allowed to influence scientific reasoning. One approach is to question the very attempt to formulate a convincing distinction between epistemic and nonepistemic values (Rooney 1992; Longino 1996). Another strategy is to argue that, because scientific claims are underdetermined by purely epistemic considerations, nonepistemic factors have a legitimate and unavoidable role to play in evaluating scientific claims (Longino 1990; Howard 2006). For the purposes of this article, I will set aside these strategies and focus on a third approach. This third strategy involves making a distinction between two different roles (namely, direct and indirect) that values can play in scientific reasoning. To a first approximation, values play a direct role when they act as "reasons in themselves to accept a claim" (Douglas 2009, 96). In contrast, values serve in an indirect role when they merely influence the evidential standards needed for justifying a claim. Over the past half century, many proponents of this distinction have argued that nonepistemic values can appropriately influence the very heart of scientific reasoning as long as they play only an indirect role.

In the middle of the twentieth century, C. West Churchman (1948) and Richard Rudner (1953) emphasized that, while it is inappropriate for scientists to accept a hypothesis merely because it accords with their ethical, political, or religious values, scientists still have to make value judgments when deciding how much evidence to demand in order to accept a hypothesis. For example, Rudner argued that the amount of evidence required for concluding that a toxic ingredient in a drug is present at a safe dose level should be higher than the amount of evidence required for concluding that a batch of machine-stamped belt buckles is not defective (1953, 2). Numerous influential philosophers of science, including Ernest Nagel (1961), Philip Kitcher (1985, 2001), and Carl Hempel (1965), have employed something like this distinction in their own work. Other philosophers, including John Heil (1983) and Carl Cranor (1990), have made similar points in the broader ethical and epistemological literature.

The distinction was especially central to Heather Douglas's recent book (2009). Her goal was to tear down the assumption that science should be value free (which, as she clarified, is really the ideal that it should be free of nonepistemic values in the heart of scientific reasoning). She acknowledged, however, that it is still important to uphold epistemic standards that promote the objectivity of science (114). Moreover, she aimed to develop epistemic standards that can be applied to individual scientists (18–19); she did not want to depend solely on a social account of objectivity like the ones developed by Miriam Solomon (2001) or Helen Longino (2002). In order to achieve this goal, Douglas depended on the distinction between direct and indirect roles for values. She argued that values of any sort can appropriately influence scientific reasoning as long as they play only an indirect role. In contrast, she insisted that values (other than narrowly epistemic ones such as internal consistency and predictive competence) should only rarely play a direct role in the heart of scientific reasoning (Douglas 2009, 94–102).

Despite this wide body of previous work, I argue that both the nature of the distinction and the purposes for employing it merit further clarification. Section 2 highlights the current ambiguity surrounding these issues. It shows that the distinction can be formulated in at least three different ways: as a logical point, as a distinction between epistemic attitudes, or as a clarification of multiple kinds of consequences that can be considered when deciding whether to accept scientific claims. It also shows that the distinction can serve in multiple roles, including as an aid to conceptual clarification, as a normative ideal, or as a tool for policing the ways that values influence science (at either an individual or a community level). Section 3 explores the conceptual cogency of all three formulations and concludes that at least some of them have the potential to serve as part of a normative ideal. More scholarship is needed, however, on several issues: characterizing different epistemic attitudes, clarifying Douglas's formulation of the distinction between direct and indirect roles, and exploring the ethical framework that Douglas employs as the foundation for her formulation. Section 4 argues that all three formulations are significantly limited in their effectiveness as tools for regulating the roles that values play in science, especially at the community level. Therefore, the article concludes that supplementary strategies for addressing values should be explored further.

2. Clarifying the Distinction. Heather Douglas introduced the terminology of "direct" and "indirect" roles for values in her recent book (2009) and in her earlier journal article (2000). As she notes, however, she was building on the work of previous philosophers of science such as C. West Churchman (1948), Richard Rudner (1953), Ernest Nagel (1961), and Carl Hempel (1965). This section argues that further clarity is needed both about the range of closely related distinctions associated with the work of these philosophers and about the purposes to which their distinctions are to be put.

The Nature of the Distinction. Let us consider, first, Hempel's famous discussion of "inductive risk" (1965). It provides a good starting point because, as Douglas (2000) herself emphasizes, it largely encapsulates the perspective of those writing on this topic from the 1940s to the 1960s. In his article, Hempel's main focus is to consider whether science can provide answers to moral questions. In the process of his analysis, he formulates a distinction between two ways in which science might presuppose values. First, the system of statements that represents scientific *knowledge* might presuppose values, in the sense that values might provide evidential support for those statements.[2] Second, scientific *method* might presuppose values, in the sense that the rules of acceptance for deciding when a hypothesis has sufficient evidential support depend on assigning values to the outcomes that result from accepting or rejecting the hypothesis. Hempel argues that science does not presuppose values in the first sense, but it does presuppose values in the second sense (1965, 91–92). Thus, Hempel's distinction is primarily a *logical* one about the relationships that can hold between values and various aspects of science. He argues that values have no logical relevance for assessing the degree to which scientific hypotheses are confirmed, but they are relevant to choosing rules for accepting hypotheses. While Churchman (1948), Rudner (1953), and Nagel (1961) were less concerned than Hempel to formulate an explicit distinction between different ways that values could influence science, they had a similar goal of clarifying that some aspects of science do logically presuppose value judgments.

It is enlightening to consider how Douglas (2000, 2009), while drawing on Hempel's work, formulates a somewhat different distinction than he did. Like Hempel, she emphasizes that values are relevant to formulating appropriate rules for accepting hypotheses in the face of inductive risk (i.e., in the face of the possibility that we might accept or reject hypotheses erroneously). However, her conception of this indirect role for values in science expands beyond the activity of accepting or rejecting hypotheses. She argues that concerns about inductive risk are relevant to numerous other aspects of scientific activity, such as characterizing evidence and interpreting results. She also expands the direct role for values beyond the boundaries of Hempel's original distinction. For example, as examples of the direct role, she includes cases in which ethical prohibitions count against particular sorts of experimentation on humans and cases in which

2. To be precise, Hempel claims that categorical judgments of value (e.g., killing is evil) do not stand in logical relationships with statements of scientific fact. He acknowledges that instrumental judgments of value (e.g., if our children are to be happy, we should raise them permissively) can stand in logical relationships with statements of scientific fact.

societal values discourage the development of new technologies (Douglas 2000, 564).

Unfortunately, while Douglas does not appear to accept the same formulation of the distinction as Hempel, it is difficult to pin down the precise nature of her own formulation. Douglas's initial paper (2000) and her later book (2009) suggest at least three possibilities. First, her paper sometimes describes the "direct role" for values as involving any case in which one is considering "the direct consequences of a particular course of action" (2000, 564). In contrast, she says that values act in an indirect way when they help scientists decide how to respond to the potential consequences of making erroneous choices or producing inaccurate results (564–65). However, the nature of "direct consequences" and the way that they contrast with the consequences of error is unclear. Suppose, for example, that a group of scientists accepts the hypothesis that a particular pesticide is relatively safe, and suppose that regulators allow extensive public exposure to the chemical on the basis of the scientists' pronouncement. Also suppose that the scientists turn out to be wrong, and their pronouncement ultimately contributes to a significant increase in cancer incidences. The increase seems to be a fairly "direct" consequence of the scientists' pronouncement, at least in a causal sense, but it is also a consequence of erroneously accepting a hypothesis. Therefore, what seems to be distinctive about the cases that Douglas calls "direct" is not that the consequences of accepting a hypothesis are direct in a *causal* sense but rather that the consequences are what scientists *intend* to bring about by accepting the hypothesis.

Douglas hits on this point when she formulates her distinction in a second way. In both her paper and her book, she sometimes claims that, whereas values in the indirect role have to do with the consequences of error, values in the direct role involve intended consequences (2000, 564; 2009, 96). Unfortunately, this formulation of the distinction (in terms of erroneous vs. intended consequences) still faces difficulties because it is not obvious that it provides either a mutually exclusive or an exhaustive categorization of consequences. For one thing, there is room for debate about whether all consequences that result from error are unintended. Douglas calls for scientists to anticipate potential errors and the consequences associated with them; moreover, she calls for them to set acceptance rules so that the likelihood of those consequences is tolerable. Therefore, they clearly foresee these consequences, and one might say that they intend them in the limited sense that they reflect in advance on their willingness to risk them. As a result, it is not entirely clear that the consequences that are intended and the consequences that result from error are mutually exclusive categories. They may not be exhaustive categories, either. One can imagine cases in which scientists accept a hypothesis that is true but that has unexpected (and therefore unintended) consequences. In a case like this, the consequences would not seem to fit either of Douglas's categories (i.e., they are neither the result of error nor intended).[3]

Douglas's third way of formulating the distinction between direct and indirect roles adds further complexity. Whereas the first two formulations are clearly concerned with consequences, the third formulation sounds more like a logical distinction. In her book, she sometimes says that values operate in a direct role when they act "as reasons in themselves" or "as stand-alone reasons" to motivate our choices (2009, 96). In contrast, she says that values act indirectly when they "act to weigh the importance of uncertainty, helping to decide what should count as *sufficient*" reason for a choice (96). Unfortunately, it is difficult to determine what it means for something to count as a "stand-alone reason" for a choice, especially when one considers that Douglas wants to talk about reasons not only for accepting hypotheses but also for choosing methodologies or developing technologies.

To further appreciate the nature of Douglas's third formulation, it is important to highlight another distinction that lurks in the background of her and Hempel's work. This is a distinction between two epistemic attitudes. When philosophers argue that nonepistemic values have a proper role to play in science, one must distinguish whether they are arguing that values have a role to play in *practical* decisions about what claims to *accept* as a basis for action or whether they are also addressing *epistemic* decisions about what claims to *believe* as true (see, e.g., Cohen 1992; Giere 2003). Hempel is not entirely clear about the relationship between his work and this distinction between various epistemic attitudes. On one hand, when he discusses rules for hypothesis acceptance, he might be talking about the acceptance of a hypothesis as a basis for action. On the other hand, his rules for hypothesis acceptance might just involve the issue of when a hypothesis should be believed to be true.

While the relationship between Hempel's work and these epistemic attitudes is somewhat unclear, other writers have been more explicit. For example, Churchman claims, "In pragmatic methodology [which Churchman espouses], every scientific hypothesis is considered to be a possible course of action for accomplishing a certain end, or set of ends" (1948, 259). Thus, when Churchman discusses the acceptance of hypotheses, he

3. Note that, in some cases, scientists might still have moral responsibilities to consider these unintended consequences when deciding what hypotheses to accept or to reject, even if the consequences were unexpected. For example, the consequences might have been unexpected only because the scientists negligently failed to consider all the plausible ramifications of accepting a particular hypothesis.

is clearly thinking in terms of acceptance as a basis for action. Similarly, Douglas emphasizes that scientists are taking actions when they make socially relevant claims as voices of authority (2009, 16). This is an important part of her argument that practical as well as theoretical considerations have an appropriate role to play in evaluating scientists' pronouncements, whereas she insists that values should not dictate what one believes to be true (16). Thus, when Douglas argues that values can appropriately play an indirect but not a direct role in hypothesis acceptance, she is apparently addressing the epistemic attitude of hypothesis acceptance as a basis for action, insofar as she is considering what pronouncements scientists can justifiably make.[4]

With the understanding that Douglas is concerned with the proper roles for values in hypothesis acceptance *as a basis for action*, we can return to the difficulty of determining what it means to say that something is a stand-alone reason for a choice. Douglas cannot offer a clear logical difference between values that act as stand-alone reasons for hypothesis acceptance and those that do not. Hempel's distinction between different roles for values was clearly a logical one, insofar as he could show that nonepistemic values are logically irrelevant for assessing the degree to which scientific hypotheses are confirmed, but they are relevant to choosing rules for accepting hypotheses. But for Douglas, values in both the direct and the indirect roles are concerned with deciding whether a hypothesis should be accepted as a basis for action, and in both cases values are logically relevant. Thus, the distinction between the two roles still turns out to be about different sorts of consequences. This is, perhaps, clearest when Douglas says that values act as stand-alone reasons when scientists are motivated by the appealing outcomes that they want to achieve by accepting a hypothesis (assuming that it is true; 2009, 96). In contrast, when values determine what should count as sufficient reason for accepting a hypothesis, scientists are motivated by concerns about the consequences of erroneously accepting a hypothesis.

Thus, although Douglas's formulations of the distinction between direct and indirect roles need further clarification, they all apparently refer to different sorts of consequences that scientists can take into account when

4. Daniel Steel (2011) has recently suggested, in contrast with most previous authors, that the epistemic attitude of acceptance need not be interpreted in a behaviorist way as a decision about how to act. According to his account, scientists can accept a hypothesis not primarily as a basis for action but rather as a way of simplifying their reasoning without significantly distorting it. Douglas could potentially argue that she is concerned, in at least some cases, with hypothesis acceptance in the sense that Steel has described rather than with the traditional notion of hypothesis acceptance as a basis for action, but this would not make a significant difference to my evaluation of Douglas's work throughout this article.

accepting a hypothesis. Going forward, there seem to be at least two promising ways to sharpen her formulation. One approach would be to focus solely on error: values would have an indirect role if they are concerned with the potential consequences of error, and values would have a direct role in all other cases. The other possibility would be to develop a more precise distinction based on intended consequences: values would have an indirect role if they involve foreseen but unintended consequences, and values would have a direct role if they involve consequences that are both foreseen and intended.

The Purpose of the Distinction. In addition to these ambiguities about the nature of the distinction between direct and indirect roles for values in science, it is also somewhat unclear what the purpose of the distinction is supposed to be. For Hempel, it appears to be primarily an aid to developing an adequate conceptual understanding of the relationships between science and values. His article is designed to clarify the ways in which science can contribute to the formation of values and the ways in which science in turn presupposes values. Similarly, Nagel's discussion of values in science (1961) revolved around determining whether the social sciences presuppose value judgments in ways that the natural sciences do not.

More recent writers, such as Kitcher (1985, 2001), Cranor (1990), and Douglas (2000, 2009), seem to have more practical, and even policy-oriented, goals in mind when discussing indirect roles for values in science. While Cranor and Kitcher are not focused on formulating an explicit distinction between direct and indirect roles for values, both emphasize that the standards of evidence for making scientific claims should be adjusted on the basis of the practical context in which those claims are made. Therefore, they are interested in providing normative guidance for scientists. Similarly, Douglas offers her distinction between direct and indirect roles for values as the basis for a new normative ideal, one that can replace the old "value-free" ideal for science. Her new ideal is "centered on the practice of limiting all kinds of values to an indirect role when making judgments concerning the acceptability of data and theories" (2009, 133).

Nevertheless, there is room for further clarification about this normative role for the distinction between direct and indirect values. On one hand, the distinction could act only (or at least primarily) as the basis for a new scientific ideal. For this to be the case, the distinction would have to be both conceptually coherent and central to the difference between good and bad science. On the other hand, the distinction between direct and indirect roles could serve not only as the basis for a new scientific ideal but also as a primary tool for policing or regulating science so as to achieve the ideal. On this view, one of the chief strategies for promoting the ideal would be for scientists to inspect whether values were playing a direct or an indirect role in their own work or in the work of other scientists. One might compare this difference between employing the direct/indirect roles distinction as an ideal versus as a policing tool to a parallel issue that arises in moral philosophy. Ethicists have debated whether the moral theory of consequentialism should act only as a criterion or standard of right actions or whether it can also act as a decision procedure or guide for actually choosing the right actions.

Douglas arguably thinks that the distinction between direct and indirect roles can serve fruitfully not only as an ideal but also as an important tool for policing scientific activity, at both the individual and the community levels. At the level of the individual scientist, she advises that scientific experts should strive "1) to keep values out of the direct role, and 2) to make values in the indirect role explicit" (2008, 13). At the level of the scientific community, she claims that the distinction between direct and indirect roles can be used "to illuminate the sound science-junk science debate, with junk science clearly delineated as science that fails to meet the minimum standards for integrity" (2009, 148). In this quotation, Douglas indicates that members of the scientific community can evaluate the ways in which values influence scientific research performed by others, thereby identifying inappropriate forms of research. Unlike Douglas, however, one could hold that the direct/indirect roles distinction can contribute to a new ideal for science, while remaining fairly skeptical about the ability of scientists to scrutinize the role of values in their own work or in that of others.

The Upshot. On the basis of the preceding clarifications, I propose to examine the fruitfulness of three different ways of formulating the distinction between direct and indirect roles. We have seen that writers like Hempel and Nagel and Rudner, to the extent that they were trying to formulate an explicit distinction between different roles for values, were primarily thinking in terms of the logical relationships between values and particular elements of science. In contrast, Douglas appears to be using the language of "direct" and "indirect" to delineate different sorts of consequences that scientists could take into account when reflecting on their actions. Finally, for the sake of completeness, it is worth considering whether the distinction between the epistemic attitudes of belief and acceptance could provide a fruitful alternative means of formulating this distinction. While we have seen that authors like Hempel and Douglas did not explicitly formulate their distinctions in this way, others have made distinctions along these lines. In an interchange with Janet Kourany, for example, Ron Giere claimed, "It may be scientifically unacceptable to *believe* in the truth of a theory because it conforms to a moral ideal, but it is not unacceptable to *decide* to rely on such a theory for purposes of practical action or policy" (2003, 20).

I will examine the fruitfulness of these three formulations of the distinction between direct and indirect roles by considering two different uses to which they might be put. Specifically, the next section of the article will consider their usefulness as components of a scientific ideal, and section 4 will study their effectiveness in helping both individual scientists and the scientific community to police the influence of values on science. There are undoubtedly many other uses for these distinctions. For example, we have already seen that they could be used as a conceptual tool for clarifying various features of science, and they could also be used descriptively as an aid to categorizing the various ways that values influence science in particular case studies. Hopefully, the following analysis of two uses for the distinction will shed light on how well it can serve a variety of other tasks.

3. The Distinction as Part of a Normative Ideal. To determine whether each formulation of the distinction between direct and indirect roles can contribute to a normative ideal for science, one has to consider two questions: (1) is the distinction conceptually coherent, and (2) is the distinction central to the difference between good and bad science? These are very large tasks for a single section of an article, so this section will focus on sketching the major issues that need to be addressed in order to answer these questions.

A Logical Distinction. The first formulation of the distinction between direct and indirect roles for values consists in a logical point. Namely, values do not stand in evidential relationships with scientific statements, but they can play a role in choosing rules of acceptance for scientific hypotheses. This distinction appears very strong conceptually, but one could challenge it in at least two ways. First, Helen Longino (1990) has argued that data stand in evidential relationships to theories or hypotheses only in the context of background assumptions. Moreover, she notes that, insofar as contextual values influence the background assumptions that scientists hold, this fact makes scientific reasoning value laden. Thus, in order to maintain the logical distinction in the face of Longino's criticism, one would have to clarify that values are irrelevant to assessing evidence *if* one is already assuming a fixed set of background assumptions.

A second challenge for the logical form of the distinction between direct and indirect roles for values might come from those who question the cogency of the fact/value distinction on which it is based. Those who reject the fact/value distinction would argue that there can, at least in principle, be logical relationships between statements about "facts" and statements about "values" (see, e.g., Dodd and Stern-Gillet 1995). Nevertheless, even if the fact/value distinction were to be more porous than Hempel thought, he seems correct to think that the sorts of nonepistemic values that typically influence science do not provide evidential support for the sorts of claims that scientists typically make (e.g., all else being equal, a biological hypothesis is not more likely to be true just because it advances egalitarian political goals). Moreover, as long as the distinction is conceptually cogent, it is surely advisable for scientists to be mindful of it, lest they be guilty of a logical error. Therefore, it is plausible that the logical distinction between direct and indirect roles for values could contribute to a normative ideal for science.

A Distinction Based on Epistemic Attitudes. The second formulation of the distinction between direct and indirect roles for values in science rests on the difference between two epistemic attitudes. According to this formulation, values play a direct role in science when they contribute to a scientist's belief that a theory or hypothesis is true. In contrast, values play an indirect role when they contribute to a scientist's acceptance of a theory or hypothesis as an appropriate basis for action. This distinction has recently been developed by numerous epistemologists (see McKaughan 2007), and philosophers of science have begun to explore these and other epistemic attitudes taken by scientists toward their hypotheses (Laudan 1981; van Fraassen 2002; McKaughan 2007). If the distinction is to serve as part of a normative ideal for science, however, it must be both conceptually coherent and central to the difference between good and bad science.

One way to challenge the conceptual coherence of the distinction is to argue that belief and acceptance are not so different after all. Most current epistemologists characterize belief as a passive state in which people simply find themselves, whereas acceptance involves active consideration of the ends that one aims to pursue (Cohen 1992). Nevertheless, some philosophical traditions, most notably American pragmatism, would regard this as a dubious distinction. In his classic book, Louis Menand recounts William James's summary of Charles Sanders Pierce's principle of pragmatism: "Beliefs, in short, are really rules for action" (Menand 2001, 354). Pierce was influenced by one of the forerunners of pragmatism, Nicholas St. John Green, who promoted psychologist Alexander Bain's definition of belief as "that upon which a man is prepared to act" (225). Green himself thought that all beliefs have a "purposive" character and that "knowledge is not a passive mirroring of the world" (225). Given a philosophical perspective that sees belief as being so tightly connected to action, it is not clear that the epistemic attitudes of belief and acceptance could be neatly distinguished.

One might also raise the worry that it is unrealistic to think that scientists actually make this sort of distinction in their daily practice. Of course, a distinction can be conceptually clear even if it is not fully realized in typical practice. However, given that this is supposed to be a conceptual distinction about the psychological states held by scientists, it is worrisome if scientists display limited psychological capabilities to maintain these distinctions in their work. This concern is exacerbated by the fact that proponents of the distinction between belief and acceptance find it very difficult to agree on the exact difference between these two epistemic attitudes (see, e.g., McKaughan 2007). In fact, assuming that the attitude of acceptance is distinct from the attitude of belief, it probably needs to be subdivided into a variety of forms: acceptance of a theory as pursuit worthy (Laudan 1981), acceptance of it as tool for simplifying scientific reasoning (Steel 2011), acceptance of it as empirically adequate (van Fraassen 1980), and so on.

Given all this confusion, together with the minimal previous scholarship on epistemic attitudes in science, it may be too early to tell how well a distinction based on epistemic attitudes can serve as part of a normative ideal for science. It is not clear which attitudes are conceptually distinct, and it is not clear which attitudes are appropriate under which circumstances. Nevertheless, this formulation of the distinction is extremely interesting, and it could be very promising once it is investigated further.

A Distinction Based on Consequences. A third way to formulate the distinction between direct and indirect roles for values is in terms of the consequences of scientific actions. Section 2 already argued that this formulation is not entirely clear at present. Nevertheless, it is plausible that Douglas could sharpen her formulation. One possibility is that values have an indirect role if they are concerned with the potential consequences of error, and values have a direct role in all other cases. Another possibility is that values have an indirect role if they involve foreseen but unintended consequences, and values have a direct role if they involve consequences that are both foreseen and intended.

Assuming that this formulation of Douglas's distinction turns out to be conceptually clear, is it central to the difference between good and bad science? As the previous section argued, Douglas is concerned with scientists' actions—specifically, their actions of making pronouncements that influence society. Thus, her advice for scientists is about what it is appropriate for them to accept as a basis for action, not about what they should believe. One might wonder, then, why scientists should make a distinction between different sorts of consequences when deciding what to accept as a basis for action. One would expect that their decisions about how to act should be based on as complete an analysis of the potential consequences as possible.

The first part of an answer to this question is that scientists are generally regarded as having special roles in society. The scientific community is respected as providing information that is relatively neutral with respect to political, religious, and ethical debates (Lacey 1999); Robert Merton (1942/1979) famously referred to this feature of science in terms of its universalism and disinterestedness. Therefore, even though scientists working in policy-relevant areas contribute to practical conclusions about how to act, many analysts want to circumscribe the roles of nonepistemic values in scientific reasoning. The remaining question, then, is why the roles of nonepistemic values should be less circumscribed when considering the consequences of erroneously accepting a theory than when considering the consequences of correctly accepting a theory.

The answer to this question rests with Douglas's ethical reasoning. According to her recent book (2009), the reason scientists should not entirely exclude nonepistemic values from their reasoning is that they have ethical responsibilities with respect to society. In particular, she is concerned that scientists are responsible for the unintended harms associated with their actions when those harms are the result of recklessness or negligence (68–71). On the basis of this moral concern, Douglas argues that scientists should take care to avoid negligently making erroneous claims that cause significant societal harm. She does not argue, however, that scientists are responsible for producing the best societal consequences possible. They are responsible only for preventing bad consequences and, specifically, for preventing bad consequences that arise because of recklessness or negligence.

But Douglas's position raises significant ethical questions. Is she correct that scientists should in fact consider the bad consequences associated with making erroneous claims? If so, why not also consider the potential *benefits* of accepting or rejecting claims erroneously, and why not consider the benefits and harms caused by accepting or rejecting claims *correctly*?[5] Douglas seems to presuppose that scientists have serious moral responsibilities to avoid causing reckless or negligent harm but little or no responsibilities to actively bring about good consequences. However, a more "consequentialist" moral framework for scientists might call for them to perform a complete cost-benefit analysis before deciding what scientific claims to accept. And, if a cost-benefit analysis were necessary, then the distinction between direct and indirect roles for values would not be relevant. Thus, while Douglas's formulation of the distinction may play a

5. My thoughts on this point benefited from the work of Dan Hicks.

promising role in a new scientific ideal, her justification for the distinction rests on ethical reasoning that merits further scrutiny.

4. The Distinction as a Tool for Regulating Values. The previous section indicated that at least some formulations of the distinction between direct and indirect roles for values may serve well in an ideal for science, although more scrutiny of the distinction is needed. This section considers how well each formulation could serve as a primary tool for policing science so as to achieve this ideal. As section 2 emphasized, this policing function could operate at the level of individual scientists or at the level of the scientific community.

A Logical Distinction. In a sense, scientists cannot actually violate Hempel's formulation of the distinction because it is logically impossible for values to play a direct role in the evaluation of hypotheses. Nevertheless, scientists can mistakenly treat nonepistemic values as if they provide evidential support for a hypothesis. This might happen, for example, if a group of scientists claims that a particular theory is more likely than another to be true because it is likely to promote feminist causes. One could criticize the offending scientists' reasoning processes by appealing to Hempel's distinction and emphasizing that nonepistemic values are logically irrelevant to a theory's truth value.

The difficulty with this suggestion is that it is unlikely that scientists' reasoning processes could typically be presented and criticized in such a straightforward fashion. Because most scientists would be likely to accept the cogency of Hempel's distinction, they would presumably evade the accusation that they were treating nonepistemic values as reasons to think that a theory is true. One evasive tactic would be to appeal to the distinction in epistemic attitudes that we have discussed throughout this article; the accused scientists could claim that they were appealing to nonepistemic values as reasons to *accept* a theory (in a nonepistemic sense) rather than as a reason to believe it to be *true*. Or, the accused scientists could insist that, while they did in fact hold to the nonepistemic values under discussion, those values did not affect their evaluation of the scientific evidence. Or, they could suggest that any differences between their views on the hypothesis under consideration and the views of other scientists could be attributed to differences in what Hempel would call their "rules of acceptance."

It is crucial to note that, while these evasive tactics could be deceptive and malicious in some cases, they could also be caused by the complexity of our mental processes and their opaqueness to our introspection. John Heil provides a good example of the psychological complexity involved in forming beliefs. He argues that the intellectual process of generating appropriate beliefs has much in common with the process of acting virtuously (1983, 762–63). In both cases, he argues that agents have dispositions to size up situations in a rather automatic or habitual way, choosing beliefs or actions that are apt under the circumstances. Just like virtuous individuals have to be trained to develop the dispositions associated with virtuous behavior, he claims that good epistemic agents need to undergo a process of "'fine-tuning' certain fundamental dispositions that underlie the process of belief formation" (763). Heil notes that this fine-tuning process can sometimes be influenced by nonepistemic considerations: "For the most part, this process of refining or honing down is aimed at increasing the efficiency or reliability of the mechanisms that lead us to form beliefs. Occasionally, however, it may prove desirable to fiddle with an intellectual virtue in light of one or another nonepistemic consideration. It is here, perhaps that moral and prudential concerns can come to bear on epistemic procedures" (763). As an example of this nonepistemic "fiddling," he suggests that a child may learn to regard evidence that challenges the reputation of his friends "in a special light" that makes him cautious about coming to believe ill of his friends.

The upshot of Heil's observations about human belief formation is that the processes underlying a scientist's theory choices are likely to be fairly murky in many cases. A nonepistemic value, such as concern for improving the welfare of women, may indeed have played an important role in a scientist's decision to accept a theory, but the precise role of that value in the decision may be fairly unclear. Did the scientist treat the benefit to women as if it were a piece of evidence in favor of the theory's truth? Or did the scientist merely perceive the overall body of evidence in a special light based on the theory's significance for women's welfare? And what exactly did this perception of the evidence in a special light involve—did it involve altering the standards of evidence required for accepting the theory, or did it involve perceiving various bits of evidence in a particularly favorable light, or did it involve an altered perception of the way those pieces of evidence fit together?[6] And what exactly was the epistemic attitude associated with the acceptance of the theory? Did the scientist accept it as pursuit worthy or as a basis for action in the policy sphere or as a true theory?

These questions highlight the fact that, in many cases, scientists are

6. In cases in which the rule of acceptance employed by a scientist can be formalized as a clear statistical rule (e.g., that the null hypothesis will be rejected if the experimental data reach a particular level of statistical significance), then it may be easier to discuss those rules of acceptance and to determine whether they are being influenced by nonepistemic values. However, in many cases when scientists are evaluating theories, neither the rules of acceptance nor the degrees of confirmation are obvious or easy to specify.

unlikely to have the clear introspection needed to determine whether they are treating a nonepistemic value as if it were evidence (in violation of Hempel's distinction). Moreover, assuming that scientists accept Hempel's distinction, they have a powerful motivation to interpret their process of belief formation in such a way that it does not violate the distinction. These problems make it unlikely that individual scientists can reliably police themselves using this formulation of the distinction. Moreover, it is even more difficult for scientists to regulate one another's use of values at a community level using this distinction. At the community level, they not only have to trust that other scientists are able to perceive how values influenced their work, but they also have to trust those scientists to provide an accurate report of those value influences when communicating with others.

One strategy for alleviating these problems is to look at the long-term behavior of scientists. For example, Douglas points out that when scientists are concerned about the consequences of error (i.e., when values play an indirect role), values become less important as uncertainty decreases (because there is less likelihood of producing erroneous results). In contrast, values acting in the role of evidence are not affected by uncertainty (2009, 97). Thus, if changes in uncertainty have little or no influence on the way values affect a scientist's practice, then one might be able to conclude that he is allowing values to influence him directly. Unfortunately, this response has significant weaknesses. First, if one's goal is to regulate the role of values in the scientific community, it is frequently impractical to be forced to wait an extended period of time before drawing conclusions about whether values are playing a direct or an indirect role in a dispute. Second, even if a scientist did not change his conclusions as uncertainty decreased, he could defend himself by claiming that he regarded the consequences of being wrong to be especially dire in the case under consideration. Thus, he could insist that, even though values were affecting him only indirectly, there was still enough uncertainty for those values to play a significant role in his judgment.

Another way to salvage the distinction between direct and indirect roles as a policing tool would be to identify some scientific activities that are so appalling that they could not possibly be caused by values operating via indirect roles. For example, if a scientist defended a theory while completely ignoring a set of conflicting data, one might claim that such an action could not possibly be motivated solely by concerns about acceptance rules. Douglas herself illustrates this approach to "policing" science; she has identified cases in which climate skeptics appealed to cooling trends from the 1940s to the 1970s while inappropriately failing to acknowledge that aerosol emissions from power plants provide a plausible explanation for the cooling (2006, 216–17). This response faces at least two problems, however. First, it allows outside observers to criticize only those activities that are so egregious that they cannot possibly be interpreted in terms of indirect value influences. Second, when activities are so egregious, it seems doubtful that one needs the distinction between direct and indirect roles in order to criticize them. For example, someone like Helen Longino, who develops a social account of objectivity rather than trying to limit the role of values at an individual level, would still insist that a minimal requirement for any theory is that it must take account of all the available data (1990). Thus, while Hempel's formulation of the distinction between direct and indirect roles contributes to a valuable ideal, it is (taken by itself) limited in its potential to catch inappropriate appeals to values.

A Distinction Based on Epistemic Attitudes. The second formulation of the distinction between direct and indirect roles for values rests on the differences between the epistemic attitudes of belief and acceptance. One of the significant difficulties with using this formulation to police the role of values in science has already come up in our previous discussion of the logical formulation of the distinction. Namely, scientists may not have a clear sense of their precise epistemic attitudes toward the hypotheses that they propound. There are at least four factors that contribute to this difficulty. First, distinctions between various epistemic attitudes are inherently subtle and psychologically difficult to discern. Second, scientists are typically not trained to make these distinctions; even professional epistemologists and philosophers of science are often relatively insensitive to them.

Third, the epistemic attitudes of belief and acceptance can plausibly be applied not only to theories but also to other elements of scientific activity, such as methodologies or interpretations of data. For example, scientists might believe that a particular methodology yields the most accurate data about a particular research domain, or they might just accept that it is to be preferred for a limited range of purposes. Similarly, scientists might believe that a particular interpretation of data is true, or they might just accept that it provides an adequate basis for action in the near term. This makes it all the more difficult for scientists to determine what their epistemic attitude toward a theory or hypotheses is (or what it should be) because they have to take into account their epistemic attitudes toward all the other aspects of scientific activity that contributed to the development and justification of the theory in question.

A fourth complicating factor is that science is an intensely communal enterprise. In pursuing a research project, scientists have to build on the work of others (Hardwig 1991). Thus, in determining the epistemic attitude that they should take toward their own results, they need to consider the epistemic status of the work that they have built on. For example, it would hardly make sense to believe a particular hypothesis to be true if most of the crucial pieces of evidence in favor of it were proposed by other scientists as being acceptable for purposes of action but not as worthy of being believed to be true.

Moreover, as in the case of the logical distinction, these individual psychological difficulties become even more problematic when scientists attempt to evaluate one another's work as members of the scientific community. Again, they have to address not only the psychological difficulties faced by individual scientists but also the further problem of deciding whether to trust the reports made by their colleagues. These concerns do not impugn the potential value of a distinction based on epistemic attitudes as part of a scientific ideal. They merely show that, at least at present, there are significant barriers to using this formulation of the distinction as a primary tool for scientists to use in policing their work.

A Distinction Based on Consequences. Finally, one could employ Douglas's formulation of the distinction between direct and indirect roles as a primary tool for regulating the role of values in science. On this formulation, scientists can appropriately appeal to values when they involve the consequences of error (and thus play an indirect role) but not when they involve the consequences associated with accepting a true theory (and thus play a direct role). Unfortunately, this formulation falls prey to the same difficulties associated with the other two formulations of the distinction. Namely, it is unlikely that people have the clear introspection necessary to determine in a consistent fashion which sorts of consequences (i.e., the intended or unintended ones) provided the motivation for them to accept or reject a hypothesis. As the discussion of Hempel's distinction emphasized, this problem cannot easily be solved, even by appealing to scientists' long-term behavior or to their most egregious activities.

Moreover, the problem of introspection turns out to be even more serious in the case of Douglas's formulation of the distinction than it does in the case of the logical formulation. For Hempel, the distinction between direct and indirect roles for values at least involves different activities. In the direct role, values influence one's *appraisal of the evidence* for a hypothesis, whereas in the indirect role, values influence one's *choice of acceptance rules*. These are conceptually distinct activities, even if they blur together in the actual reasoning processes of scientists. For Douglas, however, the very same activities can be influenced by values in either a direct or an indirect way, depending on the consequences that scientists are concerned with.

Consider, for example, the main focus of Douglas's article (2000). She claims that a scientist's concerns about inductive risk can permeate many aspects of her reasoning, including the choice of methodologies, the characterization of data, and the interpretation of results. The problem is that scientists can engage in precisely the same activities—for example, altering a particular methodology or choosing a different interpretation of results—on the basis of "direct" concerns about the consequences that these choices will have if errors do not occur. Therefore, if instances of direct as opposed to indirect influences of values are to be distinguished on Douglas's account, they have to be identified on the basis of scientists' *motives* rather than their *actions*.

There are a number of difficulties with formulating this distinction as a matter of motivation. The obvious difficulty with this approach is that humans often do not have a very clear grasp of their motivations. Suppose that a regulatory scientist who hates the chemical industry chooses to use a particular dose-response model that tends to be highly protective of public health (i.e., it tends to overestimate rather than underestimate the harmfulness of toxic chemicals). It seems unlikely that this scientist would be able to reliably distinguish whether he was choosing that particular model in order to avoid falsely exonerating toxic chemicals (an indirect role for values) or in order to cause financial trouble for the industry (a direct role for values). This problem becomes even worse if several members of a research team employ the same methodology or interpretive framework but with different motives. If two members are motivated by indirect values but a third is motivated by direct values, does their published work count as junk science or not?

These problems are further exacerbated at the level of the scientific community. Even if individual scientists could successfully scrutinize their motives, outside observers would not be able to do so. First, they would not be able to "get inside the scientists' heads" to see why they made the choices that they did. Second, even if researchers explained why they made the choices that they did, one could not guarantee that they were telling the truth. Third, even if scientists could be counted on to tell the truth, current scientific institutions are not well designed for eliciting information about researchers' motives—it would be very surprising for a scientist to be explicit in a scientific journal article about the ways in which ethical value judgments influenced his or her analysis. Fourth, scientific arguments often draw on multiple studies or activities performed by different scientists or research groups. If some groups were influenced by values in a direct way but others were influenced in an indirect way, it becomes even less clear how to categorize the resulting work.

5. Conclusion. This article has argued that the nature and the purposes of the distinction between direct and indirect roles for values in science merits further clarification. It has elucidated three different formulations of the distinction and showed that at least some formulations could serve as the basis for a scientific ideal. More scholarship is needed, however, on several issues: characterizing different epistemic attitudes, clarifying Douglas's formulation of the distinction, and exploring the ethical framework that Douglas employs as the foundation for her formulation.

Unfortunately, this article has also shown that all three formulations are limited in their potential to serve as primary strategies for policing the role of values in scientific practice. These limitations are present to some extent at an individual level, and they are especially serious at the level of the community. Therefore, this analysis encourages further conceptual and empirical research on supplementary strategies for regulating values. One of the most intriguing possibilities is to promote strategic forums for deliberation to identify how values are influencing specific areas of science and to consider which nonepistemic values should (or should not) be allowed to influence these areas of science. Examples of these forums include not only the scientific advisory committees put together by government agencies (see, e.g., Jasanoff 1990) but also a wide range of working groups that can integrate members of the lay public and stakeholder organizations with scientific experts (Douglas 2005; Elliott 2011). Those who reject distinctions between direct and indirect roles as conceptually flawed or as practically unhelpful could support these forums as a different strategy for regulating the influences of values on science. But those who continue to support the distinction between direct and indirect roles could also support these forums as a supplementary strategy. According to section 4, all three formulations of the distinction are hampered by the inability of scientists to reliably discern how values are influencing their work. The scrutiny provided by these deliberative forums could help make the role of values more transparent, thereby potentially making the distinction between direct and indirect roles more practically effective for policing science than it would otherwise be.

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