

# Feminist philosophy of science: 'standpoint' and knowledge

Sharon Crasnow

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**Abstract** Feminist philosophy of science has been criticized on several counts. On the one hand, it is claimed that it results in relativism of the worst sort since the political commitment to feminism is *prima facie* incompatible with scientific objectivity. On the other hand, when critics acknowledge that there may be some value in work that feminists have done, they comment that there is nothing particularly *feminist* about their accounts. I argue that both criticisms can be addressed through a better understanding of the current work in feminist epistemology. I offer an examination of standpoint theory as an illustration. Harding and Wylie have suggested ways in which the objectivity question can be addressed. These two accounts together with a third approach, 'model-based objectivity', indicate there is a clear sense in which we can understand how a standpoint theory both contributes to a better understanding of scientific knowledge and can provide a *feminist* epistemology.

**Keywords** Feminist epistemology · Feminist philosophy of science · Standpoint theory · Objectivity · Relativism · Models

## 1 Introduction

Feminism is a dynamic political movement, shaped in response to changing historical and social circumstances. In part as a result of that history, there are contending opinions about what the feminist project entails. Within feminism, feminist epistemology has seen its own battles. One such battle has been associated with the

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S. Crasnow (✉)  
Department of Arts, Humanities, and World Languages,  
Riverside Community College,  
Norco,  
CA 92860, USA  
e-mail: sharon.crasnow@rcc.edu

‘science wars’ and the perceived affiliation of both feminist epistemology and feminist philosophy of science with ‘social constructivism’ and its presumed counterpart, relativism.<sup>1</sup> This perception has been fueled from within feminism by internal discussions about the possibility of a feminist ‘successor science’ (Harding 1986), a unique and different feminist science, perhaps also with an alternative methodology for science.

What this successor science might look like is puzzling to those who note the success of modern science and its methodologies.<sup>2</sup> Is not that success due in large measure to objectivity: impartiality, neutrality, autonomy, and indifference to political positions and the values that they embody? And is not this objectivity ensured by adherence to methods grounded in standards of rational inquiry that are independent of social factors and political contingencies? If so, when feminist epistemology raises questions about scientific method, standards of rationality, and the role gender plays in shaping knowledge, it challenges the traditional understanding of objectivity. Consequently, many critics have thought feminist epistemology to be self-defeating.

But the literature on feminist epistemology should not be treated as representing just one position, nor should it be dismissed as self-defeating too quickly or for the wrong reasons. For one thing, it has been a fruitful arena for the exploration of scientific objectivity and the role of values in science.<sup>3</sup> In addition, as the years have passed, the idea that feminism should provide a ‘successor science’ has been revisited. Recent feminist work is more likely to seek reform, revision, or simply to rethink key concepts. As Harding puts it, ‘The leading feminist theorists do not try to substitute one set of gender loyalties for the other—’woman-centered’ for ‘man-centered’ hypotheses’ (Harding 1986, p 138). Feminist philosophy of science is not the view that a feminist science would be a feminine or “womanly” science. Nor do feminist contributions to the philosophy of science need to be radically or uniquely feminist with that feminism being of some one particular kind. Feminist philosophy of science has come to be construed more broadly as one means of providing insight into the nature of scientific knowledge, primarily through considering the role social values play in scientific knowledge. In doing so feminists suggest alternatives to traditional conceptions of objectivity, both by redescribing the objectivity of science and by offering normative recommendations.

<sup>1</sup> Although it is not always clear what critics mean when they accuse feminists of being social constructivist, since the term itself is used in many different ways. The sense which is most problematic would be one in which it is claimed that the world itself, or at least parts of it, is constructed. Hacking (2000) is an excellent source for exploring its ambiguities and misuses and argues there is much confusion about ‘constructivism’ as a result of conflating the construction of concepts with the construction of reality. ‘Relativism’ is similarly confusing, since there are many varieties. There is some agreement that an epistemological relativism leads to skepticism and thus undermines the possibility of knowledge, but even this position is not unanimous. Other forms of relativism (sociological relativism or cultural relativism) are sometimes thought to be less problematic.

<sup>2</sup> An example is Koertge (1980), ‘But a new epistemology? One that is an improvement over the one that underlies all of modern science? Frankly, I am dubious’ (p 356).

<sup>3</sup> Kitcher’s (2001) engagement with Helen Longino’s work, Rouse’s (1996) discussion of Haraway’s ideas, and Lacey’s (1999) consideration of feminist strategies as an alternative to materialist strategies are some examples of the broader reach of feminist epistemology. Also, I am not claiming that feminist epistemology is the only source of insight into the role of values in science. One example of recent work in this area is Machamer and Wolters (eds) (2004).

Through standpoint theory, one of the more frequently debated of the candidates for a feminist epistemology, I will explore the broader contributions of feminist epistemology for understanding scientific objectivity and the role of values in science.<sup>4</sup> Standpoint approaches have been proposed, criticized, and revised over the last 30 years and have articulate critics and defenders and so, standpoint theory offers one of the more promising avenues for this exploration. In addition, standpoint approaches have been explicitly adopted by many feminist social scientists and are taught as current methodology and social theory, particularly in sociology, and anthropology (DeVault 1999; Hesse-Biber and Yaiser 2003; Rheinharz 1992). Standpoint theory thus provides insight into objectivity, the role of the social in science, and the connection between applied and theoretical knowledge. I explore each of these areas and, in the final section, consider their implications for science education.

## 2 The lay of the land: feminist epistemology

Sandra Harding's classification of feminist epistemologies into feminist empiricism, standpoint theory, and postmodernism does not provide definitive and mutually exclusive categories, but offers a useful framework for understanding some of the criticisms of feminist epistemology. From the perspective of traditional Anglophone epistemology, postmodernism is the most unappealing as it is most closely identified with epistemic relativism that threatens the very possibility of knowledge. Sometimes critics of feminist epistemology identify it with postmodernism exclusively, but such readings frequently fail to recognize the differences among those working in feminist epistemology. Although Harding, Haraway, and others acknowledge that there are elements of postmodern critique that they embrace, they do not embrace the relativism with which postmodernism is associated.<sup>5</sup> Neither Harding nor Haraway believes that rejecting the 'godtrick' (Haraway's term)—the idea that knowledge somehow provides a God's-eye view of the world—commits us to relativism. However, even if it were the case that all feminist epistemologies did embrace postmodernism, the wholesale rejection of postmodernist feminism is based on a false dichotomy between modernist and non-modernist. Rorty and others have argued that there are alternatives to thinking of knowledge as representational as modernist conceptions of objectivity do. Pragmatism, for instance, can provide an alternative to both modernist and postmodernist epistemology. Clough (2003) has made this point specifically with respect to feminist epistemology, and consequently concludes that feminists do not need epistemology, if by epistemology we mean a modernist, representational epistemology.<sup>6</sup> So while it might be worthwhile to explore postmodernism, the main benefit could be to motivate an alternative understanding of epistemology.

At the other end of the spectrum, feminist empiricism is often seen as the least objectionable of the three options. At least it is an empiricism, which suggests it is a

<sup>4</sup> As with most philosophies of science that take the role of the social in the production of scientific knowledge seriously, the emphasis is on social values not the values of individual scientists.

<sup>5</sup> But then it is not even clear that it is correct to claim that postmodernists embrace relativism, as they frequently reject the presuppositions that lead to the relativist/absolutist divide. Rorty (1979) and Haraway (1991) both make this point.

<sup>6</sup> Another alternative might be a hermeneutic approach.

perfectly respectable sort of epistemology. But its very plausibility results in one of the other difficulties associated with feminist epistemology: indifference. What is so particularly feminist about these epistemologies? For instance, Helen Longino's contextual account of evidence in *Science as Social Knowledge* is probably the most widely known example of what might be described as feminist empiricism. She gives an account of evidence that clarifies how social values, such as feminist values, can be part of the context that determines what counts as evidence. But in her later book, *The Fate of Knowledge*, there is no suggestion that there is anything particularly feminist about the account that she is giving. That feminist values might be among those that come into play is possible but in no way required. So while feminist empiricism has been the least problematic, it is also would seem to be the least 'feminist'.<sup>7</sup>

So feminist postmodernism appears not to be epistemology, and feminist empiricism appears not to be feminist. This leaves standpoint theory. Theorists and practitioners from different disciplines (sociology, political science, anthropology, philosophy) and traditions (Marxist, feminist) have advocated standpoint theory. What is 'feminist' about standpoint approaches seems clearer than in the case of feminist empiricism, though not entirely transparent. Advocates of standpoint theory describe it variously as providing knowledge for women, by women, and from the standpoint of women, but what such knowledge is and what it means to say that it is for or from woman's standpoint is unclear. Nonetheless, standpoint theory remains the most clearly identifiable feminist approach and so provides a window into the role feminism can play in the examination of values and scientific knowledge.

### 3 Standpoint examined

Hekman's (1997) critique of standpoint provides an entry point into the discussion. She identifies what she takes to be two particularly problematic presuppositions: (1) standpoint demands that some viewpoints, i.e., those of women, are epistemically privileged; and (2) standpoint does not acknowledge the diversity of women and so replaces the universal man of modernism with universal woman, treating characteristics of some women as essential for all women.

Unfortunately, much of what Hekman claims about standpoint theory is undermined by inaccuracies. First, advocates of standpoint theory do not claim that women are automatically epistemically privileged. Standpoint theorists claim that marginalization is a necessary but not a sufficient condition for their epistemic privilege.<sup>8</sup> So, for instance, Dorothy Smith, a sociologist who was an early advocate of standpoint as a feminist methodology, claimed standpoint is a starting place for inquiry. The problems to be explored and the evidence that is relevant can be seen best from the standpoint of women. Also, women's standpoint is something that is achieved and is in no way automatic. Smith and others have noted that there are various ways in which standpoint can be achieved, but it involves 'studying up',

<sup>7</sup> Although this may depend on what is meant by 'feminist.' So, for instance, Alison Wylie's understanding of standpoint theory might be described as a feminist empiricist version of standpoint theory.

<sup>8</sup> This is not always clear in the work of standpoint theorists. One value of Hekman's (1997) critique has been that subsequent explanations of standpoint have clarified this point (Harding 1997; Wylie 2004).

becoming conscious of the power relations that maintain social place. She mentions consciousness-raising, for example, as one of the means for achieving this awareness.<sup>9</sup> While epistemic privilege may require that one occupy a particular position in the social and political structure, it is not sufficient for achieving standpoint that one occupies that position.

Additionally, those who have advocated standpoint, including Smith, display an awareness of and a sensitivity to the diversity of women. The prominence of those who think through race, class, and other diversities using standpoint (Collins 1986; Uma Narayan 1989, among others) would seem to indicate that there is nothing in standpoint per se that precludes the recognition of multiple and diverse standpoints. Collins for instance, advocates the use of a standpoint to analyze race and class in addition to, and in combination with, gender. In describing the ways in which Afro-American women might have insights that other sociologists might not, Collins says

Traditional sociological insiders, whether white males or their non-white and/or female disciples, are certainly in no position to notice the specific anomalies apparent to Afro-American women, because these same sociological insiders produced them. In contrast, those Black women who remain rooted in their own experiences as Black women—and who master sociological paradigms yet retain a critical posture toward them—are in a better position to bring a special perspective not only to the study of Black women, but to some of the fundamental issues facing sociology itself ([1986, S29]; 2004, p 121).<sup>10</sup>

Traditional sociological insiders lack the necessary condition that the standpoint of the Black women provides. Collins thus advocates the standpoint of African-American women for the African-American sociologist and adopting the dual vision of the insider/outsider. For Collins, achieving this dual vision is what holds the promise of epistemic advantage. This standpoint also requires the recognition of diversity among women. There are as many social locations that produce the insider/outsider awareness as there are ways of being an outsider. The insider/outsider may be capable of seeing things that other sociologists cannot. Even so, the insider/outsider is not assured this ability merely because of his or her social location. The social location is a necessary though not sufficient criterion for whatever epistemic privilege derives from standpoint.

Diversity of standpoints raises other issues, however. If there are many standpoints, then which should be preferred? How can they each be epistemically privileged? But these questions depend on the idea that knowledge requires some one privileged epistemic position, an assumption that standpoint theorists reject. Although a particular standpoint can provide insight, there is no one standpoint that is absolutely privileged for producing knowledge. If we think of standpoints as providing alternative positions from which to discover relevant evidence, a plurality of standpoints is less problematic. However, standpoint theory is not the same as 'perspectivalism'. Standpoint is achieved. Epistemic privilege does not come from viewing things from the perspective of those in subordinate positions, but rather

<sup>9</sup> The appeal to consciousness-raising reflects standpoint theory's roots in the feminist political movements of the late 1960s and early 1970s.

<sup>10</sup> 'Traditional ... insiders' are in 'no position' to 'notice the specific anomalies' because they do not experience them as anomalies.

from that perspective together with an awareness of social, political, and other factors that maintain the status quo.

Although Hekman's criticisms are off the mark, she does identify the key elements that need to be illuminated if standpoint theory is to be understood as a viable epistemology. How being an insider/outside might produce some sort of epistemic privilege and which standpoints are relevant at which time needs to be explored. As we will see below, those who have engaged in such elucidations have done so by focusing on the question of objectivity. From the perspective of the philosophy of science the primary question is whether feminist epistemology produces good science or at least better science than science produced by other methods. However, without some agreement about the criteria for good science, neither feminists nor anyone else can support this claim.

The question of what makes good science is central for any discussion of values in science. Although there is general agreement that good science is objective and has strong evidentiary support, what these requirements amount to, how they are to be spelled out, is less clear. Debates about these issues are not confined to disputes between feminist philosophers of science and others who do not identify themselves as feminists. When evidence is relevant, how it should be weighted, to what extent other epistemic virtues such as simplicity and explanatory power are important are debated. For these reasons it is difficult to evaluate some of the claims that have been made about feminist epistemology.

So, for instance, Pinnick (2005) notes that supporters of standpoint theory have claimed that good science requires feminist methodology.

Harding contends that the feminist project will do better than extant methods to achieve common cognitive aims. By way of an example, the particular cognitive aim that is a steady focus in Harding's critique (and her replacement epistemology) is the cognitive aim for beliefs and theories that have high-evidentiary warrant based upon objective standards of rationality (2005, p 106).

But the shared cognitive aim of 'high-evidentiary warrant' is meaningless without a shared understanding of that phrase. Furthermore, as we shall see, what Harding means by 'objectivity' is not an objectivity in which the cognitive aims and the social, non-cognitive, or contextual aims can be scrutinized without reference to each other.<sup>11</sup> Questions about objectivity and the role of values in science, whether feminist or other sorts of values, are contentious making it difficult to evaluate claims like Harding's.

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<sup>11</sup> There is no one complete accounting of the sorts of values that potentially play a role in science. There is some consensus around a distinction between cognitive/non-cognitive, epistemic/non-epistemic, or sometimes epistemic/social values. I have used something like the latter distinction but have done little to analyze it, something that is a pressing need. But there are other distinctions that are made that seem related to those above and yet do not map onto them exactly. So, for instance, Longino (1990, 2001) distinguishes between constitutive and contextual values. This distinction is supposed to cut across the cognitive/non-cognitive distinction and allow for the possibility of contextual values, which might include social values, playing cognitive roles. Solomon (2001) makes a distinction between theoretical virtues and empirical virtues of theories. This too would seem to be an effort to re-organize the distinction. As Machamer and Wolters (2004) put it in their introduction, 'But as soon as we turn to inquiring into the kinds of values there are a veritable plethora of confusions and unclaritys greets us. Just think of cognitive, epistemic, truth preserving, social, cultural, political, emotional, personal, individual, subjective, economic, ..., and the notorious family values' (p 2).

If it can be shown that standpoint theory provides increased objectivity then there is reason to think that it is a valuable methodology. But unless there is a viable explication of objectivity—one recognizing a role for social values in good science—this does not seem likely. What follows are three accounts of objectivity that are compatible with standpoint and also show how standpoint can increase objectivity and, hence, improve science.

#### **4 Strong objectivity: Harding**

Two of the clearest recent attempts to address the issue of objectivity and standpoint are those of Harding and Wylie. Harding calls her account 'strong objectivity', and contrasts it with what she refers to as 'objectivism', a kind of objectivity that demands disinterestedness, impartiality, impersonality, and is value-free.<sup>12</sup> According to Harding, critics of standpoint theory 'have assimilated standpoint claims either to objectivism or some kind of conventional foundationalism or to ethnocentrism, relativism, or phenomenological approaches in philosophy or the social sciences' (2004, p 127). Either one has a foundationalist epistemology, grounding claims through some appropriate methodology and fundamental knowledge (empiricism, for instance) or we are left with relativism because of the dependence of our judgments on 'subjective' elements like interests and values. When examining standpoint through this false dilemma, the first horn gives rise to criticisms that identify standpoint as advocating the epistemic privilege of women (or other outsiders). The other horn has us abandoning the possibility of knowledge, for relativism results in skepticism. If we accept this dilemma, then the only escape would seem to be objectivism, the view that Harding identifies with a traditional account of objectivity.

The problem with objectivism is that because it denies that contextual values should have any epistemic power, the positive role that they sometimes do play cannot be accounted for. So, for instance, Harding points out that it is frequently claimed that democratic values are more conducive to knowledge than non-democratic values. Recently Kitcher (2001) and Longino (2002) have also explored the question of what it is about some values, most notably democratic values, that contributes to better knowledge. Harding proposes strong objectivity as an alternative to objectivism in order to address this failing.

Strong objectivity requires that the subject of knowledge be placed on the same critical, causal plane as the objects of knowledge. Thus strong objectivity requires what we can think of as 'strong reflexivity.' This is because culturewide (or nearly culturewide) beliefs function as evidence at every stage in scientific inquiry: in the selection of problems, the formation of hypotheses, the design of research (including the organization of research communities), the collection of data, the interpretation and sorting of data, decisions about when to stop research, the way results of research are reported, and so on (2004, p 136).

Standpoint theories provide a way of achieving strong objectivity through their acknowledgment of the role of values in producing good science as well as bad. They do this by focusing on the subject as crucial to knowledge, explicitly identifying the

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<sup>12</sup> This account is first developed in Harding (1991).

subject, her perspective and interests, and reflecting on the role the subject plays in knowledge production. The conscious identification of these factors enables us to compare and assess which communities of subjects and which of their values produce better knowledge. So better knowledge does not depend on eliminating subjectivity (beliefs and values) and conforming to some false ideal of objectivism. It results from examining whether and how understanding improves when these new viewpoints are incorporated. Although Harding acknowledges that standpoint involves a sort of relativism, she claims that this relativism is sociological, not epistemological, and so not the worrisome sort. She claims that it is possible to judge whether seeing the world from a particular group's standpoint rather than some other enables that group to achieve their goals and so results in a successful account of the world. This judgment is an evaluation of the strong objectivity of the theory.<sup>13</sup> Because the subjects are themselves so intimate a part of knowledge production, the means by which it comes about must itself be studied.

...[A] maximally critical study of scientists and their communities can be done only from the perspective of those whose lives have been marginalized by such communities. Thus strong objectivity requires that scientists and their communities be integrated into democracy-advancing projects for scientific and epistemological reasons as well as moral and political ones (2004, p 136).

Strong objectivity not only requires, but also generates standpoint.

Strong objectivity leaves many questions unanswered. For instance, by what criteria are we to judge which values are more conducive to good science than others? The primary example that Harding gives is the claim that democratic ideals result in better science. But how do democratic values lead to greater success for science that incorporates them?<sup>14</sup> Perhaps it is not necessary to identify fixed criteria. Another option might be to think of scientific method as a sort of bootstrapping procedure, where we have standards by which we judge whether theories are good and when something does not work we revise both the belief judged as well as the standards by which we judge.<sup>15</sup> In this way, methodology evolves. Developing this idea would be consistent with Harding's notion of strong objectivity and might lead to a more complete account.

Harding's account clearly indicates a role for the social or at least the assessment of the social. However, evaluating which social values are more conducive to knowledge production requires distinguishing the social values from the epistemic ones, and then evaluating those social values by the epistemic criteria. So, with Harding's account we would need to be clear about the distinction between the social and the epistemic values. An account of objectivity that indicates how values play a role in identifying evidence and evaluating theories in addition to seeking to identify the sorts of values that, in fact, are better at producing knowledge would

<sup>13</sup> Notice that she is not saying that strong objectivity is achieved *when* any particular standpoint is adopted. The question of whether the standpoint produces better knowledge remains to be judged.

<sup>14</sup> That this is a legitimate sort of question to ask has been affirmed by the work of Kitcher and Longino to which I have already referred.

<sup>15</sup> I am using the idea of bootstrapping in the spirit of Glymour's (1980) account. It is a non-foundationalist approach that allows for a recalibration of both theory and evidence, each in light of the other. I am deliberating evoking the spirit, if not necessarily the details of the account. All three of the accounts of objectivity discussed in this paper are consistent with this spirit in that they are non-foundationalist.



provide a more complete understanding. The two accounts below are further steps toward such a solution.

## 5 Alison Wylie: rehabilitating objectivity

Over the last 15 years, Alison Wylie has also been exploring standpoint theory. Whereas Harding attempts to straddle the postmodernist/modernist divide, to have it 'both ways,' as she herself puts it, Wylie's understanding of standpoint is more directly connected to traditional standards of theory assessment and is more closely related to feminist empiricism (Wylie 1992, 1998, 2004).

Wylie notes that 'objectivity' is frequently used to indicate a particular relationship between theory and the world and so is identified as a property of knowledge claims. Rather than attempting to analyze this property, she proposes that when we say such claims are objective we really mean nothing more than that they conform to a standard set of epistemic virtues, such as: empirical adequacy, explanatory power, internal coherence, consistency with other established bodies of knowledge, and perhaps others. Precisely which epistemic virtues are on this list is not a concern for Wylie and she acknowledges that there could well be disputes over one or more of the proposed properties and the degree to which it is important. Empirical adequacy stands out since it appears on all such lists, but 'empirical adequacy' is ambiguous. It is either 'fidelity to a rich body of localized evidence (empirical depth), or ... a capacity to 'travel' (Haraway) such that the claims in question can be extended to a range of domains or applications (empirical breadth)' (2004, p 345).

Objectivity refers not only to knowledge claims.<sup>16</sup> It is also variously construed as disinterestedness, impartiality, neutrality, or lack of bias. When used in this way, objectivity refers to methodology, either the methods themselves, those who are using them (researchers), or their proper use. The objectivity of knowledge claims is thought to be secured by eliminating bias through using appropriate methodologies. One problem with standpoint theory is that it appears to challenge this connection. But, as Kuhn (1977) noted, the epistemic virtues associated with knowledge claims frequently cannot all be maximized at the same time. Which of these properties are maximized depends on our interests, purposes, intentions, and goals. Even with empirical adequacy there are trade-offs because of its ambiguity. The two senses of empirical adequacy, breadth and depth, often compete and sometimes other properties will conflict with empirical adequacy.<sup>17</sup> So objectivity is nothing more than exhibiting these virtues, but some virtues could be more useful to maximize than others depending on standpoint. In fact, standpoint might even become a factor in *increasing* objectivity by throwing light on the sorts of empirical adequacy, explanatory power, or other virtues that are relevant for a particular project.

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<sup>16</sup> Wylie is identifying two aspects of objectivity here. Recent work on objectivity parses the meaning of the term in a variety of different ways (Lloyd 1995; Douglas 2004; Janack 2002). All have listed more varieties of objectivity, but I would argue that most of the distinctions they make could be grouped into these broader categories that Wylie uses.

<sup>17</sup> For example, we use Newtonian physics, which is less accurate, rather than Einsteinian physics for many calculations because the less accurate but simpler calculations are pragmatically adequate.

Using this analysis, Wylie discusses a variety of claims that have been made for standpoint theory. So, for instance, standpoint theorists have touted an epistemic advantage for those in positions of subordination, claiming better access to some sorts of evidence, special inferential heuristics, interpretative and explanatory hypotheses that may not be available to others, and ‘critical dissociation from the taken-for-granted that underpin authoritative forms of knowledge’ (2004, p 346). There is nothing automatic either about the epistemic advantages that might accrue to these politically disadvantaged groups, nor is there any assurance that the sorts of epistemic advantage that they have will increase the objectivity of science. Nonetheless, Wylie affirms standpoint theory as a resource for those who are engaged in science studies and attempting to understand the nature of scientific knowledge. She argues that by looking at objectivity as meeting some set of virtues from a standard list in addition to serving the goals of feminists, we can see why it is that standpoint might be able to contribute to objectivity. Standpoint enables judgments about which epistemic virtues are to be maximized in particular circumstances in order to achieve the goals that are relevant to those circumstances.

Wylie’s and Harding’s views on objectivity are complementary. Wylie agrees that the standards of objectivity should be applied to the methods and values shaping the scientific activity itself. However while Harding suggests that we will get an answer to the question of which standards are better, Wylie disputes that we will get only one definitive answer that will serve in all circumstances. When we ask if the theory displays the appropriate epistemic virtues to the appropriate degree the answer will be dependent on the context, particularly interests and goals. These contextual factors shape what it is that we accept as knowledge by adjudicating among potentially competing epistemic virtues.

Wylie sees justification as determined in light of contextual values, including those explicitly connected with the relevant standpoint. These values do not directly determine whether the theory is one that we should accept, but they do determine which of the epistemic virtues are most important in the particular context and so are integrally linked to theory acceptance. In addition, Wylie contends that this achieved epistemic privilege (standpoint) can result in revealing evidence that might otherwise have been unnoticed.

In discussing the use of standpoint theory in sociology, DeVault gives several examples that show how the standpoint of women can reveal evidence that might have otherwise gone unnoticed (1999, pp 64–65). She describes the work of Elizabeth Stanko, investigating the various strategies women employ to avoid assault. By asking the women to give an account of ‘things that we do to keep safe’ she elicited descriptions of a variety of activities that had not previously been seen as ‘self-defense’: choosing a place to live, deciding when and where to walk, choosing a time to go to the laundromat or grocery shopping, deciding what to wear, and so on. The descriptions women give of these activities become evidence for an account of women’s strategies to avoid assaults. In conducting her interviews, Stanko functioned as an insider/outsider. As a woman, she is herself aware that there are many things women do that are associated with ‘keeping safe’ but are not strictly self-defense. She is also a sociologist and so recognizes both the role that such behaviors play in shaping the daily lives of women and the

way they are behaviors shaped by the societal structures in which these women live.<sup>18</sup>

DeVault discusses another way in which evidence can be revealed through the use of standpoint theory. She found that the 'messiness' of everyday speech frequently revealed relevant emotional attitudes. Traditional interviewing and transcribing methods call for the interviewer to 'smooth out' these features of speech and focus on the content of the respondent's remarks. DeVault came to believe that these features of speech were evidence for the work she was doing because they revealed the respondent's relevant emotions towards the topics discussed.

In both of these examples, the sort of evidence that a standpoint approach reveals is more specific and local. As Wylie notes, to require that an account be empirically adequate is not unambiguous. When the researcher takes details previously thought to be irrelevant as evidence, he or she argues for preferring depth of empirical adequacy rather than breadth. This is particular clear in the case of DeVault's transcription of her interviews. The question of how detailed an account needs to be given is a legitimate one. I will explore this in more detail in Sect. 7.

Both Harding and Wylie propose accounts of objectivity that provide means of explaining how it is that employing standpoint theory might improve science and enrich our understanding of science. Wylie's account makes clearer a kind of bootstrapping approach, where researchers sort out standards as they go based on successes or failures, revising standards when their use is re-evaluated in light of new sorts of evidence. Wylie's account is more explicitly contextualized however. There is no reason to conclude on the basis of having opted for one ranking of epistemic virtues at one time that the same ranking should be chosen in another circumstance, though the set of epistemic virtues are acknowledged to be relevant to the success of science broadly. Harding, on the other hand, seems to think that searching for strong objectivity will lead to general claims about which social values should play a role in good science.

There is an additional issue with Wylie's account. She starts with the 'standard list' of epistemic virtues and so is using an extant empiricist approach that is not without problems. Nearly all the features on her list have been challenged at one time or another. Although she is not proposing necessary and sufficient conditions for choosing the best theory, even the requirement that some, empirical adequacy, for instance, need to be met requires defense, in spite of the inclusion of this virtue on all lists. Also, underdetermination arguments suggest that empirical adequacy is not sufficient to produce a robust account of theory choice even if we were to accept it as being the one fixed requirement. But more importantly, Wylie's account requires distinguishing the cognitive/epistemic from the non-cognitive/non-epistemic values, since the list of virtues is defined by what cognitive/epistemic properties are valued. That list of virtues is to be adjudicated and weighed through values that may not be directly epistemic (as they are linked to the social position, goals, and interests of the evaluators). These are non-cognitive/non-epistemic and presumably social values. In any given situation, it may be possible to distinguish between the

<sup>18</sup> Taking the ordinary actions of 'everyday/everynight' life, as Smith puts it, and understanding the way in which they are shaped by social factors is one of the key features that standpoint theory provides. 'The household work process that I analyze and the defensive strategies that Stanko studies are activities that most women learn to take for granted, activities that are normally only partly conscious, learned without explicit attention' (DeVault 1999, p 64).

two sorts of values, however, to give a generalized account of that distinction is harder. Why should we treat these as epistemic values when it is so clear that they vary with contexts? In what sense then are they to be identified as epistemic values? Can a distinction of this sort be made in a meaningful way?

## 6 Model-based objectivity

I offer a third account of objectivity that does not require delineation of the social from the epistemic, the non-cognitive from the cognitive, and suggests that they are intertwined in ways that would discourage such a delineation. I call this account ‘model-based objectivity’.<sup>19</sup> I begin with the idea that it will be more fruitful to think of science in terms of models, an idea that grows out of the rejection of the standard or ‘received view’ of theories. Model-theoretic accounts differ over a variety of issues, such as, whether models should be thought of as primarily representational, what sorts of entities models are, and whether their important features should ultimately be understood linguistically. I will not address such disputes here, though I acknowledge that a complete account must do so. I understand models not to be *primarily* linguistic entities. Although some may be linguistic and all may generate claims, their linguistic features do not capture much of what is crucial to the role they play in scientific knowledge.

The key strength of model-theoretic accounts is the focus on pragmatic considerations. Models are mediators between ‘theory and the world’. They function primarily as tools and though they are partially representational, it is their role in scientific practice that is most important. Models provide a means of interacting with the world and thus knowing it.<sup>20</sup>

How do we get from models to model-based objectivity? Daston and Galison have noted that ‘All sciences must deal with this problem of selecting and constituting “working objects”, as opposed to the too plentiful and too various natural objects’ (1992, p 85). In order to get at the ‘working objects,’ or what I will call the ‘objects of scientific knowledge,’ we make choices about which features of the multivarious natural world we will focus on and in doing this we model the objects of scientific knowledge.<sup>21</sup>

<sup>19</sup> In order to explicate ‘model-based objectivity,’ I will be using an understanding of ‘model’ akin to Cartwright’s (1999). According to Cartwright, theories do not represent the world directly and models do not constitute theories. ‘There are not theories, on the one hand, that represent and phenomena on the other hand, that get represented (though perhaps only more less accurately). Rather, ... models mediate between theory and the world’ (1999, p 179). Models might be physical, scale models, mathematical, conceptual, representations, analogies, drawings, or even narratives. Other similar understandings of ‘model’ include Giere (2004), Morrison (1999), and Bailer-Jones (2002a, b, 2003). A model-theoretic account is not the same as the ‘semantic view’ of theories on which models are formal or mathematical, however the semantic view is a kind of model-theoretic account (i.e., van Fraassen 1980).

<sup>20</sup> As Morrison puts it ‘models have a rather hybrid nature (neither theory nor simple descriptions of the world) ... they are able to mediate between the theory and the world and intervene in both domains’ (1999, pp 44–45).

<sup>21</sup> It is with trepidation that I use ‘construct’ here. Let me just be clear that I am not claiming that we construct the world. The scientific objects are not intended to be isomorphic with objects in the world on this account, but are a means through which we can know those objects. It is the model that is constructed and the scientific objects are part of the model.

Decisions about which features of the natural world will be incorporated into a model are, in part, constrained by previous choices. Background knowledge gives us reason to believe that some features are more relevant to our interests than others. We choose characteristics that we have reason to believe will allow us to answer questions that we have before us at any given time. Such questions are expressions of our interests and it is because those interests that we emphasize or focus on certain aspects of the world rather than others.

The question of which features are the 'right' ones is a broadly empirical question. Do the models constructed enable us to do what we want to do in the world? Are we able to successfully meet our goals and address our interests? The construction of the model and the construction of the scientific objects proceed in tandem and over time. We interact with the world through the model and both use it and revise it. Shifts, adjustments, and possibly even 'revolutions' occur as we determine whether the selected features are salient to our goals or not. Models are altered when our interests are extended, we fail to achieve our goals, or our interests and associated goals themselves change. An overarching theory can guide and limit model choices by only allowing certain sorts of objects to be modeled.<sup>22</sup>

Since models are tools, like all tools, each is designed for specific purposes. Modeling requires making choices about the world; we focus on the features that we believe are salient to what we want. As a result, what we value is an integral part of the construction of the model. In this way, values are intrinsic to science and to our negotiating our way through the world in general. Model-based objectivity directs us to examine social values as one of a group of factors directing our choice of characteristics.

Model-based objectivity does not require that we make a global distinction between epistemic/non-epistemic values, cognitive/non-cognitive values, or cognitive/constitutive values.<sup>23</sup> I am proposing that modeling always involves values and consequently that the preferences values shape are reflected in all models. If one holds values fixed, one might then distinguish epistemic criteria and similarly if one holds epistemic criteria fixed we can distinguish social criteria. However, such distinctions could only be made in specific contexts and so are local. This is why I reject a global distinction or continuum. When values enter into the very conception of objects, when they shape the 'scientific object' of study, they do not function as add-ons, or extra-scientific, social factors that influence our judgments about which among many empirically adequate theories we ought to accept. They are an intrinsic part of knowledge production and need to be identified and examined as such. This is not to say, that values shape the objects of our world. The modeled objects of science and the objects of our world are not the same (recall that the models are mediators), however the success of the model depends on the accuracy of the 'fit' between it and the world. The model must be based on real attributes of the objects in the world and attributes that are indeed relevant to the goal for which we are modeling.

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<sup>22</sup> Giere refers to 'principles' as directing model construction in this way (2004).

<sup>23</sup> The latter is Longino's distinction, but some version of this distinction is either made by or assumed by most who address the issue of values and science, including, among others, Solomon (2001), Lacey (1999), and Kitcher (2001). As I have noted above, Harding and Wylie also implicitly make use of the distinction.

Thinking about the production of scientific knowledge as model-building also provides a means of understanding what might be of value in a feminist standpoint approach. Standpoint calls for an explicit awareness of interests as they are used in constructing models of the world and legitimizes their role. When using standpoint theory the science produced is ‘for women,’ the idea that the knowledge is a tool and serves the interests of some group is explicit.<sup>24</sup> The model that a standpoint theorist advocates is a model of the social world in which features that contribute to maintaining the power relations that keep women in positions of subordination are revealed and explicit. The purpose of doing so is to provide knowledge that will enable women to negotiate their way through and ultimately transform those power relations.

To see how standpoint theory might work in a way that incorporates both features of Wylie’s account and model-based objectivity, consider the following example. Scheper-Hughes, a medical anthropologist, has argued that the bonds between mother and child are cultural. She makes this case in her *Death Without Weeping* (1992), based on her fieldwork during the 1980s in a shantytown in Northern Brazil, the Alto de Cruzeiro, Crucifix Hill, in a town that she refers to as Bom Jesus da Mata.<sup>25</sup> When she began her research she took mothering and the mother/infant bond to be natural.<sup>26</sup> But her interactions and political involvement with the women of the Alto led her to believe that the women were complicit in the high-infant mortality rate, identifying some infants as destined to thrive and others as ‘visitors’ on their way to another place. When she originally approached the question of infant mortality in the Alto, she had believed that the primary causes of high-infant mortality were the conditions of scarcity and poverty there. These conditions led directly to poor diet for infants, resulting in disease and dehydration. Given these causes, she and others believed that it should be relatively easy to address this problem, at least in individual cases, through ‘rescues’.<sup>27</sup> Dehydrated and undernourished babies could be nursed back to health through intervention. However, when attempted, such rescues were often short-lived. Children returned to their homes where they frequently died even if an adequate food supply was available to the family. Scheper-Hughes reasoned that if mothering was a solely natural response of all mothers to all infants, the frequency with which such deaths occurred was difficult to explain. Scheper-Hughes proposed that the role the culture of the Alto played in shaping motherhood be taken into consideration. The interactions of the women of the Alto both with their children and with each other indicated that mothering is better modeled as a cultural phenomenon, rather than a purely natural bond formed in early infancy through specific ‘natural’ interaction between mother and infant (nursing, feeding, bathing, etc.). In the case of the Alto children, this bond

<sup>24</sup> But to say that the knowledge is ‘for woman’ is misleading since it suggests that all women have the same interests. As noted above standpoint theory must recognize diversity. Interests may need to be locally identified. The question of how broadly interests are shared is an empirical one.

<sup>25</sup> The name of the town is a pseudonym however the shantytown (Alto do Cruzeiro) is referred to by its actual name.

<sup>26</sup> She attributes this view to Sara Ruddick.

<sup>27</sup> Rescues are only a first stage. Organizing a crèche and distribution of food were thought of as longer term solutions, however, these measures failed to eliminate the problem as well.

does not form automatically at birth, but only under particular conditions that are identified as relevant within the culture.<sup>28</sup>

Of the two competing models Scheper-Hughes considers (natural versus cultural mothering), each can accommodate the empirical evidence. It is possible to 'save' mothering as a natural relationship between mother and child and view the Alto women as behaving as they do in order to lessen the pain of loss given the realities of their environment. It could be argued that such an account of mothering—an account that takes it to be universal (and natural)—has the potential for greater breadth. On the other hand, it might be preferable to maximize empirical adequacy as depth (faithfulness to detail, in this case, the details of the ways in which daily activities are carried out in the specific cultural context of the Alto) as opposed to breadth. Here we have competing epistemic values. Because one of the goals for an account of the high rate of infant mortality, its causes and effects, is the political goal of finding a policy through which to improve the lives of the people of the Alto, those political values point to preferring the cultural account of mothering. The other model is not as successful at achieving this goal. Focusing on the details of interpersonal relationship that make up the culture, going for empirical adequacy as depth rather than breadth, serves those political goals better.<sup>29</sup>

The analysis above is also relevant to the question of evidence. Wylie suggests that one plausible benefit of standpoint approaches is that standpoint can provide access to evidence that might not be available otherwise. In Scheper-Hughes's work there are two ways in which this is the case. First, Scheper-Hughes tells us that after her first year of fieldwork she was confronted by a group of women who informed her that they would not cooperate with her on any future work unless she also joined them in their political struggles.

The women gave me an ultimatum: the next time I came back to the Alto I would have to 'be' with them—'accompany them' was the expression they used—in their *luta*, and not just 'sit idly by' taking field notes. 'What is this anthropology anyway to us?' they taunted (1992, p 18).

So she would literally have been denied access to relevant evidence if she had not joined them in their struggle to improve their lives. Although this is not strictly equivalent to having their standpoint, it is at least one of the requirements for doing so. But there is a more interesting second sense in which standpoint provides access to evidence. It is only apparent that something is evidence given a particular understanding of the phenomena. If a model of mothering treats it as exclusively natural, then it is not clear that what a woman says about her infants has a bearing on her motherhood. However, when cultural elements are seen as relevant and so included in the model, then the conversations that women have about their children and about themselves in relation to them do have a bearing. Such conversations are part of the fabric of the culture. Accordingly, these conversations become part of the

<sup>28</sup> Whether the bond is fundamentally cultural or only partially shaped by culture need not be specified for the purposes of the discussion. The main point is that a model that treats the bond as purely natural will be inadequate to the goal.

<sup>29</sup> Notice that what is being explained by the account is not the individual deaths of the infants. What is being explained is the high rate of infant mortality in this population. The alternative models both have to capture the physiological factors that are relevant. Scheper-Hughes preferred model incorporates key cultural elements as well. The model is not better because it is more detailed. It is better because the details are causally relevant to explaining the rate of infant mortality.

evidence that Scheper-Hughes uses for her account. Both the mothers' talk about their infants and the specific details of the ways that they interact with them and other women are relevant evidence for an account of how the women of the Alto come to form bonds with their children over time given that these bonds are neither automatic nor natural. Women describe their infants as 'visitors' and might leave them in a separate room away from the family when they cry so as to facilitate their passage from this world. They sometimes describe themselves as sacrificing these infants, so that others who are more robust may live. To see these conversations as evidence requires understanding the world from the perspective of these women, understanding how they see these infants and why. This is one aspect of using a standpoint approach. However, as an insider/outsider Scheper-Hughes also sees how their perception is shaped by other cultural structures that play a role in maintaining the status quo.<sup>30</sup>

Scheper-Hughes's argument that the cultural model of mothering provides a better account should not be construed as an argument that one account is more empirically adequate than the other. Rather the argument is that given the application of each model, one is more successful than the other. But this argument depends on accepting as a primary value the improvement of the lives of the women and children of the Alto. The preference of one model over the other is a matter of which works better to achieve the desired goals.

What about the problem of relativism? Model-based objectivity appears to make science relative to interest and goals, and so would seem to be relativistic in some problematic way. Although models are preferred relative to interests and the values that shape those interests, empirical constraints on values ultimately ground objectivity. So model-based objective knowledge is secured through values rather than through putatively value-free standards of knowledge. Pernicious relativism is avoided only if it is possible to make objective claims about values. Although this is contentious, this is the line I propose that we pursue. There are some things that we as human beings *should* value because, in fact, some circumstances do and some do not enable human beings to flourish. Within a particular set of boundary conditions, 'flourishing' may have many interpretations and possible instantiations, but there are certain minimum requirements. We need to have the basics to survive, for instance, food, shelter, and human companionship. Minimally, when our models are constructed within the confines of fulfilling those needs then our science is objective in the sense that the modeled objects of study enable successful interactions with the world. When we successfully model those objects we are better able to achieve our goals than when we do not. Just how much further out from these basics we can push judgments about which interests do indeed serve us is an ongoing empirical issue.

So, for instance, a robust result in political economy indicates that the education of women increases not only *their* economic well-being, but that of their community as a whole (Schultz 2002; Coleman 2004). Although there may be a variety of different social and political structures under which the economy would flourish, the argument is that even those that do relatively well will do better when women are not barred from education. If there is to be a debate over women's education here, it will have to be over values, with those against pushed to argue that the economic benefit is not worth the loss of some other goal which requires denying women

<sup>30</sup> For example, religion plays such a role. The women interpret Christ's death on the cross as an example of how some must die so that others live.



education. Such an argument is imaginable, of course, but it indeed pushes us to fundamental questions of values.

Model-based objectivity turns the problem of science and values on its head. Instead of asking how science can manage to be objective even though values play an intrinsic role in knowledge production, I am claiming that since values do play a role, we should be asking questions about the objectivity of value claims. We should be holding and operating with values that are objectively based in projects which will be better for human beings, allowing humans to achieve goals that are more closely tied to their flourishing. Feminists believe that projects that are inclusive, that recognize the social effects of gender, and where they are negative, seek to correct them, are projects that will produce better science. The question is not how science can be objective if values enter, but rather which values are the ones that will give us objectivity in this sense.<sup>31</sup> The standard by which we measure the objectivity of science is whether the models that we adopt are, in fact, conducive to human flourishing. If so, then we have successfully captured the objects and their relevance to us.

Model-based objectivity differs from value-free, traditional objectivity in the following ways. Where objectivity sometimes is linked to the correctness of knowledge claims (their truth), the pragmatic questions about the success of the model are the most important here. So my account is pragmatic. It is also a minimalist account, in that the world constrains models (not all models are equally successful) and some models will be ruled out because of this empirical constraint. The epistemological underpinnings of the account reside in the view that rationality is a limiting, but not a directing concept. Within the confines of rationality there may be a plurality of options for good models, all of which will be 'objective' by my criteria. The account also requires that we be conscious of the modeled objects of scientific knowledge as being different from the objects in the world. The recognition of this difference and the role that researchers play in modeling these objects requires ongoing assessment of the relationship between the model and the world. That 'toward the world' directionality of these objects of scientific knowledge is part of what assures objectivity in the ontological sense. Finally, model-based objectivity is objective in that it requires that the values that guide our model building are subject to the same constraints as all the other aspects of the model in virtue of their incorporation in the model. The model must work as a tool for achieving our goals.

## 7 Lessons for and from feminist epistemology

The discussion of these three accounts of objectivity is motivated by a desire to understand how feminist standpoint approaches might have something to offer for philosophy of science and science education. To understand the role that feminist epistemology is playing in contemporary philosophy of science I suggest that we read work in feminist epistemology as part of a process of coming to understand how it is

<sup>31</sup> The account also can explain the 'greater objectivity' of the physical sciences. This objectivity rests in the greater agreement about goals and interests in relation to the physical world. The success of Western science and its adoption throughout the world is based in a value agreement about what we want to do with the world. Lacey (1999) refers to this as adopting 'materialist strategies' and considers whether there might be other strategies that could be equally successful under different values and interests.

that we can have value commitments and yet still have objective scientific knowledge. All three accounts attempt to identify what awareness of social values brings to the improvement of both the understanding of science and science itself. None of the accounts is complete, nor are they without potentially serious problems. Yet each account suggests reasons for pursuing a further exploration of questions of science and values.

Even if feminist epistemologists can make substantial contributions to the conversation about science and values, the question of what makes these contributions *feminist* remains. But is it really the case that feminist epistemology is required to contribute something uniquely feminist, something that no other approach could offer in order to count as a *feminist* epistemology? This is an unreasonably strong requirement. More importantly, it is not at all clear that we could identify criteria that would enable us to make sense of what is uniquely feminist without committing to some suspect notion of an essential nature of women and the way that they know. As we saw while examining the standpoint theory debate, such an essential nature or knowing is neither required nor claimed by all or even most feminist epistemologists.

There is a larger meta-philosophical point here, however. It is not at all clear that the best way to think of adopting a particular philosophical approach is to identify the tenets that are unique to that approach. I believe that we gain more when we investigate the implications of viewing an issue through some set of ideas or some key notions, none of which should be thought of as either necessary or sufficient. I propose instead that we think of feminism as descriptive of a particular attitude or group of attitudes—what van Fraassen (2002) has called a ‘stance.’ His discussion revolves around what he refers to as ‘the empirical stance.’ Although there may be certain beliefs that empiricists have, it is not a commitment to any particular set of beliefs that makes one an empiricist but rather a commitment to a particular approach.<sup>32</sup> In the case of trying to identify what counts as feminist epistemology, we run the risk of identifying feminism too closely with some particular feminist position or some particular women. If we think of feminism as an attitude or stance rather than a position or adherence to a particular set of beliefs, we can avoid this error.

In the case of feminism, the features of the attitude seem to be the following. First, feminists identify themselves as feminists, that is, they ‘self-identify.’ So they are viewing problems through the lens of that commitment. Second, they are committed to egalitarian values and that commitment guides their assessment of goals. Third, their identification as feminists means minimally that they are conscious of gender as a relevant or at least, *potentially*, relevant category of analysis, but does not determine the content of that analysis or even that the analysis will be relevant in any particular case. Finally, they approach thought as linked to action and not disembodied and so do not disconnect values and beliefs, the ends toward which we aim and the means, the tools (models) through which we achieve those ends. This final feature is what informs the third. Precisely how this plays out as a particular theory of knowledge is not predetermined by this stance, although it is constrained. A feminist stance differs from a feminist position in that there is no set of beliefs that

<sup>32</sup> I have supported the idea that this is a better way to think of philosophical ‘positions’ elsewhere. In the context of rethinking the realism/antirealism debate in science, I advocate that these ‘positions’ be seen as attitudes or stances that are adopted locally by particular scientists for particular purposes (Crasnow 2000).

earmarks it as feminist. It is consistent with this feminism that there could be agreement about general issues of evidence, the role of the empirical, and other issues associated with traditional philosophy of science. But it is clear that accounts that do not allow a role for values other than those traditionally identified as epistemic or cognitive values will be found wanting.

Thinking about feminism as a stance rather than a position has the advantage of reshaping the discussion about objectivity. By thinking about feminism as a stance, we recognize that commitments may alter how an object is studied but there is no reason to think that they alter the object itself. The questions that are of interest in evaluating knowledge are questions about what knowledge is for; how can we use it? The approach is pragmatic and claims that objectivity requires looking at the sciences in some way other than as a match between theory and the world. Instead they should be seen as embodying a relationship between ourselves, theory and world. Feminist accounts tell us something about knowledge more generally, but surely this does not count against such accounts being *feminist*. We might get to this understanding in ways other than through a feminist stance, but this is also not a criticism. All that feminist epistemology needs to claim is that seeing the world from the perspective or perhaps standpoint of a feminist can lead to important insights that can serve feminist goals. This is certainly something that work in feminist epistemology has and will continue to accomplish.

## 8 Implications for science education

What conclusions, if any, should we draw from all of this for science education? There are two sorts of lessons that epistemology more generally can offer for science education. The first is that insofar as epistemology is descriptive it can give a fuller understanding of the nature of scientific knowledge. Feminist epistemology is one of a group of approaches in science studies that urges us to recognize the role of the social in the production of knowledge. Feminist epistemology does this in a particularly strong way, at least in the versions that I have discussed here, since it directs us to consider features of ourselves and our culture as knowers that had previously been outside the realm of what was considered appropriate. Each of these accounts indicates that the goals of researchers and the values that shape the choice of goals are relevant to the knowledge we arrive at. This has implications both for how we train scientists and for how we educate everyone about science.

In training scientists we need to emphasize that good science requires awareness of the evaluative assumptions that shape the recognition and assessment of evidence. Minimally, this means a new awareness of what values drive our sciences and so science students need to learn how to recognize these values. This can be difficult when the values are so embedded in what we take for granted in our understanding of the world, but this is precisely what standpoint theory urges that we develop the ability to do.

But not all teaching of science is the teaching of future scientists. It is increasingly the case that complex social policy is dependent on scientific knowledge. It is also increasingly the case that questions about how spend tax dollars on research are put before governing bodies or even directly before the electorate. How are people

without science training to evaluate such projects and such spending? As Lewontin (2002) put it,

The penetration of science into political and civil society...poses a special problem for the operation of the democratic state. On the one hand the behavior of the state is supposed to reflect the popular will, as determined either by a direct appeal to the opinion of the people or through the intermediary of their elected representatives. On the other hand, the esoteric knowledge and understanding required to make rational decisions in which science and technology are critical factors lie in the possession of a small expert elite. Even within the ranks of 'scientists' only a tiny subset have the necessary expertise to make an informed decision about a particular issue (2002, p 28).

Lewontin draws the conclusion that we will increasingly need to rely on experts to guide public policy decisions. Although it is quite true that in many cases only experts will have a full understanding of the scientific problems, models, and theories that are involved, it is problematic for a democracy to cede all such deliberations to experts. The false belief that social values play no legitimate role in science threatens to take these sorts of policy decisions out of the public sphere. An improved public understanding of science is one of the means through which to prevent this. But the other is to ensure that reasoned debate includes debate about values and the ways in which the sciences are to serve those values.

To return to the specific issue of feminism and science education, the discussion of standpoint theory is particularly relevant. In a complex democratic society, the diverse needs of the population need to be taken into account. Understanding science as serving the needs of that diverse population and recognizing that in doing so we need to know what those needs are reinforces what we already know. We need to promote science education for traditionally underrepresented groups. In the physical sciences, this includes women. It is interesting that the sciences in which the role of social values are most clearly acknowledged, the social sciences, women are much more strongly represented. As model-building is more and more the norm in scientific practice and 'hands-on' teaching continues to be promoted the ways in which scientific knowledge serves human goals will be clearer to students.<sup>33</sup> One of the main reasons why males persist in science careers whereas females do not appears to be motivational. If science is seen as more connected to application, more related to human needs and desires, traditionally underrepresented groups will have greater motivation to succeed and persist in their science courses or even pursue scientific careers. Motivation will be greater as members of underrepresented groups see how science can produce knowledge that matters to their concerns in ways that are consistent with good scientific methodology. Feminist epistemology urges a continued exploration of science in this way and so has much to offer science education.

<sup>33</sup> Bailer-Jones (2002a) discusses the increase in the prevalence of modeling as a way of doing science. Hands-on techniques in teaching are discussed in a variety of sources. Howes (2002) includes these among other methods in her book.

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