Social Empiricism and Science Policy

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Miriam Solomon's *Social Empiricism* is an exceptional work in contemporary philosophy of science in that it aims to contribute to science policy, and not merely to a philosophical debate about the social nature of scientific knowledge. In an attempt to contribute to science policy, Solomon proposes a novel theory of scientific rationality. She claims that we should evaluate scientific communities on the basis of how well they succeed in distributing research effort, instead of evaluating the reasoning and decision-making of individual scientists. We argue that Solomon's anti-individualist theory of scientific rationality does not provide an adequate account of epistemic responsibility. We argue also that social empiricism fails to be relevant to science policy because science policy makers are not capable of identifying the kind of factors that social empiricism deems as relevant to science policy.

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During the last three decades a number of scholars in science and technology studies have challenged philosophy of science by claiming that social values play a more significant role in the production of scientific knowledge than what philosophers have acknowledged (see e.g., Barnes, 1977; Bloor, 1991; Proctor, 1991; Shapin and Schaffer, 1985). In philosophy of science it is uncontroversial to suggest that social values are allowed to play a role in decisions about what research topics are considered as interesting and for what practical ends scientific knowledge is pursued. However, it is controversial to suggest that social values are allowed to intervene in the reasoning and decision-making processes that scientists are engaged in when they decide to accept something as scientific knowledge, either individually or collectively (see e.g., Haack, 1996; Rolin, 2002). Philosophers of science have responded to concerns about the role of social values in the production of scientific knowledge in a variety of ways. One response has been to design ways to strengthen the methods of scientific reasoning in the hope of minimizing or eliminating the influence of social values in the production of scientific knowledge (Laudan, 1984; Norton, 2008). Another response has been to argue that social values do not necessarily undermine the epistemic integrity of scientific knowledge; instead, they can contribute to the epistemic success of science (Hull, 1988; Kitcher, 1993; Longino, 1990; 2002).

Miriam Solomon's *Social Empiricism* (2001) is one of the most ambitious representatives of the latter strategy. Solo-

mon argues that social values can play a positive role in the production of scientific knowledge by generating and maintaining an efficient distribution of research effort amongst those theories that have some empirical successes. Solomon develops this argument into a thoroughgoing criticism of individualism in philosophy of science. She claims that instead of evaluating the reasoning and decision-making of individual scientists, philosophers should evaluate scientific communities on the basis of how well they succeed in distributing research effort. Like many other philosophers of science, Solomon aims to develop a theory of scientific rationality. Her theory is novel in claiming that insofar as scientific knowledge is an outcome of a rational process, scientific rationality is realized at the collective level, not the individual level. Also, Solomon intends her theory of scientific rationality to be relevant to science policy. According to her, science policy makers are responsible for realizing most of the normative recommendations given by social empiricism. To individual scientists social empiricism gives minimal guidance.

In this paper we argue that Solomon has not provided adequate grounds in support of her novel theory of scientific rationality. We also argue that the normative implications of her theory are unacceptable. Specifically, we object to the implications her theory has for individual scientists and for policy makers. We argue that there needs to be more constraints on individual scientists' decision-making than Solomon demands. In their efforts to acknowledge the fact that social values can play a positive role in the production of scientific knowledge philosophers should not neglect the traditional project of evaluating the reasoning and decision-making of individual scientists. Further, we argue that Solomon is mistaken to rely on science policy makers to ensure that scientists achieve their epistemic goals. Even though we welcome philosophers' attempts to contribute to science policy, we argue that social empiricism fails to be relevant to science policy.

In section I, we present Solomon's theory of scientific rationality. In section II, we argue that Solomon's argument for her radical new normative theory of scientific rationality is a *non sequitur*. In section III, we argue that Solomon's theory of scientific rationality fails to give an adequate account of epistemic responsibility. We explain what we mean by epistemic responsibility and why we think that philosophy of science should give an account of epistemic responsibility. In section IV, we argue that social empiricism fails to be relevant to science policy. We conclude by drawing a lesson for philosophers who aim to develop normative theories which are relevant to science policy.

What is social empiricism?

Traditionally, many philosophers of science contrasted epistemic values with non-epistemic values. Epistemic values were thought to be constitutive of science, and include such values as accuracy, consistency, scope, simplicity, and fruitfulness (Kuhn, 1977; Longino, 1990). These values are understood to be desirable features of scientific theories throughout the history of science. In contrast, scientists' personal values, like moral and social values, are non-epistemic values (see e.g., Carrier, Howard and Kourany, 2008; Machamer and Wolters, 2004; Kincaid, Dupré and Wylie, 2007). Some philosophers of science have sought ways to mitigate the effects

of non-epistemic values on science (see e.g., Norton, 2008). Thomas Kuhn (1977), Helen Longino (1990), Philip Kitcher (1993) and others have argued that such values do not only impede scientists, but often play a constructive role in science.

Solomon invites us to take a fresh look at the distinction between epistemic and non-epistemic values. She suggests that we need to radically re-conceptualize the debate about the role of non-epistemic values in scientific inquiry. Indeed, she recommends that we start by re-conceptualizing the notion of scientific rationality.

Solomon believes that any scientific practice that leads to empirical success or truth deserves to be called scientifically rational (2001: 52). This conception of rationality is *externalist* in the sense that scientific rationality depends on the consequences of scientific practices (16). From the externalist perspective that Solomon recommends, it does not matter whether scientific practices are "logical," "clear," or "objective" (52). It matters merely whether they are conducive to empirical success or truth.[1]

Solomon believes that empirical successes come in many forms. Successful predictions of new phenomena, explanations of already known phenomena, and successful control and manipulation of natural processes all count as empirical successes (2001: 27). Solomon argues that empirical successes are the primary goals of scientific inquiry because they are "contingent on the world outside the inquirers" (17). Thus, they are the proper aim of science. In Solomon's view, the outcomes of scientists' reasoning and decision-making—whether they are hypotheses, theories, models, diagrams or artefacts—deserve to be called scientific knowledge if they are used to count for some empirical successes.

Solomon rejects the traditional practice of equating non-epistemic values with "biasing factors" (2001: 53). In fact, given an externalist account of scientific rationality, Solomon argues that even those values that have traditionally been conceived as non-epistemic can play a *rational* role in science. They can play a rational role by distributing research efforts in the community among those theories that have some empirical successes. Given this re-evaluation of non-epistemic values, Solomon recommends replacing the traditional distinction between epistemic and non-epistemic values with an epistemologically neutral concept, "decision vectors." A decision vector is any factor that influences the *direction* of research (53). Solomon believes that "scientific rationality — conduciveness to scientific success — is not an intrinsic property of most decision vectors" (63). Hence, a particular type of decision vector is sometimes conducive to scientific success but sometimes not.

Whether or not a decision vector is conducive to scientific success will depend on circumstances (Solomon, 2001: 53, 63). For example, the desire for fame can motivate scientists either to aspire towards higher standards of research or to succumb to fraud. In the former case, the desire for fame would be conducive to scientific success. In the latter case, it would be an obstacle to scientific success. Solomon argues that we should not prematurely judge any decision vector to be either irrational or a-rational since it may be able to function in many ways in scientific inquiry.

However, Solomon makes a distinction between two types of decision vectors, *empirical* and *non-empirical*. According to Solomon, "empirical decision vectors are causes of preference for the-

ories with empirical success," and "non-empirical decision vectors are other reasons or causes for choice" (2001: 56). Solomon emphasizes that "only the empirical decision vectors are always conducive to some scientific success, and even then, they do not typically maximize attainable empirical success" (63). She cites the salience of data and the ability to generate novel predictions as examples of empirical decision vectors (57). The salience of data is an empirical decision vector simply because "preference for a theory with salient data is a preference for a theory with *some* data" (57). Solomon's examples of non-empirical decision vectors include conservativeness, competitiveness, peer pressure, deference to authority, elegance, and simplicity (57-58). Just as salient data may cause a scientist to accept one of two competing hypotheses, conservativeness could also play a causal role in determining which hypothesis one accepts.

Solomon's social empiricism provides a novel solution to the problem of under-determination in philosophy of science. The problem of under-determination is the question of what criteria ought to guide theory choice when theory choice is under-determined by empirical evidence. Solomon's solution involves two claims, a negative thesis, which we will refer to as (SN), and a positive thesis, which we will call (SP). The two theses are as follows.

> (SN) A normative theory of scientific inquiry should not discourage the influence of non-empirical decision vectors at the individual level in determining a scientist's choice of one theory over another.
>
> (SP) A normative theory of scientific inquiry ought to address the role of both empirical and non-empirical decision vectors at the community level by determining a rational distribution of research efforts in the community.

Let us now examine these two claims in detail, beginning with (SN). According to Solomon, "social empiricism is social because what matters, normatively speaking, is the distribution of empirical and non-empirical decision vectors across a community of investigators" (2001: 120). As Solomon explains, "normative judgments are not [to be] made of the thoughts and decisions of individual scientists" (120). Given (SN), provided that an individual scientist works with a theory with some empirical success, she is not violating her epistemic obligations. The shift in focus to the evaluation of research communities makes Solomon's position both radical and thoroughly anti-individualist.

For an individual scientist, social empiricism gives only one guideline. A scientist should work with empirically successful theories (Solomon, 2001: 150-151). Perhaps the most striking feature of social empiricism is that it imposes no constraints on the influence of non-empirical decision vectors on the reasoning and decision-making of individual scientists. As Solomon explains, her account of rationality "does not require individual scientists to make overall impartial assessments" (135). In this respect, social empiricism demands less than most normative accounts of scientific rationality (135).

Solomon argues that non-empirical decision vectors should be permitted to influence an individual scientist's theory choice since they can play a *rational*

role in scientific inquiry. They play a rational role insofar as they distribute research efforts in the community among theories that have some empirical successes.[2]

Social empiricism focuses on "a new locus of epistemic responsibility" (2001: 150). Whereas prescriptions in epistemology and philosophy of science are typically addressed to individual knowers, social empiricism focuses on epistemic responsibilities at the level of science policy (150). That is, social empiricism is meant to be applied in science policy and funding decisions (13).[3]

Consider Solomon's positive thesis (SP), the claim that a normative theory of scientific inquiry ought to determine a rational distribution of research effort in the community. According to Solomon, a community of scientists should distribute research efforts when different theories have different empirical successes and none of the theories has all available empirical successes in a domain of inquiry.

Solomon explicitly denies that an optimal distribution of research effort takes place by "an invisible hand of reason" (2001: 67, 95). This is why her normative theory is concerned with directing science policy and funding decisions. According to Solomon's theory, a rational distribution of research effort requires two things. It demands that

> (SP1) empirical decision vectors be *equitably* distributed in proportion to the empirical successes of the various theories under consideration so that each theory will receive its fair share of attention,
>
> and
>
> (SP2) non-empirical decision vectors be *equally* distributed among those theories that have some empirical successes (77, 95, 117-18).

Solomon emphasizes that an equitable distribution of empirical decision vectors is not necessarily an equal distribution. An equitable distribution is a proportional distribution. Hence, if one theory has more empirical successes than others, it deserves more attention than the others (76). On the other hand, not all scientists should abandon a theory which has less empirical successes than another theory. Like Larry Laudan (1977), Solomon suggests that the *pursuit* of a theory can be rational even when it is not the superior theory. She believes that every theory that has some empirical successes deserves some attention. Only theories without any empirical success should not be pursued (2001: 95).

Besides defining conditions for a rational distribution of research effort, social empiricism defines conditions for a *normatively appropriate consensus*. According to Solomon, a consensus on a theory is normatively appropriate only when a theory has all the empirical successes available in a domain of inquiry (2001: 119).

Evaluating Solomon's argument for (SN)

In the remainder of the paper, we discuss the concerns we have with Solomon's theory of scientific rationality. First, we argue that Solomon's argument for (SN) is not valid. Indeed, it is a *non sequitur*. Second, we take issue with what she fails to say about epistemic responsibility. Third, we take issue with the role she attributes to science policy makers.

According to Solomon, we should accept (SN) because non-empirical decision vectors can play a rational role in

scientific inquiry. They can play a rational role by distributing research efforts in the community among theories that have some empirical successes. Even if this latter claim is right, it does not support (SN), the claim that a normative theory of scientific inquiry should not set any constraints on non-empirical decision vectors in individual scientists' reasoning and decision-making. In order for Solomon's argument to be valid, she would have to make the stronger claim that non-empirical decision vectors *always* function in a rational way in scientific inquiry. This claim, however, is false. In fact, Solomon concedes that non-empirical decision vectors are not always scientifically rational (2001: 53). Non-empirical decision vectors can lead astray a whole community of scientists and not only some individual scientists. Whether non-empirical decision vectors function in a rational way in science depends on the context.

In an attempt to challenge the traditional view that the influence of non-empirical decision vectors is always a sign of bad science, Solomon ends up glorifying the role of non-empirical decision vectors in science. We believe it is possible to appreciate the insight that non-empirical decision vectors *sometimes* play a constructive role in scientific inquiry without accepting (SN), the claim that a normative theory of scientific inquiry should not set any constraints on non-empirical decision vectors in individual scientists' decision making.

A more adequate account of the role of non-empirical decision vectors in science would benefit from an in-depth analysis of where and how these decision vectors enter into scientists' reasoning and decision-making, both at the individual and the collective level. Indeed, other philosophers interested in the role of social values in scientific inquiry have produced detailed analyses of how non-empirical decision vectors interact with evidence, background assumptions, and cognitive values (see e.g., Anderson, 1995; 2004; Douglas, 2000; Lacey, 1999; Longino, 1990; Wylie, 2002). Such analyses help philosophers and other science studies scholars become aware of the often tacit influence of non-empirical decision vectors on individual and collective decision-making, and thus enable them to provide more adequate accounts of the production of scientific knowledge. Whether non-empirical decision vectors have a positive, negative or neutral impact on the epistemic success of scientific inquiry is to be decided on a case by case basis.

Is social empiricism an adequate theory of epistemic responsibility?

In this section we assess Solomon's negative thesis (SN) independently of the argument she presents in support of it. We argue that Solomon's normative theory of scientific rationality does not include an adequate account of epistemic responsibility. An adequate account of epistemic responsibility will set more demands for individual scientists than Solomon's thesis (SN). After explaining what we mean by epistemic responsibility, we explain why social empiricism fails to give an adequate account of it.

By the term 'epistemic responsibility' we refer to a particular conception of epistemic justification. When one asks for epistemic justification, one can seek to answer the following question: Under what conditions is a scientist justified in believing or accepting a particular view? Thus, a philosophical account of epistemic responsibility aims to identify normatively appropriate conditions for

a scientist's being justified in believing or accepting a particular view.

In accordance with a widely accepted view, a scientist is epistemically responsible in believing or accepting a view if she provides sufficient evidence in support of the view. Some philosophers, most notably Michael Williams, argue that a scientist can be epistemically responsible in believing or accepting a view under more relaxed conditions. On Williams's view, one is epistemically responsible in believing or accepting a view also if one adopts a "defence commitment" with respect to the view (Williams, 2001: 25). A defence commitment means that one accepts a duty to defend or revise one's view *provided that* it is challenged with an appropriate argument. As Williams explains, epistemic justification is "like innocence in a court of law: presumptive but in need of defence in the face of contrary evidence" (2001: 25). Epistemic justification has a "default and challenge" structure: "entitlement to one's belief is the default position; but entitlement is always vulnerable to undermining by evidence" (2001: 25). Thus, epistemic responsibility does not require a scientist to cite evidence in support of all her views. Insofar as her views are not challenged, she does not need to defend them.

Arguably, the notion of epistemic responsibility is applicable to both individuals and groups. For an individual scientist, being epistemically responsible means that when she is faced with a challenge to her view, she has a duty to produce evidence in favour of it (Williams, 2001: 25). For a group of scientists, being epistemically responsible means that someone in the group has to carry out the duty involved in a defence commitment, that is, the duty to defend (or revise) the group's view when it is challenged in an appropriate way. In order for a group to be epistemically responsible, it is not necessary that each member of the group carry out the duty involved in a defence commitment. The group members can decide to distribute defence commitments among themselves (Rolin, 2008).

Clearly, this conception of epistemic responsibility is at odds with Solomon's account of scientific rationality. According to Solomon, an individual scientist is epistemically responsible insofar as she works with a theory with *some* empirical success. In accordance with Solomon's negative thesis (SN), social empiricism does not set any constraints on non-empirical decision vectors in an individual scientist's reasoning and decision-making. Given Williams's conception of epistemic responsibility, individual scientists have greater epistemic duties than Solomon suggests. Given his account, if an individual scientist is asked why she works with a theory which has a particular kind of empirical success rather than another kind of empirical success, she has a duty to provide an explanation. And if questions are raised about her non-empirical decision vectors, she has a duty to defend them *insofar as they can be defended*.

One problem in Solomon's social empiricism is that the category of non-empirical decision vectors includes a diverse set of factors. Some of them may remain unconscious or tacit, whereas others are put forward as explicit reasons in scientific debates. Among non-empirical decision vectors which can function as explicit reasons are such values as simplicity and consistency. As Kuhn points out, simplicity can mean a preference for a theory which involves less computational labour to make predictions than an alternative theory (1977:

324). Simplicity in this sense is clearly a non-empirical decision vector. Nevertheless, it is a decision vector which can be put forward as an explicit reason. Also, appeals to simplicity can be challenged and defended. Similarly, consistency is a non-empirical decision vector because it is a desideratum that we impose on our knowledge claims. The use of consistency as an explicit reason can be defended by arguing that the value of consistency is derivable from the value of truth. Insofar as truth is a goal of scientific inquiry, theories are not allowed to include inconsistent statements (see also Klee, 2003: 250). Thus, at least some non-empirical decision vectors can be articulated, challenged, and defended and we see no reason why they should be exempt as decision vectors. Indeed, the norm of defence commitment means that an appeal to simplicity or consistency should be defended provided that it is challenged in an appropriate way.

We conclude that Williams's conception of epistemic responsibility is not consistent with Solomon's negative thesis (SN) because it sets a constraint on those non-empirical decision vectors which play a role in an individual scientist's theory choice. Some non-empirical decision vectors can be adopted with a defence commitment and defended if they are challenged. Some others may turn out to be motivational factors which cannot be defended.

Moreover, given Williams's conception of epistemic responsibility, it is incoherent to suggest, as Solomon does, that epistemic responsibility be located in scientific communities and not in individual scientists (2001: 150). The suggestion is incoherent because a community is epistemically responsible only insofar as at least one member of the community is epistemically responsible. In order for a community to be epistemically responsible, it is not necessary that each member of the community carry out the duty involved in a defence commitment. But someone in the community has to carry it out. Otherwise, the community as a whole is epistemically irresponsible.[4] Thus, Williams's conception of epistemic responsibility implies that it is impossible for a community's epistemic responsibility to emerge from a community where all individuals are epistemically irresponsible.

We argue that Williams's conception of epistemic responsibility is superior to Solomon's minimal conception of epistemic responsibility because the former enables scientists to achieve their epistemic goals better than the latter. We acknowledge that Solomon is right to suggest that a distribution of research effort among those theories that have some empirical successes is epistemically beneficial for scientific communities. However, the potential benefits in such a distribution are likely to be lost unless different perspectives are brought into interaction with each other. Williams's conception of epistemic responsibility is designed to promote such interactions. When an individual scientist or a group of scientists is faced with a challenge, the scientist or the group has a duty to defend or revise their views. Such challenges can give the scientist or the group reasons to look for novel empirical evidence in order to defend their views. Or they can give them reasons to revise their theory. In either case, the practice of challenge and response enables scientists to advance their epistemic goals. If on the other hand, scientists refuse to act in accordance with the defence commitment, they are in danger of losing a motivation to defend or revise their theory. Thus, the lack of epistemic responsi-

bility, as Williams understands it, poses a potential obstacle to the progress of scientific inquiry by removing a motivation to pursue new empirical successes.

We believe that epistemic responsibility, as Williams understands it, is as crucial for the achievement of empirical successes as is the distribution of research effort. Together — the effective distribution of research effort and individual epistemic responsibility — can generate a dynamic scientific community which makes progress towards empirically successful theories. A distribution of research effort alone can generate a fragmented and stagnated scientific community. By ignoring the importance of epistemic responsibility, social empiricism ignores the epistemic importance of the practice of challenge and response in science.

Williams's conception of epistemic responsibility is superior to Solomon's minimal conception of epistemic responsibility also because it gives a more accurate account of the actual practices in the sciences. Science, as a matter of fact, involves various practices, some of which involve the use of instruments and technologies and require skills which remain tacit. Nevertheless, science involves also explicit discursive practices where arguments and counter-arguments are exchanged. Scientists expect other scientists to present evidence and arguments in support of their results and to respond to counter-arguments. In our view, scientists expect such behaviour because it is epistemically responsible.

We argue also that it is not plausible to disconnect a community's epistemic responsibility from an individual scientist's epistemic responsibility in the way that Solomon does (2001: 150). Imagine a community of researchers in which no single scientist could defend her judgment that a particular hypothesis is superior to the competitors, despite the fact that everyone working in the subfield accepted the hypothesis. It is hard to believe that anyone would say that such a community is rational. Indeed, it is hard to believe that such a situation could possibly occur. Hence, contrary to what Solomon suggests, we believe one cannot separate individual epistemic responsibility from a community's epistemic responsibility. Williams's conception of epistemic responsibility has the virtue that it enables one to understand how a community's epistemic responsibility is dependent on an individual community member's epistemic responsibility.

We recognize that some philosophers of science think that systems in which cognition is distributed may seem to be counter-examples to our claim that it is impossible to attribute epistemic responsibility to a community without attributing it to some individuals in the community (see e.g., Giere, 2002). In such systems, one might argue, no individual need be epistemically responsible in our sense. We disagree. Consider a classic example of distributed cognition, Edwin Hutchins's example of a crew bringing a ship into a harbour (see Hutchins, 1995). If Solomon is right, then no single crew member need have a personally justified belief in order for the crew to have the knowledge of how to dock the ship. That is, no single crew member need be able to personally defend her judgment when challenged. We think that if no single individual were able to personally justify her decisions about what needs to be done, it is unlikely that the boat would be docked successful. More importantly, it seems odd to say that the crew knew how to

dock the boat in such conditions. What is unusual about distributed cognitive systems is that each individual involved has only partial knowledge, and no single individual has the full perspective. But, when such systems function well, they do so because many individuals are each individually epistemically responsible for their parts in the whole. Their many individual responsible acts give rise to a capacity and knowledge that no single one of them could have alone.

Given Williams's conception of epistemic responsibility, it follows that Solomon's negative thesis (SN) is unacceptable. Contrary to (SN), individual scientists have greater epistemic obligations than to work with empirically successful theories. They have a duty to defend (or revise) not only the empirical reasons but also the non-empirical reasons for their choice of theories if someone challenges them. And if it turns out to be the case that they are not capable of defending some of their non-empirical decision vectors, then they should consider the question of what other theories might account for the same empirical successes as their favourite theory.

Indeed, Helen Longino argues that reflection on non-empirical reasons is epistemically beneficial for science because such reasons can play a crucial role in evidential reasoning (1990: 83). As Longino explains, evidential reasoning is dependent on background assumptions which establish the relevance of empirical data to a hypothesis or a theory, and background assumptions can encode non-empirical reasons (1990: 44). In other words, non-empirical reasons can influence evidential reasoning indirectly by providing scientists with reasons to prefer some background assumptions to others. Longino suggests that epistemic responsibility with respect to non-empirical reasons is beneficial to scientific inquiry because non-empirical reasons can have an impact on which observations count as empirical evidence and which ones fail to do so. In Longino's view, empirical and non-empirical decision vectors are not two separate categories of reasons. Instead, they interact with each other in evidential reasoning. Therefore, she argues, scientists should take responsibility for their non-empirical reasons, and not merely for the empirical ones.

For example, Longino (1990) argues that the background assumption of gender dimorphism has influenced research on human evolution and behavioural differences among women and men. By gender dimorphism she means the assumption that certain behavioural patterns are best classified as belonging to two categories, either masculine or feminine (1990: 120-121). Longino argues that this assumption tends to focus the attention of scientists on the differences between men and women rather than the variation among individuals when examining a body of data. Anne Fausto-Sterling (2000) presents an alternative to gender dimorphism, a more complex theory of the sexes that challenges traditional background assumptions about gender and gender differences. Thus, reflection on the role of non-empirical decision vectors can give scientists a motivation to look for novel evidence or to reinterpret existing bodies of evidence. Consequently, it enables scientists to achieve the epistemic goals of science better than they would do without such reflection.

Like Longino, we believe that an individual scientist or a group of scientists has an epistemic duty to reflect on their non-empirical decision vectors when they are challenged. We believe also

that relying on background assumptions that encode non-empirical decision vectors is not itself grounds for rejecting research provided that research has some empirical success (see also, Longino, 1990: 128-130). Thus, we agree with Solomon that sometimes non-empirical decision vectors play a positive role in scientific inquiry by distributing research efforts in the community. Hence, for an individual scientist to be epistemically responsible, it is not required that she eliminate the effects of non-empirical decision vectors from her reasoning and decision-making. However, she has a duty to defend or revise them if they are challenged. And if she cannot defend them, then she should be ready to consider alternative assumptions and theories.

To summarize, in this section we have argued that Solomon's negative thesis (SN) is unacceptable because individual scientists have greater epistemic obligations than to work with a theory with some empirical success. More specifically, individual scientists have the epistemic duty to defend, revise, or abandon their empirical and non-empirical decision vectors if they are challenged. Such duties enable scientists to achieve their epistemic goals better than they could do without them. We have argued also that it is impossible to attribute epistemic responsibility to a community without attributing it to some individuals in the community. Contrary to what Solomon suggests, an adequate normative theory of scientific rationality needs to make normative judgments of the thoughts and decisions of individual scientists. Such judgments play an indispensable role in enabling scientists to realize their epistemic goals. Hence, it is a mistake to suggest, as Solomon does, that *all* that matters is the distribution of empirical and non-empirical decision vectors across a community.

Can science policy makers really do the job?

In this section, we take issue with the positive prescriptions that Solomon makes. First, we do not believe that science policy makers will have the ability to effectively bring about the desired end. Second, we believe that the concerns that lead Solomon to attack individualist accounts of rationality will ultimately arise again at the level of science policy makers.

Solomon's social empiricism defines conditions for a rational distribution of research effort in a scientific community. According to Solomon, what counts as a rational distribution of research effort in a scientific community changes over time as the distribution of empirical successes among competing theories changes over time. According to (SP1), research efforts should be focused more on those theories that have been successful in accumulating empirical successes.[5] According to (SP2), non-empirical decision vectors should be equally distributed among theories that have some empirical successes. And according to (SN), a normative theory of scientific inquiry should not set any constraints on non-empirical decision vectors in an individual scientist's decision making. Solomon merely recommends that an individual scientist works with a theory with some empirical success. In social empiricism it is science policy makers who have the responsibility of ensuring that changes in research efforts in a research community track changes in empirical successes.

We argue that the ability of science policy makers to direct scientific com-

munities in accordance with social empiricism is restricted because their capacity to identify and control non-empirical decision vectors is limited. Whereas scientists typically report at least some of the empirical decision vectors that have influenced their decisions, they seldom report the non-empirical ones. And those scientists who have connections to special interests groups, such as religious groups or industries, may even try to cover up such connections in order to appear as "disinterested" in front of other scientists and the larger public.

Historians of science often face the difficult task of trying to discern the non-empirical decision vectors that might have influenced scientists' decisions in the past. For example, Solomon identifies the captain's religious beliefs aboard the Beagle as a non-empirical decision vector that played a role in Darwin's acceptance of the theory of evolution by natural selection. It is hard to imagine what science policy makers are to do in order to alter the distribution of such factors in a systematic way as new evidence is gathered and one of two competing theories gains more empirical successes. But, that is precisely what Solomon suggests policy makers ought to do. That is, science policy makers are expected to identify non-empirical decision vectors in order to ensure that they are equally distributed in a research community. Indeed, other critics of Solomon's social empiricism point out that it is not clear how we can discover empirical and non-empirical decision vectors (Klee, 2003: 252; Schmaus, 2005: 109-110). And Solomon herself acknowledges that identifying decision vectors is one of the most difficult challenges facing social empiricism (2001: 151).

We grant that science policy makers can attempt to cultivate dissent in scientific communities by ensuring that those research projects which have some empirical successes even though they do not belong to the mainstream in some scientific specialty gain some resources to pursue their alternative theories. But insofar as science policy makers attempt to cultivate dissent in scientific communities, they can do this by considering the distribution of empirical successes among alternative theories. They do not need to pay attention to non-empirical decision vectors. Consequently, it is not clear why they need social empiricism to justify their decisions. Their attempts to cultivate dissent can be justified by plain old fashioned empiricism which claims that a scientific theory is worthy of pursuit insofar as it has some empirical successes.

Further, Solomon provides no evidence to support the confidence she has in the ability of science policy makers to direct scientific communities. If individual scientists are unreliable at decision making, as social empiricism implies, then it seems that the individuals involved in directing policies to yield the desired results are apt to be equally unreliable. Moving to the level of the community in the manner that Solomon recommends seems to provide no shield against the problems she believes plague traditional individualist normative theories of scientific rationality. Someone has to make a decision somewhere. Clearly, scientists are apt to be as reliable in their decision-making as science policy makers are in their decision-making.

To summarize, in this section we have argued that science policy makers are not capable of directing scientific communities in the way social empiricism requires them to do. The reason for this is that their capacity to identify non-empirical decision vectors is limited. Yet

such factors would be highly relevant in their decision-making if they acted in accordance with social empiricism. For these reasons, social empiricism is not relevant to science policy.

Conclusion

In summary, we have argued that Solomon does not offer a valid argument in support of her most radical claim, the thesis that a normative theory of scientific inquiry does not need to make normative judgments of the reasoning and decision-making of individual scientists. Moreover, we have argued that social empiricism is not an adequate theory of scientific rationality. Individual scientists have greater epistemic responsibilities than to work with empirically successful theories. They have a duty to defend or revise their views if these views are challenged. The defence commitment covers not only empirical decision vectors but also non-empirical ones. Hence, it is false to claim, as Solomon does, that a normative theory of scientific rationality should not set any constraints on non-empirical decision vectors in individual scientists' decision-making. Further, an epistemically responsible research community cannot emerge from a group where every individual member is epistemically irresponsible. For a research community to be epistemically responsible, at least some individual members of the community have to be epistemically responsible.

Also, we have argued that science policy makers are not in a position to carry out the responsibilities given to them by social empiricism. Social empiricism fails to be relevant to science policy because it requires that policy makers be capable of identifying non-empirical decision vectors. However, their capacity to do so is limited.

Despite our criticism of social empiricism we welcome philosophers' attempts to design normative theories which are relevant to science policy. The lesson to be learned from our criticism is that such theories should be based not only on an epistemic analysis of social practices in science but also on an epistemic analysis of indicators which are actually accessible for policy makers. For example, if policy makers are concerned with cognitive diversity in scientific communities, as Solomon recommends they be, they can try to develop indicators which track such diversity. In some circumstances scientists' gender or ethnic background may function as a useful proxy indicator of diverse perspectives even though neither gender nor ethnic background guarantees that a person will bring cognitive diversity to a community. However, in the absence of direct access to non-empirical decision vectors such proxy indicators are often the best available indicators science policy makers can rely on in their decision making. Much work of course remains to be done to develop an epistemic analysis of science policy indicators.

Notes

1 In Solomon's (2001) social empiricism the emphasis is on empirical adequacy. In Alvin Goldman's (1999) veritism, what matters is whether social practices are conducive to truth.
2 Solomon compares her social empiricism with other philosophical accounts of how scientific communities distribute research effort (2001: 66-67). Kuhn (1977), for example, suggests that a distribution of research effort is a function of rational

disagreement. Rational disagreement is possible because scientists may interpret the norms of scientific rationality in different ways. According to Kuhn, epistemic values, such as accuracy, internal and external consistency, breadth of scope, simplicity, and fruitfulness, are not so precise as to forbid rational scientists from disagreeing (322). Kuhn also points out that epistemic values may conflict with one another (322). Solomon argues that Kuhn's account of rational disagreement is too simple to give an accurate description of the causes of disagreement. According to Solomon, "disagreement is caused by multiple decision vectors, some 'rational,' some 'reasonable,' some decidedly 'non-rational,' 'unreasonable' or even 'irrational' by traditional standards" (2001: 68).

3 Solomon's position, with its confidence in science policy makers, has affinities with Steve Fuller's (2000) view.

4 To think otherwise is to attribute the epistemic responsibility of the research community to the operation of an invisible hand, something that Solomon is explicitly loath to do (see Solomon, 2001: 67, 95).

5 Solomon's social empiricism has affinities with Imre Lakatos's (1970) theory of progressive research programmes in that social empiricism favours those theories that have been successful in accumulating empirical successes.

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