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# Scientific Realism, Perceptual Beliefs, and Justification<sup>1</sup>

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## 1. Introduction

If one compares various skeptical arguments about our perceptual beliefs with arguments against scientific realism one immediately notices important similarities. Skeptical arguments about perceptual beliefs are often based on the premise that all of our perceptual beliefs could be wrong. Our experience is consistent with many different states of affairs; some familiar examples are hallucination, an evil demon, and brains in a vat. Thus it is claimed we have no reason to believe that the perceptual beliefs we normally form are true and alternative beliefs are false.

One of the most powerful arguments against scientific realism is based on the claim that our data underdetermines our theory. There exist empirically equivalent theories, which means that there is no observation that could lead us to accept one and reject the other. Each member of a class of empirically equivalent theories will be equally supported by the evidence. But then we have no basis for believing that one is more likely to be true than the others. As a result it is claimed that we are not justified in believing a theory to be true, and instead we should limit our concerns to empirical adequacy.

Given the similarities between these arguments one might expect skepticism about our perceptual beliefs to go hand in hand with skepticism about scientific theories and entities. In reality this is far from the truth. Few philosophers are convinced of skepticism regarding perceptual beliefs, but many are convinced of skepticism regarding scientific beliefs. Some philosophers are explicit about their different responses to these skeptical arguments. For example, van Fraassen accepts the skeptical argument about scientific theories, but he admits it would be unfortunate if this committed him to a general skepticism (1980, pp. 70-1). Many responses to van Fraassen's constructive empiricism have attacked his 'selective skepticism' (Churchland 1985 and Boyd 1985). In the following I will investigate whether one is justified in having different epistemic attitudes toward perceptual beliefs and scientific beliefs. I believe that the arguments based on the underdetermination of our beliefs by our evidence do not always provide an adequate basis for skepticism. Whether they are successful and whether we are justified in forming perceptual beliefs or scientific beliefs depends upon other factors.

Since there are different accounts of scientific realism we must get clear about what sorts of beliefs we are investigating. According to Hacking (1983) there are two main varieties of scientific realism: realism about scientific theories and realism about unobservable entities of the kind that are referred to in scientific theories. Although there are many accounts of what realism is, let us say that realism about theories involves the belief that the theories are true or approximately true. Hence antirealism about theories withholds belief that they are true, but settles for something less, such as empirical adequacy. Realism about unobservable entities involves the belief that these unobservables exist. For example, a realist about entities might form the belief that electrons really exist. Antirealism about entities withholds belief in the existence of these unobservable entities. It is important to notice that antirealism about theories does not imply antirealism about entities. One might be an antirealist about theories, but hold realist beliefs about entities (Cartwright 1983 and Hacking 1983). Hence we can form realist beliefs about scientific theories or about unobservable entities. In the following I will concentrate on the beliefs that realists think we should have toward certain unobservable entities, and will refer to them simply as 'realist beliefs'. I will refer to the beliefs that a realist has about scientific theories as 'realist beliefs about theories'.

Traditionally many philosophers attempted to justify our perceptual beliefs by giving an argument for them. One method of doing this would be to give an argument for the truth of our perceptual beliefs, based on other more basic beliefs. If this were successful, our perceptual beliefs would be justified because certain other beliefs were justified. A different method would be to give a 'transcendental' argument, and show that the truth of our perceptual beliefs is required by the experience we have. Other arguments, such as those based on inference to the best explanation have also been proposed. I think it is clear, however, that all arguments that attempt to justify our perceptual beliefs fail. We are left in the position that Kant lamented when he remarked that this is a scandal in philosophy.<sup>2</sup>

Although one might conclude from these failures that our perceptual beliefs are not justified, many philosophers have simply concluded that the justification of our perceptual beliefs is not based on other beliefs via argument. We normally do not form perceptual beliefs on the basis of argument, and thus we should not expect them to be justified on the basis of argument. We generally form perceptual beliefs directly, and it is claimed that they are directly justified by experience instead of being justified in virtue of some other beliefs we have. Many philosophers would say that our perceptual beliefs are 'basic beliefs', which means that in our noetic framework they are not justified on the basis of other beliefs.<sup>3</sup> They are based on or grounded in experience instead of on other beliefs which are supposed to support them. Their justification does not depend on support from other beliefs, but rather they are justified by experience. I will hereafter assume that our perceptual beliefs are directly justified by experience.

Scientific realists have proposed arguments for realist beliefs that are very similar to the arguments proposed for the truth of our perceptual beliefs. For example, some arguments attempt to show realism follows directly from other beliefs we have, just as it was argued that the truth of our perceptual beliefs follows from more basic beliefs. Another claim is that scientific realism is required to make sense of science. This argument is very similar to the transcendental arguments for our perceptual beliefs. Other realists argue that scientific realism is the best explanation for the success of science, and thus we should accept realism based on inference to the best explanation. I think all of these attempts to justify scientific realism fail, just as the corresponding arguments about perceptual beliefs fail. Often they fail for the exact same reasons that the arguments for our perceptual beliefs fail.

## 2. The Justification of Realist Beliefs

In what follows I will investigate whether it is plausible to claim that realist beliefs are basic beliefs and thus are directly justified by experience. Since all attempts to justify scientific realism indirectly fail, if realist beliefs are justified they must be directly justified. Philosophers of science have concentrated on whether there are arguments that justify scientific realism, and the question of whether realist beliefs are directly justified has been ignored. I find this unfortunate, because I think most people who hold realist beliefs do not base their beliefs on some argument, but rather they have formed those realist beliefs directly in response to experience, much as we directly form perceptual beliefs in response to experience.<sup>4</sup> The lack of an argument supporting their realist beliefs would not affect these people, because their realist beliefs are not based on other beliefs. Realist beliefs are basic beliefs in their noetic framework, and no other more basic beliefs support them. In order to determine whether these realist beliefs are directly justified we must decide whether realist beliefs can be properly formed in direct response to experience in much the same way that perceptual beliefs can be formed in response to experience.

I think that very few of our beliefs are justified on the basis of other beliefs we hold. Most of our beliefs are similar to perceptual beliefs and are formed in response to certain experiences. For example, after sufficient investigation a scientist may come to believe that a certain unobservable entity exists. The traditional way of viewing this situation is to see the scientist as inferring his belief that the entity exists from other beliefs he acquired during his investigation. Another way of viewing this phenomena is that by investigation the scientist placed himself in a situation in which he directly formed the belief that the entity exists; he does not come to believe the entity exists because he has other more basic beliefs. On one view reason is useful because it provides the basis for the beliefs; reason transfers warrant or justification from more basic beliefs to the realist beliefs. On the other view reason is useful because it is helpful in putting us in situations in which we directly form the beliefs; reason does not transfer warrant or justification to realist beliefs, but it puts us in situations in which our realist beliefs receive warrant or justification. I believe the second alternative is closer to what really happens. Philosophers have been unwise to focus on the justification of forming realist beliefs on the basis of other beliefs, since so few of our beliefs are held on the basis of other beliefs.

According to the position presented here, both perceptual beliefs and realist beliefs are highly dependent upon the entire epistemic situation. If we look at an ordinary perceptual belief we find it is not formed in isolation, but rather factors such as sensory stimuli and other background beliefs are relevant to what perceptual belief is properly formed. The same is true of realist beliefs; other factors, including what other beliefs are held, are part of the epistemic situation in which the realist beliefs are formed. Instead of transferring or producing justification, reasoning affects or modifies this epistemic situation, and it is the epistemic situation which determines what beliefs are formed. Reason is not used to infer the perceptual or realist beliefs from other beliefs, but rather reason can affect the background beliefs that perceptual and realist beliefs depend on.

For example, one may bombard nuclei with protons to get pions. Although a scientist may simply recognize the pions or form the belief that pions are in a certain region of spacetime, those beliefs are dependent upon being able to identify pions and upon beliefs about the experimental setup. If the scientist didn't have those beliefs, he would not have formed the realist belief about the pions. But this does not mean that the realist belief is inferred from those beliefs or that the realist belief's justifica-

tion comes from those beliefs; the justification or warrant comes from the experience one has in that epistemic situation. It may be the case that some of the background beliefs are not directly justified by experience and are instead inferred from other more basic beliefs. If this is so, reasoning is important to the realist belief, but not in the traditional manner. It is important because it brings about part of the epistemic situation relative to which the realist belief is directly justified by the experience. It is not important in virtue of providing justification or warrant to the realist belief. This is similar to the formation of simple perceptual beliefs, such as when I form the belief that there is snow on a mountain when I look at a snow covered mountain. The belief is dependent upon my knowing what a snowy mountain looks like. My perceptual belief is not justified by that belief, but it is dependent upon it and other background beliefs because they are part of the epistemic situation. In that epistemic situation it is experience and not inference that justifies my belief that the mountain is covered with snow, even though I may believe those background beliefs on the basis of reason.

Support for this position comes from the actual behavior of scientists. Scientists find themselves in situations in which they form scientific beliefs in direct response to experience and not on the basis of an argument from other beliefs they might have. Kuhn has argued that much of a scientist's education takes place in labs because they are learning to see the world in a certain way. The students are not learning to reason from certain beliefs to other beliefs, but rather they are training themselves to 'see' certain things. I propose they are learning to form the appropriate beliefs in response to certain experiences. Hacking has observed that whereas a trained technician will be able to recognize objects with a microscope, an untrained person will only see light and dark spots. The difference between the trained and untrained person lies not in their visual stimulation, which may be the same; the difference is that they form different beliefs in response to that stimulation. They see different things. It would be incorrect to say that they have the same basic beliefs, and then the trained person reasons from those beliefs to beliefs about what is being seen with the microscope. The actual behavior of scientists indicate that many of their scientific beliefs are basic beliefs in their noetic framework.

The above distinction between using reason to support a belief and using reason to put oneself in a situation where experience will support a belief provides a framework for viewing formulations of 'miracle arguments' for scientific realism. These arguments are often devised as an attempt to give a precise formulation of the reasons that scientists became convinced of realism. For example, Wesley C. Salmon says

Since it seemed unlikely that scientists would have been moved by the kinds of arguments supplied by philosophers, I felt that some insight might be gained if we were to consider the evidence and arguments that convinced scientists of the reality of unobservable entities. ... Examination of these works [*Molecular Reality and Les Atomes*] reveals a clear-cut form of argument. (1984, pp. 213-4)

Salmon then develops an argument that attempts to show that belief in atoms and molecules is supported by the common cause principle and various beliefs the scientists might have had about the data available. This argument is supposed to show that scientific realism is supported by various other beliefs that scientists held at the time. It is a construal of an argument that scientists might have used to justify their forming realist beliefs. If one believes that the scientists were rational in adopting realist beliefs, and that they did so by reasoning from other more basic beliefs, one must provide an argument that can plausibly be thought of as justifying their beliefs. This is why arguments such as Salmon's are so appealing. They seem to provide an argument that represents how rational people might have reasoned.

However there is another way of viewing the situation. Perhaps the scientists at the turn of the century did not become realists by reasoning from beliefs about the data that was available. Perhaps they formed realist beliefs in direct response to their knowledge of the various experimental results. Their realist beliefs are not justified because one can reason to them from beliefs about the experiments, but they are justified because they are a proper response to the experience of learning about experiments. One need not find an argument that the scientists might have employed to think that they were justified in their beliefs. I see no reason to think the scientists at the turn of the century became realists because of some argument instead of forming realist beliefs directly in response to their epistemic situation.

This position also accords well with Hacking's claims about manipulation and realism. Although Hacking claims that "if you can spray them then they are real" (1983, p. 23), he also claims that he is not presenting an argument for realism. Instead he claims that being able to manipulate entities gives a reason to believe they are real. I propose that we read Hacking as claiming that the justification for realist beliefs does not come from any argument based on our beliefs about being able to manipulate entities, but rather it comes from the experience of manipulating them. There is a difference between the justification of a belief inferred from beliefs about manipulating entities and the justification of a belief directly formed in response to experience of manipulating entities.

An example from another field of philosophy may clarify this issue. Some theologians, such as John Calvin and Herman Bavinck, have thought that observing the night sky provides one with justification for believing that God exists or that he has other attributes, such as omnipotence or greatness (Plantinga 1983). Philosophers who have discussed these claims have almost universally attempted to construct an argument that would justify these theistic beliefs on the basis of beliefs about what is observed in the night sky. These arguments are known as the argument from design or the teleological argument. I think these arguments fail, and one cannot legitimately reason from beliefs about what one sees in the night sky to various theistic beliefs. But that does not mean that Calvin and Bavinck were wrong in their claim that observing the night sky justifies various theistic beliefs. The failure of teleological arguments would be relevant to Calvin and Bavinck's claim only if they thought the theistic beliefs were justified on the basis of beliefs about the night sky via argument. But there is no reason to think they thought this, and there is good reason to think they did not hold this position. One could hold that the experience of observing the night sky directly justifies the theistic beliefs in question. In order to be justified in forming the theistic beliefs one need not have a good argument from more basic beliefs if the beliefs are directly justified in virtue of having the experience. For this reason the endless discussions on the argument from design have been somewhat misguided. Similarly, 'miracle arguments' for scientific realism do not capture the justification provided to realist beliefs by experience.

I have been arguing that realist beliefs might be directly justified by experience much as our perceptual beliefs are. In response, one could object that there are relevant differences between perceptual beliefs and realist beliefs, and thus it is a mistake to think realist beliefs are directly justified. In support of this one might point to an abundance of unobservable entities once believed to exist that we now agree do not exist. Since beliefs about unobservable entities can be given up, it might be held that our practice of forming realist beliefs is not as reliable or trustworthy as our practice of forming perceptual beliefs. Hence our realist beliefs cannot be basic beliefs in a rational noetic framework.

A realist might respond that our perceptual beliefs are not completely reliable either. We often make mistakes and later correct them. Although it is true that our perceptual beliefs are usually correct, many of them are eventually given up. Likewise, there are instances in science in which an unobservable entity strongly believed to exist has been given up, but errors of this sort do not appear to be any more common than errors in perceptual beliefs. The reliability of our perceptual beliefs does not appear to be significantly greater than the reliability of our scientific beliefs about the existence of unobservable entities.

One might also claim that realist beliefs about unobservable entities are not basic beliefs by arguing that realist beliefs are theory-dependent. One might argue that beliefs about unobservable entities are theory-dependent in a way that our normal perceptual beliefs are not. Thus unlike perceptual beliefs, our realist beliefs about unobservable entities would be dependent upon the truth of certain scientific theories. This, it is claimed, makes our scientific beliefs less likely than our perceptual beliefs to be true; accordingly, these scientific realist beliefs are less justified than our perceptual beliefs.

In response to this many philosophers have noted that our perceptual beliefs are also theory-dependent. van Fraassen gives examples of theoretical entities that are observable (1980, p. 58). We don't question the justification of our belief that there is a certain crystal in front of us, even though that is highly theory-dependent. The theory-ladenness of language does not prevent us from effectively using language, nor does it prevent our beliefs from being justified. I suspect this objection is based on something like the description theory of terms, upon which the reference of a term is highly dependent upon a certain description being satisfied. However there are serious problems with these theories of reference, and recent work on reference has provided accounts in which reference is not dependent upon satisfying a certain description that is theory laden. It certainly seems as if we can successfully refer to an entity even though the theoretical beliefs we have about the entity are completely wrong. Thus the theory-ladenness of language does not prevent us from having basic beliefs about either observable or unobservable entities.

Another objection is that upon this position too many beliefs become justified. For example, suppose a scientist sees a path in a bubble chamber and uses his theory to conclude that it is due to a certain particle. This belief may not have a high degree of justification. But suppose the scientist trains his students to recognize that particle and immediately form the belief that the particle exists when they see certain paths in a bubble chamber. The students' beliefs are formed directly in response to experience. However it seems wrong to claim that the students' beliefs are more justified than the scientist's beliefs, since their beliefs are actually parasitic on his belief.

In response to this one must realize that not all beliefs formed in response to experience are justified. Our beliefs that are directly formed in response to experience are neither infallible nor automatically justified; we can train our minds to form false beliefs. For example, one could train oneself to see entities in a microscope that are only artifacts of the microscope, or one could train oneself to form false perceptual beliefs. Both our perceptual beliefs and realist beliefs are fallible and capable of being without warrant. In the case described above the epistemic situation may not be sufficient for the students' beliefs to be justified. If Hacking is correct, some experience of manipulating the entity may be needed, or we may follow Cartwright and require some experience with the causal capacities of the particle. It will usually be the case that when realist beliefs are directly formed the epistemic situation is different from the problematic one described above. A theory of justification would help determine what beliefs formed in response to experience are justified.

### 3. Justification

I have been arguing that the best way to defend scientific realism about unobservable entities is to claim that these realist beliefs are directly justified by experience, much as perceptual beliefs are. I have assumed that perceptual beliefs are directly justified by experience, but have not argued for that claim. It is time to look at whether perceptual beliefs, and realist beliefs, could possibly be directly justified by experience. This depends upon the nature of epistemic justification. Although philosophers have proposed theories of justification that are quite different from each other, none of the currently popular theories of justification exclude either perceptual beliefs or realist beliefs from being directly justified on the basis of experience.

Traditionally philosophers have distinguished between two general accounts of justification. On one account to say that a person is justified in holding a certain belief means that the person has violated no intellectual obligation in holding the belief. Just as an action is ethically justified if it doesn't violate an ethical obligation, according to this view holding a belief is justified if holding it does not violate an intellectual or epistemic obligation. Let us call this the normative account of justification. The other account of justification is not concerned with intellectual obligations, but is concerned with the person being in a good epistemic situation (Alston 1983). According to this account a person is justified in holding a certain belief if there is something about the epistemic situation that renders the belief proper. There are epistemic goals or aims, and beliefs are justified in accordance with whether they contribute to the attainment of those goals. For example, many believe that our epistemic goal is to have true beliefs and avoid having false beliefs. Given this, some hold that beliefs are justified if they are the result of a reliable belief producing mechanism. Since neither of these conceptions of justification implies the other, we will look at perceptual and realist beliefs in relation to both of these concepts of justification.

Most philosophers who adopt a normative sense of justification construe rationality as giving us *permissions* to believe certain propositions. For example, Bas van Fraassen says: "I construe the term *rational*, as applied to opinion here, as a term of *permission* rather than of *obligation*. To say that you are rational in your opinions does not mean that your opinions are rationally compelled ..." (1985, p. 248). The question that now arises concerns when it is permissible to hold a belief. One might claim that we are permitted to hold a belief only if we have a good reason to believe it is true. This would be to require that all beliefs be justified on the basis of some other beliefs. Such a requirement is too strong, because few of our beliefs, including our perceptual beliefs, are justified on the basis of other beliefs. A weaker version of the normative sense of justification would be to claim that we are permitted to hold a belief if we do not have a good reason for thinking it is false. Beliefs can be defeated by other beliefs, and upon this construal of justification we are justified in holding a belief if that belief is not defeated by some other belief.<sup>5</sup>

I think it is clear that our perceptual beliefs are justified in this normative sense; we do not have a good reason for thinking our perceptual beliefs are false. In contrast, one might claim that our beliefs about unobservable entities are not justified in this normative sense because we do have a reason to believe that they are false. Throughout history scientists have believed in unobservable objects that we now know do not exist. Examples of this are calorics, phlogiston, and the ether. I have already argued that our beliefs about unobservables do not appear to be significantly different from our perceptual beliefs in this regard. Neither realist beliefs nor perceptual beliefs are incorrigible, and both are continually revised in light of new experi-



ences or information. Thus it is possible for both perceptual beliefs and realist beliefs to be justified in the normative sense of justification.

Let us now consider our other sense of justification, that of being in an epistemically good situation. This conception of justification does not construe justification as something internal, such as fulfilling intellectual obligations, but rather it has to do with external aspects of the epistemic situation that contribute to the fulfillment of our epistemic goals. There are many different accounts of this type of justification, depending on what people think is crucial to being in a good epistemic situation. In the following we will take the accounts given by Dretske, Goldman, and Plantinga to be representative of this type of justification. These philosophers give analyses of knowledge, but since justification is intimately connected with knowledge, we can investigate whether our realist beliefs can constitute knowledge. Certainly a realist would be satisfied if it turned out that our beliefs about unobservable entities constituted knowledge. Although the theories we will look at are quite complicated, I will look only at the aspects of the theory that are relevant to realism. In particular, I will not attempt to provide any assessment of these theories. Our goal is simply to see what these accounts of knowledge would say about unobservable entities.

According to causal theories of knowledge we have knowledge if there is an appropriate causal relation between some state of affairs and our beliefs. A leading proponent of a causal theory of knowledge is Fred Dretske. Dretske proposes the following account of knowledge:

K knows that *s* is *F* = K's belief that *s* is *F* is caused (or causally sustained) by the information that *s* is *F*. (1981, p. 86)

A simple perceptual belief, such as the mountain is steep, is knowledge if somehow the mountain being steep causes us to have the belief that the mountain is steep. Of course the analysis is more complicated, since it involves the idea of information, but that does not affect the present discussion. In order to have knowledge that an unobservable entity exists, the existence of the unobservable entity would have to cause us to believe that the entity exists. If unobservable entities exist this situation would seem to occur all the time. For example, an electron in a cloud chamber might cause a visible track, which might cause us to form the belief that an electron is in the cloud chamber. Since the electron's existing caused our belief that the electron exists, we would have knowledge that the electron exists. Similar examples could be constructed with other beliefs, such as a particle having a certain spin, momentum, position, or velocity. Hence, according to this theory of knowledge, realist beliefs about unobservables constitute knowledge just as our perceptual beliefs are knowledge.

Another important account of justification is reliabilism. Although there are many forms of reliabilism, a classic version is due to Alvin Goldman. Goldman proposes the following:

If *S*'s belief in *p* at *t* results from a reliable cognitive process, and there is no reliable or conditionally reliable process available to *S* which, had it been used by *S* in addition to the process actually used, would have resulted in *S*'s not believing *p* at *t*, then *S*'s belief in *p* at *t* is justified. (1979, p. 20)

The basic idea of this analysis is that a belief is justified if it is the result of a reliable belief producing mechanism. Thus our perceptual beliefs are justified if the belief producing mechanism that produces them is reliable. The same situation holds for beliefs about unobservable entities. If the methods used to detect and learn about unob-

servable entities are reliable, then those beliefs are justified (assuming they are not defeated by some other reliable belief producing mechanism). Whether or not realist beliefs are justified according to reliabilism depends on whether they are the result of reliable belief producing mechanisms.

According to Alvin Plantinga being in an epistemically good situation is dependent upon our cognitive faculties functioning properly. Plantinga says:

... a belief B has positive epistemic status for S if and only if that belief is produced in S by his epistemic faculties working properly in an appropriate environment ... (1986, p. 17).

According to this account our perceptual beliefs are justified if they are the result of properly functioning cognitive faculties. The same is true of belief in unobservable entities. If our cognitive faculties are functioning properly in producing beliefs about them, then those beliefs are justified. Hence according to Plantinga it is possible for realist beliefs to be justified; it depends on whether our cognitive faculties are functioning properly.

We have seen that on the above accounts of knowledge realist beliefs about unobservable entities are not excluded from being cases of knowledge. But what is important is that according to those theories we could be in an epistemically good situation even if our beliefs are underdetermined by the empirical evidence. Skeptical arguments rely on a gap between our experience and perceptual beliefs, or experience and realist beliefs, to conclude that our perceptual beliefs or realist beliefs are not justified. The above accounts of knowledge grant that there is a gap between our experience and our beliefs, but they deny that this prevents them from being justified. According to the skeptic it does not matter if our beliefs are actually causally connected with their subject, are a result of a reliable belief producing mechanism, or are the result of properly functioning cognitive faculties; what matters is that error is conceivable. But according to the theories discussed the possibility of error is not detrimental to knowledge; eliminating the possibility of error is not necessary to being in an epistemically good situation. Hence the traditional skeptical arguments have no force against the type of theories we discussed. We also saw that upon a normative account of justification there is no relevant difference between our perceptual beliefs and realist beliefs. Hence the skeptical arguments discussed at the beginning of this paper are unsuccessful. Skepticism about perceptual beliefs or realist beliefs is not supported by the underdetermination of theory by evidence. We have no reason to think that our realist beliefs are worse off than our perceptual beliefs in this regard.

#### 4. Realist Beliefs About Theories

The above defense of realism was limited to realism about unobservable entities; we must now inquire as to whether we can give a similar defense of realist beliefs about scientific theories. The important issue is whether a belief that a certain scientific theory is true is formed in direct response to experience or whether it is inferred from other beliefs we have. I propose that most of our realist beliefs about theories are formed on the basis of other beliefs we have, and beliefs about the predictive success, simplicity, and coherence of a theory often form the basis of an inference that the theory is correct. The inference may not be an easily recognized deductive or inductive form of argument; what is important is that the realist belief is inferred from other beliefs. Furthermore, the justification of the realist belief depends upon inferences from other beliefs. All such inferences to the truth of a theory are suspicious to me, and I am not inclined to accept realism about scientific theories. However, this is

not the place to discuss various arguments for realism about theories. I am interested in whether it is plausible to claim that realist beliefs about theories are directly justified by experience much as our perceptual beliefs and realist beliefs about entities are. Although I believe most of these realist beliefs about theories are based on inference, one might read Kuhn as claiming that in some instances of theory change the scientist simply changes how he sees the world. In discussing paradigm change Kuhn says "Scientists then often speak of the 'scales falling from the eyes' or of the 'lightning flash' that 'inundates' a previously obscure puzzle, enabling its components to be seen in a new way that for the first time permits its solution." (Kuhn 1970, p. 122) It sounds as if Kuhn is describing a situation where the scientist doesn't infer that the theory is correct, but rather suddenly 'sees' that it must be true. More study is needed here, but if scientists really are forming some realist beliefs about theories directly from experience we would have to investigate whether this practice is justified according to a reasonable account of justification.<sup>6</sup> There appear to be relevant differences between realist beliefs about theories and ordinary perceptual beliefs; thus I am skeptical that realist beliefs about theories can be directly justified by experience.

## 5. Concluding Remarks

In the above I have attempted to give a defense of realism about unobservable entities that avoids the problems with many current defenses of realism. Most defenses of realism construe our realist beliefs as the result of reasoning about evidence we have. I think all such arguments for realism fail. In order to defend realism, and in order to be true to experience, we should consider realist beliefs as being formed on the basis of experience and not on the basis of belief in other propositions. Realist beliefs are justified directly on the basis of experience, and not on the basis of being inferred from other beliefs. We then saw that there is little relevant difference between perceptual beliefs and realist beliefs. I argued that upon current theories of justification or knowledge it is possible that realist beliefs are directly justified by experience. According to these theories of knowledge and justification it does not matter if our beliefs are underdetermined by the evidence; hence the major skeptical argument presented at the beginning of this paper is defused. This does not mean that scientific realism is justified; I have only attempted to show how scientific realism can be given a better defense than is normally given. There are many ways an antirealist could claim that beliefs about unobservables differ from perceptual beliefs. For example, on Plantinga's account of knowledge it may be the case that our cognitive faculties are functioning properly when forming perceptual beliefs, but they malfunction when forming certain realist beliefs. Or in a reliabilist framework, it may be the case that the belief producing mechanisms that result in perceptual beliefs are reliable, whereas the ones that result in beliefs about unobservables are unreliable. If so, then there is an epistemic difference between perceptual beliefs and beliefs about unobservables. But such epistemic differences are independent of any underdetermination of theory by evidence. The debate over scientific realism should begin to focus on whether realist beliefs are significantly different from perceptual beliefs and on whether they can be directly justified by experience, instead of on whether realist beliefs can be inferred from other beliefs we have.

## Notes

<sup>1</sup>I would like to thank Davis Baird, Alvin Plantinga, and Fred Suppe for comments on an earlier version of this paper.

<sup>2</sup>"... it still remains a scandal to philosophy and to human reason in general that the existence of things outside us (from which we derive the whole material of knowl-

edge, even for our inner sense) must be accepted merely on *faith*, and that if anyone thinks good to doubt their existence, we are unable to counter his doubts by any satisfactory proof.”(Kant 1929, p. 34n)

<sup>3</sup>By using the term ‘basic beliefs’ I am not endorsing a foundationalist account of knowledge; I just mean that some of our beliefs are directly justified by experience and not by other beliefs we have.

<sup>4</sup>This position is similar to one that Arthur Fine argues for. Fine argues that our ordinary beliefs and scientific beliefs have the same epistemic status, and thus we should accept both:

Even if the realist happens to be a talented philosopher, I do not believe that, in his heart, he relies for his realism on the rather sophisticated form of abductive argument that I have examined and rejected .... Rather, if his heart is like mine (and I *do* believe in a common nature), then I suggest that a more simple and homely sort of argument is what grips him. It is this, and I will put it in the first person. I certainly trust the evidence of my senses, on the whole, with regard to the existence and features of everyday objects. And I have similar confidence in the system of “check, double-check, triple-check” of scientific investigation, as well as the other safeguards built into the institutions of science. ... One can summarize this homely and compelling line as follows: it is possible to accept the evidence of one’s senses and to accept, *in the same way*, the confirmed results of science only for a realist; hence, I should be one (and so should you!). (1984, p. 95)

<sup>4</sup>See Pollock (1986) for a discussion of ways in which beliefs can defeat other beliefs.

<sup>5</sup>Even if we assume scientists form beliefs about theories in direct response to experience, an interesting question arises as to what type of beliefs are directly formed. It may be the case that the beliefs formed are not realist beliefs, but rather beliefs that the theories are empirically adequate.

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