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I

Being able to make correct novel predictions has long been trumpeted as one of the most important virtues a scientific theory could have. Imre Lakatos (1970, pp. 91-195) has even gone so far as to claim that a research program can supersede its rival only by making some correct novel predictions. Others have based an entire defense of realism on the claim that realism is the only adequate explanation of the success of scientific theories, particularly their success in making correct novel predictions.[1] For still others, the ability of the theories of science to make correct novel predictions (and hence be tested) is what separates science from other explanatory enterprises, such as history, economics, natural theology, and psychoanalysis.[2]

From Christopher Clavius in the sixteenth century to the present, the ability of a theory to make correct novel predictions has been accorded, at the very least, a special epistemic value: in addition to Clavius, one can cite authors as diverse as Leibniz, Robert Boyle, William Whewell, C. S. Peirce, and more recently Lakatos and Ronald Giere among others.[3] Specifically, many philosophers have claimed that, everything else being equal, we should have more confidence in a theory if it correctly *predicts* a set of data, or phenomena, than if it *accommodates* the data.[4] Indeed, in a recent article Michael Gardner tells us that this position is part of a "lengthy tradition-not to say consensus-in the philosophy of science" (Gardner, 1982, p. 1). There have been a few dissenters from this tradition, however, most notably John Maynard Keynes. For instance, in response to C. S. Peirce, Keynes writes: "The peculiar virtue of prediction or predesignation is altogether imaginary" (1921, p. 305). I too am one of the dissenters: I shall argue that Keynes is basically right, that at least when it comes to the truth of a theory, the *special* virtue of prediction is "altogether imaginary." Before presenting the

the details of my argument, however, it will be helpful to consider some reasons classically presented for and against giving prediction a special epistemic status. Those who want to attach a special epistemic value to prediction typically contend that, everything else being equal, scientists put more confidence in a theory that *predicts* some phenomenon than one that was merely *designed to account for* that phenomenon. In support of this contention, they cite various historical examples in which the scientists involved in judging the merits of a theory seem to have attached a special epistemic value to prediction. Consider, for instance, the famous case cited by Ronald Giere, that of Fresnel's wave theory of diffraction, and its prediction of a bright spot at the center of a shadow produced by a circular disk (1983, pp. 279-87). According to Giere's rendition of the episode, in the years 1810 to 1818, the French Academy of Sciences offered a prize for the best treatment of diffraction, a prize that Fresnel eventually won for his wave model. Initially, the Commission was not persuaded by the evidence Fresnel presented, partly, no doubt, because most members of the Commission (e.g., Laplace, Poisson, and Biot) were advocates of the particle theory of light. A correct novel prediction of Fresnel's model discovered by Poisson, however, eventually persuaded the Commission. Poisson applied Fresnel's model to the case of a shadow produced by a circular disk and concluded that the resulting diffraction pattern should have a bright spot at the center. According to current particle models, such a bright spot was not supposed to appear. And, apparently, the members of the Commission did not expect it to appear; indeed, they thought this prediction of the bright spot was a *reductio* of Fresnel's model. When, however, Francois Arago performed the experiment, and the bright spot appeared as predicted, the commissioners were persuaded to give the prize to Fresnel.

According to Giere, it was because Fresnel's model *predicted* the bright spot that the commissioners were persuaded. Giere implies that if the appearance of such a bright spot were common knowledge at the time Fresnel developed his model, and he specifically developed his model to account for the bright spot, it is unlikely that the members of the Commission would have been persuaded. For, Giere notes, they were not persuaded by Fresnel's success in explaining the diffraction pattern of straight edges, a pattern which, by Fresnel's own account, he designed his model to account for. Hence, Giere claims, it seems that in the case of the bright spot, the commissioners considered prediction to have more epistemic value than accommodation.

On the other hand, the opponents of attaching a special epistemic value to prediction argue that the way in which a theory was discovered or constructed, or when it was developed, is not, in and of itself, relevant to whether or not it is true. For instance, according to Keynes,

> It is the union of prior knowledge, with the inductive grounds which arise out of the immediate instances, that lends weight to an hypothesis, and not the occasion on which the hypothesis is first proposed. (Keynes, 1921, p. 305)

Thus, according to Keynes, what determines the probability of a theory being true is what he elsewhere calls "general considerations"; hence, he claims, the information that a theory *predicted,* instead of accommodated, a set of data is epistemically relevant only insofar as it provides us with relevant information about these general considerations:

> The fact that the theory which precedes the statistics is more likely than the other to be supported by general considerations-for it has not, presumably, been adopted for no reason at all-constitutes the only valid ground for this preference. If it does *not* receive more support than the other from general considerations, then the circumstances of its origin are no argument in its favor. (1921, pp. 305-306)

I shall call these "general considerations" the *structural/ relational features* of a theory; these are the features pertaining to the structure of the theory, its relation to background theories and assumptions, and its relation to the relevant extant empirical data, but not pertaining to how or when it was discovered or constructed.[5]

As it stands, the argument for each position is less than entirely convincing. Regarding the first argument, scientists could be mistaken in attaching a special epistemic value to prediction, or philosophers could be misinterpreting what the scientists are doing.[6] As for Keynes's argument, he seems to take it as obvious that, apart from providing us with information regarding the structural/relational features of a theory, the origin of a theory is irrelevant to its truth. But considering that many philosophers and others disagree with Keynes, it is not obvious that he is right. His claim needs to be argued for, not merely stated. I shall present a two stage argument for his position. First, I shall present a direct argument for his position; second, I shall attempt to expose the mistaken (as I see it) assumptions underlying the opposing position.

II

Making the Claims More Precise

I shall use *'SEP'* to denote the claim that prediction has some special epistemic status, and *'-SEP'* to denote the opposing claim. The first order of business is to make SEP more precise. To do this, we first need precise definitions of "accommodation" and "prediction."

Definitions

Prediction: Let H be a scientific theory, let B_0 represent some subset of the background information available at the time H was developed, and let Q be some phenomena or data not entailed by B_0 alone.[7] Theory H *predicts* Q if there exists a B_0 such that H&B_0 entails Q, and H (when conjoined with B_0) was *not designed* to entail Q. H *correctly* predicts Q if H predicts Q and data, or phenomena, Q exist.

Accommodation: Same as prediction except that H (when conjoined with B_0) was *specifically designed* to entail Q.[8] (For convenience, throughout the rest of this paper I shall say *H entails Q* instead of $H\&B_0$ entails Q, although the latter is always meant.)

Two remarks are in order regarding the above definitions. First, the above definitions do not require that a theory **H** be propounded prior to the discovery of **Q in** order for it to predict Q. For example, the degree of the precession of the perihelion of Mercury was already known before the development of general relativity, but, because general relativity was not designed to entail the correct amount of precession, it is nonetheless usually considered to have correctly predicted it.

Second, given the above definitions, what differentiates accommodation from prediction is the occurrence of certain psychological processes **in** those who developed **H:** namely, those processes involved in *attempting* to construct **H** in such a way that it entails Q (for making such an attempt, and succeeding, is just what it means to *design* **H** to entail Q). If those psychological processes occurred, then **H** accommodates Q; if they did not occur, then **H** predicts Q. Whether or not prediction has any epistemic value over accommodation, therefore, depends entirely on whether or not, in general, the information that such processes occurred should decrease our confidence in the truth of **H,** given that we already know that **H** entails Q. I shall argue that such information should not, as a general rule, decrease our confidence in H's truth, and thus that prediction has no special epistemic value.

Besides clarifying the definitions, we need to clarify the nature of the debate over the epistemic value of prediction. To begin with, all sides to the debate agree that knowing that a theory predicted, instead of accommodated, a set of data can give us an additional reason for believing it is true by telling us something about the structural/relational features of the theory.[9] For, because of the natural tendency to add special *(ad hoc)* hypotheses to a theory to make it account for a set of data, it is a rather trivial point that, everything else being equal, we should expect a theory that predicts a set of data to provide a more unified (or simple) account of the data than one that accommodates it. Thus, as Michael Gardner (1982, pp. 1-15), Paul Horwich (1982, pp. 110-17), and George Schlesinger (1987, pp. 33-42) make clear, and as can be seen from the passage from Keynes cited above, the real issue behind the debate is whether or not prediction has some epistemic value over and above that resulting from our lack of knowledge of the structural/ relationalfeatures of a theory. Put differently, the issue is whether or not the information that a theory predicted, instead of accommodated, a set of data should increase our confidence in the theory *given that we already know the relevant structural! relational features of the theory*. The proponents of the special epistemic value of prediction (SEP) say it should; the opponents, such as Keynes in the passage cited above, say it should not.

To see the issue more clearly, consider a concrete illustration. Suppose you are an expert on general relativity (GR): you know all about its structure (for instance, its various equations and their interrelations with one another) and all the known data it is purported to explain; but, because of some doubts about whether Einstein knew of the correct degree to which light bends around the sun before his final development of GR in 1915, you do not know whether GR accommodated or predicted the correct degree of bending. Now suppose you discovered that GR actually predicted, instead of accommodated, the bending. The proponents of SEP would say that your discovery should have increased your confidence in the truth of GR; the opponents would say that it should not.

Before presenting my argument against SEP, it is worthwhile to look a little more closely at how the information that a theory predicted a set of data might tell us something about the structural/relational features of the theory relevant to its truth. Generally, if **H** predicts Q it is also a good, or even the best, explanation of the other relevant extant data E. For, since **H** was not designed to entail Q, its initial merit (before it was found to account for Q) would rest solely on its ability to explain E. For example, Fresnel's wave model of light must have been a reasonable explanation of the various properties of light known in 1810 before the discovery of the bright spot mentioned above, for, otherwise, it is very unlikely Fresnel would have proposed it or anyone would have taken it seriously. On the other hand, if H accommodates Q, it will not necessarily be a very good explanation of the other extant data E: other theories might explain E much better, but they are ruled out because they cannot account for Q. Thus, the fact that **H** predicts **Q** tells us that **H** has a certain important merit that, ifH accommodates **Q,** we have no reason to expect it to have: namely, the merit of being a good, or the best, explanation of E.

I shall call this merit "unifying power," for I think it is a precise way of spelling out at least part of what philosophers such as Michael Friedman (1983) mean by theoretical unification. It is also easy to see why one might think that this sort of unifying power gives us a reason to believe a theory is true. Consider a theory **H** that both entails Q and entails E. From a realist perspective, if, besides merely entailing E, **H** is a good explanation of E, it is reasonably likely that **H** is true on evidence E alone. But this will not be the case if **H** fails to provide a good explanation of E. Hence, assuming that the boost of confirmation **H** gets from **Q** (by virtue of the fact it entails Q) does not significantly depend on how well it explains E, **H** will be more probable on E & Q if it is a good explanation of E than if it is not. **It** follows, therefore, that **H** is more probable on E & Q if it unifies E & Q than it would otherwise be. So, from a realist perspective, it is easy to see why this sort of unifying power is considered a merit.

Finally, to illustrate the above points, it is worth looking at a case in which the above considerations regarding the structure of a theory can come into play in such a complex way that it is easy to be fooled into thinking that prediction has some special epistemic value. Consider Freud's psychoanalytic theory and Karl Popper's criticism of it. Karl Popper criticized Freud's theory because it could account for practically any case of human behavior; thus, he concluded, its ability to account for any individual case of behavior does not really confirm it. For instance, Popper cites how Freud's theory could account for two opposing behaviors (a man who deliberately drowns a child and a man who sacrifices his life to save a child) by means of repression and sublimation, respectively (1963, p. 35). From our perspective, it is easy to see why the behaviors Freud's theory "explained" do not count much in its favor. The problem is not that Freud's theory accommodated these behaviors, but rather that, strictly speaking, in accounting for them, his theory changes: that is, to account for them, the person using Freud's theory must change his theory by adding new hypotheses to it-e.g., hypotheses concerning who is suffering from repression and who from sublimation.[10] Consequently, the support coming from the additional behavior this new, changed theory explains is at least partially offset by its added complexity as compared to the old theory. Accordingly, in opposition to what one might initially think, it is not necessarily because Freud's theory accommodates, instead of predicts, a behavior that the behavior does not count in favor of the theory; rather, it might be because his theory must be made more complex to account for the new behavior.

The Argument Against SEP

Now, as stressed above, the fundamental issue underlying the accommodation/prediction debate is whether or not the information that a theory predicted instead of accommodated a set of data should increase our confidence in its truth *given that we already know the relevant structural/relational features of the theory.* I shall argue that it should not. First, I shall argue that there is no plausible, non-mysterious way in which the information that a theory predicted, instead of accommodated, a set of data could affect our confidence in the truth of a theory, except by telling us something about the structural/relational features of the theory-something excluded by the stipulation made above that we already know these features. Second, I shall argue that the reasons commonly offered for thinking that prediction has some special epistemic value fail.

As mentioned above, what distinguishes H's accommodating Q from H's predicting Q is the occurrence of certain psychological processes in those who constructed H, namely, those processes involved in *attempting* to construct H in such a way that it entails Q. So, given, as we are assuming, that we already know that H entails Q (since this is one of the structural/relational features of **H**), the information that **H** accommodates Q is equivalent to the information that the above mentioned psychological processes took place, whereas the information that **H** predicts Q is equivalent to the information that they did not take place. We shall let A denote the claim that these psychological processes took place (since their occurrence corresponds to the case of accommodation), and **P** denote the claim that they did not take place (since their non-occurrence corresponds to the case of prediction).

Now, given that we know the relevant structural/relational featu!es of **H** as stipulated above, neither the information that A is true, nor the information that **P** is true, could affect our confidence in the truth of **H** by affecting our confidence in the structural/relational features of **H.** Hence, the only way such information could affect our confidence in the truth of **H** is by directly affecting our confidence as to whether or not the physical states of affairs that **H** asserts obtain, actually obtain.[11] For instance, given that we know the structural/relational features of general relativity (GR), the only way that the information that Einstein had certain intentions (e.g., those corresponding to the case of accommodation) could affect our confidence in GR is by affecting our confidence in the existence of those states of affairs that GR asserts obtain-e.g., the states of affairs consisting of free particles following geodesics, of space-time being curved to the degree given by Einstein's field equations, and the like.

So, our question is, How can the information (i.e., either A or **P)** that certain psychological processes did or did not take place in the mind of those who developed **H** affect our confidence as to whether or not the relevant physical states of affairs obtain? To begin answering this question, consider two arbitrary concrete state of affairs, S_1 and S_2. Usually, the information that S_1 obtains would rationally affect our confidence that S_2 obtains by what I shall call *C-affecting* our confidence, where the information that S_1 obtains *C-affects* our confidence that S_2 obtains if and only if it (rationally) affects our confidence in S_2 obtaining *because* we believe, or suspect, that there is some (relevant) causal or lawlike connection between S_1 obtaining or not obtaining, and S_2 obtaining or not obtaining. For example, given that we did not already know that Jane is a smoker, the information that Jane has lung cancer **(S_1)** typically would (rationally) affect our confidence that she is a smoker **(S_2)** because we believe, or suspect, that there is some causal, or lawlike connection between smoking and lung cancer; **it** is the believed or suspected causal connection that makes the one state of affairs relevant to the other: if we did not believe or suspect that there was such a connection, the fact that Jane has lung cancer should be no more relevant to her being a smoker than, say, to her having blond hair.

Alternatively, consider a jury deliberating about whether or not a defendant intended to murder the victim. Pieces of evidence such as a fired gun, alcohol in the bloodstream, or fingerprints normally would be relevant. The reason is that we know of various relevant causal or lawlike connections between intending to murder and these sorts of facts-for example, we know that alcohol in the bloodstream tends to make people lose control, and thus in many circumstances can lead people to murder, or intend to murder. In contrast, such pieces of evidence as that the defendant ate glazed doughnuts for breakfast would normally not be relevant, unless the prosecution could show some relevant causal or lawlike connection between the eating of glazed doughnuts and intending to murder.

Now, in order to determine whether the information that A is true (or the information that P is true) could *C-affect* our confidence in the truth of H, we need to consider the various types of causal connections that might exist between the (psychological) state of affairs corresponding to A (or to P) and the states of affairs that **H** asserts obtain.[12] For concreteness, let **H** be general relativity **(GR),** and let A be the claim that Einstein attempted to find a theory (general relativity) that entails the correct degree to which light bends around the sun, and let **P** be the claim that Einstein did not make such an attempt. The question we then need to consider is: What relevant causal or lawlike connections might exist between the states of affairs that GR asserts are actual-such as that space-time is curved-and the relevant psychological occurrences corresponding to A, or to P?

One relevant causal or lawlike connection is the one between the states of affairs that GR asserts are actual and certain experimental data Einstein or some other scientist in the community had access to, data which in tum is relevantly connected to Einstein's intentions. For instance, if space-time is really curved to the degree GR says it is, then this fact will be causally responsible for the degree to which light bends around the sun. This degree of bending, in tum, could be relevantly connected, in a lawlike way, to Einstein's intentions: e.g., if the degree of bending was measured before 1915, and Einstein knew about the measurement, it is likely he would have attempted to make GR entail the correct degree of bending.

Consequently, because of this lawlike connection, knowing that Einstein attempted to make GR entail the correct degree of bending could give us reason to believe that GR actually does entail it, and thereby give us additional reason to believe in GR. However, this could only be the case if we did not already know that GR entails the correct degree of bending; but this is something we do know since, by assumption, we know the relevant structural/relational features of GR. Thus, the information that A is true (or the information that P is true) cannot affect our confidence in the truth of GR in this way.

Certainly, however, given the complexity of causal connections in the world, there are probably a myriad of other ways in which, for instance, the curvature of space-time is connected in a causal or lawlike way with Einstein's psychological state, much as it is probably connected to the number of hairs Einstein had on his head, or what he usually ate for breakfast. But there is no reason to believe or suspect that any of these ways is relevant: knowing the relevant intentions of Einstein when constructing GR should no more affect our confidence in the truth of GR (because we believe or suspect that this myriad of causal connections exists) than knowing that Einstein ate oatmeal for breakfast should affect our confidence in the truth of GR (because we recognize there is probably a myriad of causal connections between the curvature of space-time and Einstein eating oatmeal). So, I conclude, the information that A is true (or the information that P is true) does not *C-ajfect* our confidence in GR given that we know the relevant structural/relational features of **GR** as stipulated above.

Of course, there are other ways that the information that one fact is the case can (rationally) affect our confidence that another fact is the case, besides C-affecting our confidence. For instance, the information that masses always attract each other here on earth gives us some reason to believe they always attract each other in other parts of the universe, even parts that are causally disconnected from ours, for a universe in which masses always attract each other is simpler than one in which they do not. Or, suppose God told us that most true theories that either have been or will be produced accommodate the set of data they are (or will be) known to entail. In such a situation, the information that A is true (or Pis true) would certainly be relevant to the truth of H. Or, again, A (or P) could be relevant to the truth of H in some direct, non-causal way, as, for instance, from a realist perspective, the simplicity of a theory is relevant to its truth. Nonetheless, although these are all *possible* ways in which the information that A is true or the information that P is true could affect our confidence in the truth of H, none of them seems very plausible.

It appears, therefore, that for the typical scientific theory H, there is no non-mysterious, plausible way that the information that A is true (or the information that Pis true) could (rationally) affect our confidence in the truth of **H,** given that we know the relevant structural/relational features of **H** as stipulated above. Thus, we can conclude, there does not appear to be any plausible, non-mysterious way in which prediction could have a special epistemic value.

Of course, the fact that we cannot find a non-mysterious connection does not *prove* that there is *no* connection. For instance, proponents of the special epistemic status of prediction (SEP) could either claim that there is some relevant, non-mysterious connection between A (or P) and the truth of H that we have not yet discovered, or they could simply claim that the connection is *sui generis.* Although they could do this, I take it to be a methodological rule that one should not invoke *sui generis* relations or claim that there are relations we have not yet discovered (even though we have looked very hard) unless one has good grounds for doing so. Unless one adopts something like this as a methodological rule, it seems that the door is open to all kinds of irrationalism. Moreover, we normally act in accordance with this methodological rule: if the prosecution in the "jury" example above claims that the defendant's eating glazed doughnuts for breakfast is evidence that the defendant intended to murder, we would demand that she demonstrate some kind of connection between the eating of glazed doughnuts and intending to murder. Clearly, it would not be sufficient for her merely to claim that there was some *sui generis,* or simply unknown, connection between the two. Similarly, it is not sufficient for advocates of SEP to claim that there is some unknown, or *sui generis,* connection between prediction and the truth, unless they can offer us some good reasons for thinking such a connection exists.

I shall now examine the major reasons typically offered and argue that they all fail.

III

The following is a list of three commonly offered reasons for SEP.

Reason 1

As we saw at the beginning of this paper, one reason often cited in favor of SEP is the claim that scientists accord more weight to prediction than accommodation. But this fact is perfectly compatible with the denial of SEP, for the tendency of scientists to attach more weight to prediction can easily be explained by noting that theories that predict a set of data are more likely to provide a unified account of the data than ones that merely accommodate the data. What the proponents of SEP must show is that scientists do not attach more weight to prediction merely because it tells them something about the structural/relational features of a theory. As far as I know, no one has shown this. Indeed, historian of science Stephen Brush (1989) claims that scientists generally do not attach any special weight to prediction, though it should be noted that Brush mainly addresses the issue of the special epistemic value of temporally novel predictions such as general relativity's prediction of the bending of light around the sun; and, as noted in note 6, John Worrall (1989, pp. 135-57) makes a similar claim about Fresnel's novel prediction of the bright spot. But, even if someone were to show that scientists generally attach a special epistemic value to prediction, it would not count as very strong evidence in favor of SEP: the scientists who attach a special epistemic value to prediction could simply be mistaken for the same reasons as philosophers who advocate SEP.

Reason 2

The reason given here is a simplification of that presented by Giere (1983, pp. 277-92). Giere's basic idea is that if a theory is false, it is unlikely for it to correctly predict phenomena, [13] but if it is true, then, in general, it is *not* unlikely for ii to correctly predict phenomena. Thus, our discovery that a theory **H** correctly predicts a phenomenon Q confirms it (i.e., it raises its probability of being true). In contrast, he tells us, "It is not in fact unlikely that a model designed to accommodate a given result should in fact do so. And this is true no matter whether the corresponding hypothesis is true or false" (p. 286). Thus, in contrast to the case of prediction, our discovery that a hypothesis accommodates a certain result does not significantly confirm the hypothesis, for it would be about as likely to accommodate the result whether it were true or false. Consequently, in general, prediction confirms a hypothesis more than accommodation. The reasoning here is subtly faulty. **H** *correctly* predicts Q if and only if the following conjunction is true: *H entails Q* and *H was not designed to entail Q* and *Q is the case.* Clearly, the truth or falsity of His irrelevant to whether or not **H** entails Q (the first conjunct), since H's entailing Q (given the appropriate background information) is a necessary truth. And similarly, in general the truth or falsity of **H will** be practically irrelevant to the truth of the second conjunct: e.g., the commissioners would have judged it unlikely that Fresnel deceived them and really designed his model to accommodate the bright spot whether or not they believed his model was true. Thus, presumably, what makes it unlikely that **H** correctly predicts **Q** when **H** is false (but not when it is true) is the last conjunct: **Q** is unlikely to be the case if **H** is false. For example, if the commissioners had believed that Fresnel's wave theory is false, they probably would have thought that the existence of the predicted bright spot is very unlikely. But, if Q is unlikely if His false, then the conjunction *Q is the case* and *H entails Q* and *H was designed to entail Q* will be at least as unlikely, for the probability of a conjunction is always less than or equal to the probability of any one of its conjuncts. But, this latter conjunction is just the claim that H accommodates Q. Thus, if it is unlikely for H to predict Q if it is false, then it is unlikely for **H** to accommodate Q if it is false, for in both cases it is unlikely that Q is the case.

Reason 3

The third, and I suspect most important, reason that philosophers and scientists think SEP is highly plausible is that they implicitly assume that the best (or only adequate) explanation of the predictive success of a theory is the hypothesis that it is (approximately) true. (This is the assumption underlying what is known as the explanatory defense of realism [e.g., see Boyd 1984, p. 49].) That is, if a theory H correctly predicts a significant set of data Q, they implicitly assume that the best explanation of this fact is that His true; for, they reason, if His false-if it does not adequately reflect reality-it would be very unlikely for it to be predictively successful. But, if a theory successfully accommodates a set of data, it does not seem we need to invoke any hypothesis about the truth of the theory to explain this fact: the explanation in this case appears to be merely that it was designed to account for the data. So, they conclude, the fact that a theory correctly predicts a set of data gives us some special reason to believe that it is true, a reason not available in the case of accommodation.[14]

This reasoning is faulty. Here is why. The truth of a theory **H** does *not* explain why it *predicts* a set of data Q, for a theory **H** predicts Q if and only if **H** entails Q, and **H** was not designed to entail Q. If **H** entails Q, that fact is a necessary truth, and therefore would be true whether **H** is true or false-for example, general relativity would still entail the bending of light around the sun even if space-time were not curved. So, the hypothesis that **H** is true does not explain why **H** entails Q. Moreover, neither does it, in general, explain why **H** was not designed to entail Q: for instance, the fact that space-time is curved does not explain why Einstein did not design his theory to entail the bending of light around the sun.

The only thing the truth of **H** could explain is the fact that **H** *correctly* predicts

Q. But for **H** to correctly predict **Q** is just for **H** to predict Q and for Q to be the case. Thus, since the truth of **H** does not explain the fact that H predicts Q, it can only explain why **H** correctly predicts **Q** by explaining why **Q** is the case.[15] Consequently, if the truth of **H** is the best explanation for why **H** correctly predicts Q, it is because it is the best explanation for why **Q** is the case. But if the truth of **H** is the best explanation for why **Q** is the case, it will be the best explanation for this fact whether **H** predicts or accommodates Q. For instance, if the curvature postulated by general relativity is the best explanation of the bending of light around the sun, it will be the best explanation of this fact whether or not general relativity was designed to account for the bending. For to say that such a curvature is the best explanation of the bending is simply to say that no other postulate explains the bending better, and whether or not this is the case is certainly not dependent on how general relativity was developed. Thus, if the truth of His the best explanation of why **H** correctly predicts phenomenon Q, it will also be the best explanation for why **H** accommodates Q, for in both cases what is being explained is why **Q** is the case. [16]

Conclusion

The result that prediction does not have any special epistemic value over accommodation (-SEP) is not a trivial result. Here, in brief, are a few of the important consequences that follow from -SEP. First, -SEP overturns what Michael Gardner (1982, p. 1) calls the "lengthy tradition-not to say consensus-in the philosophy of science" according to which, everything else being equal, prediction is of more epistemic value than accommodation. Second, -SEP helps to re-establish the confirmation/discovery distinction advocated by the positivists, a distinction that has fallen out of favor in recent philosophy of science: as the positivists claimed, the probability of a theory being true is not intrinsically dependent on the way it was discovered. Third, **-SEP** undermines any epistemological justification for one of the fundamental claims of Lakatos's theory of scientific methodology, namely, the claim that one research program can supersede another only if, in addition to accounting for the data the other research program accounts for, it predicts new, unforseen, phenomena. For, if prediction does not have any special epistemic value with regard to the truth (or empirical adequacy) of a theory, neither does it seem it will have such a value for a research program. [17] Thus, although it still might be true, as Lakatos claims, that scientists choose one research program in favor of another only if the successor program makes some novel predictions, -SEP, and its analogue in terms of empirical adequacy, show that this way of selecting programs is not epistemically justifiable.[18]

Finally, -SEP casts doubt on the epistemic value of a common distinction between science and other explanatory enterprises such as history, natural theology, economics, and psychoanalysis-the distinction according to which science has been considered a superior form of knowledge to these other enterprises because scientific theories make new predictions, whereas the theories of these other enterprises merely account for extant data. For if -SEP is true, as far as the truth or the empirical adequacy of a theory is concerned, the ability of a theory to make correct new predictions is not what is ultimately important; rather, what is important is the theory's general structural/relational features. [19]

Notes

'See, for instance, Richard Boyd (1984).

[2]Karl Popper is the most well-known advocate of this claim.

[3]For instance, Whewell writes: "If we can predict new facts which we have not seen, as well as explain those we have seen, it must be because our explanation is not a mere formula of observed facts, but a truth of a deeper kind" (1860, p. 273). Similarly, in various places Peirce advocates the general principle that "A hypothesis can only be received upon the ground of its having been *verified* by successful *prediction"* (e.g., see Peirce, 1965, 2.739). For Boyle, see Laudan (I 981, p. 79); for Clavius, see Jardine (1979, pp. 154-155); for Leibniz, see Leibniz (1969, p. 364); for Lakatos, see Lakatos (1970, pp. 91-195); and, for Giere, see Giere (1983).

[4]Henceforth, the term "prediction" will be used in opposition to "accommodation," that is, as synonymous with "novel prediction": roughly, H *predicts* Q if and only if H entails Q and H was *not designed* to entail Q, and H *accommodates* Q if and only if H entails Q and H was *designed* to entail Q. (More precise definitions are presented later.)

[5] For example, the fact that general relativity (GR) entails the bending of light around the sun would be included in the structural/relational features of GR, but the fact that it predicted instead of accommodated the bending would not, for this latter fact pertains to how the theory was discovered or constructed.

Also, the structural/relational features of a theory H are meant to include all known data that are relevant to the truth of H *because* of H's success, or failure, at explaining that data. In rare cases, the origin of a theory itself could be such a piece of data-for example, if a theory is a sociological theory concerning how scientific theories are developed. Because of problems this creates for the above definition, the ensuing discussion is not meant to be applicable to such theories.

[6]At least in the case of Fresnel's bright spot, the latter appears to be the case. In a recent article John Worrall presents a convincing case that, contrary to what Giere and others claim, the prediction of the bright spot by Fresnel's model played only a minor role in its acceptance (1989, pp. 135-157).

[7]If the background information entails Q, then B_0 will be a proper subset of the background information. If it does not entail Q, then B_0 will simply be all the background information available at the time H was developed.

[8]Under the view that a theory is some sort of abstract object-e.g., a model-it is somewhat paradoxical to speak of a theory H being *designed* to entail a set of data Q, especially if one thinks that abstract objects exist necessarily. (It would be like saying that 2 + 2 was designed to equal 4.) It is therefore perhaps better to say that H was initially selected, chosen, considered, discovered, or accepted because, when conjoined with background assumptions, it entails Q. Despite these points, for convenience I shall continue to speak of a theory as being *designed* to accommodate a set of data. Also, it should be noted that some philosophers who accord a special epistemic value to prediction define it in the sense of forecast: that is, H *predicts* Q if and only if H&B_0 entails Q and H was developed before data Q was discovered. With minor modifications, however, the argument given below against SEP also applies if one uses this definition.

[9]Recall that, as defined earlier, the structural/relational features of a theory are the features pertaining to the structure of the theory, its relation to other background theories, and its relation to the known data.

[10]Such hypotheses usually cannot merely be considered part of the background assumptions, instead of part of Freud's theory, since generally there would be no independent evidence in favor of them.

[11] By *directly affect,* I mean affect without first affecting our confidence in the structural/relational features of H.

[12] Recall that the state of affairs corresponding to A (P) simply consists of the occurrence (nonoccurrence) of a certain set of psychological processes in the scientists who developed H: namely, those processes involved in their attempting to construct a theory H such that it entails Q.

[13] At least in those circumstances involving an "appropriate test" (p. 278).

[14] Paul Horwich (1982, pp. 108-116), Jarrett Leplin (1984, p. 205, note 17), and John Worrall (1989, p. 155), among others, cite this as the reason why philosophers and scientists think that prediction has some special epistemic value. (Leplin and Worrall agree with the reason; Horwich does not.) Also, Keynes (1921, p. 304) credits C. S. Peirce with presenting a similar reason. Horwich's and Keynes's diagnoses of what is wrong with the above reason, however, are different from mine.

[15] I' m assuming here that the truth ofH can explain why H correctly predicts Q only by explaining one of the three facts of which H's predicting Q consists: that is, H's entailing Q, H's not being designed to entail Q, and the existence of data Q. Sometimes one can explain why a conjunction of facts occurs without explaining the occurrence of any of the conjuncts: for example, one could explain the correlation between the outputs of two causally connected random devices without explaining the output of either device by citing the causal relation between them. It does not seem that one can do this for the case at hand, however. For instance, consider how the truth of general relativity (GR) might explain GR's correct prediction of the bending of light around the sun (CPBL). The fact (CPBL) consists of the conjunction of three facts, (BL) & (D) & (E): *light bends around the sun* (BL) and *Einstein did not design GR to entail BL* (D) and *general relativity entails that light bends around the sun* (E). Clearly, since (E) is a necessary truth, the truth of GR cannot explain why (E) is conjoined with (D) and (BL) except by explaining the occurrence of the conjunction (BL) & (D). And, it seems clear, the truth of GR-i.e., the curvature of space-time along with other facts about the world that GR asserts are the case-cannot explain the joint occurrence of (BL) and (D) except by explaining the occurrence of either (BL) or (D).

[16] Another way of seeing this point is to note that any other theory that entails Q will also explain why H's prediction of Q turned out to be correct, even if the other theory is incompatible with H. For example, any of the three known alternatives to general relativity (GR) can explain why GR's prediction of the degree to which light bends around the sun turned out to be correct, for they each entail that light bends to degree D, where Dis the correct degree of bending. Thus the truth of His the only adequate explanation of **H** *correctly predicting Q* if and only if no alternative theory exists that adequately explains Q. But if no such alternative theory exists, then the truth of **H** must also be the only adequate explanation of H's accommodating Q, for H's accommodating Q includes the fact that Q is the case. Consequently, if the truth of His the only adequate explanation of H's predicting Q, it must also be the only adequate explanation of H's accommodating Q.

[17] It should be noted here that my arguments for -SEP work for research programs as well as theories. Also, one can slightly modify my arguments above to show that prediction does not have any special epistemic value with regard to the *empirical adequacy* of a theory or research program.

[18] 0 f course, one could attempt to salvage this aspect of Lakatos's program by introducing, as John Worrall seems to do (1989), a new definition of 'novel prediction' that allows cases of accommodation to count as cases of novel prediction. Such definitions, however, appear quite far removed from the intuitive notion of novelty that seems to underlie Lakatos's views and ones like his.

[19] I wish to thank Arthur Fine, Bas van Fraassen, Vaughn McKim, Alvin Plantinga, and A. A Howsepian for helpful comments on earlier versions of this paper.

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