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SELECTION AND EXPLANATION

1.INTRODUCTION

Explanations appealing to natural selection have an unusual and *prima facie* paradoxical feature. While we may explain general truths using such explanations, those explanations do not transfer to the particular instances of those general truths. Thus natural selection and the selective advantage of speed in escaping predators can explain why healthy, normal, adult gazelles can run fast. Yet such an explanation does not explain why any particular gazelle can run fast—the explanation in individual cases would appeal to the physiology of the animal, in particular its musculo-skeletal structure and heart and lung capacity and so forth. This contrasts with an explanation of why diamonds are hard, which does transfer to individual diamonds. The reason why all diamonds are hard is the same reason why any particular diamond is hard. Such explanations one might call 'particularizable'. Explanations appealing to natural selection are not particularizable.

In this paper I aim to isolate the source of the difference in the two kinds of explanation and thereby resolve the apparent paradox in the case of selection explanations. While the interest in such explanations stems from their use in evolutionary biology, the feature referred to is not limited to biological explanations alone. Any selection explanation has the property of not being particularizable, and it will be helpful in this paper to focus on a non-biological example. A restaurant has a rule that no gentleman will be admitted who is not wearing a tie. We may imagine that the rule is newly introduced and that potential customers do not know about it—and so the rule itself does not influence the wearing of ties on the particular evening we are considering. So it is true on this evening that all the men in the restaurant are wearing ties. And the explanation is a selection one. Many men wanted to dine in the restaurant; only those wearing ties were admitted; the tieless were sent away. But this explanation of the general proposition, that all the men are wearing ties, does not explain why any individual diner is wearing a tie. Mr Grey has just come from his office and is wearing the suit and tie he wears for work; Colonel Black is a very formal gentleman who always wears a tie; Dr White is trying to impress his new date, etc.. So the selection explanation of the general proposition is not particularizable.

2.HEMPEL ON EXPLANATION AND CONFIRMATION

Hempel, as is well known, gave related accounts of explanation and confirmation (Hempel 1965). To *explain* some fact is to cite a law or laws plus other relevant conditions from which the explanandum may be deduced (the deductive-nomological (D-N) model of explanation). To *confirm* a hypothesis is to deduce some observed phenomenon from the hypothesis plus other relevant known conditions (the hypothetico-deductive model of confirmation). Putting these two together tells us that an observation confirms a (nomic) hypothesis if that hypothesis would, if true, explain the observation.

That relationship between explanation and confirmation is itself open to question. Nonetheless it is not far from the truth (c.f. Dretske 1977, p. 261). What I want to focus on is the fact that because of the intimate relationship between the two models, problems for one frequently translate into problems for other. That is, if the relationship is roughly right, then a counterexample to the model of explanation ought to be also a counterexample to the model of confirmation.

An example of this is the following. Achinstein's famous counterexample to the D-N model of explanation cites the law that anyone who ingests a pound of arsenic will die within 24 hours (Achinstein 1983). Jones ingests a pound of arsenic and indeed does die within 24 hours. However shortly after taking the arsenic he is run down by a bus. So in this case the explanandum is deducible from the law and conditions. Yet clearly they do not constitute an explanation. Now imagine that we were *testing the hypothesis* that anyone who ingests a pound of arsenic will die within 24 hours. We see Jones ingest a pound of arsenic and subsequently record the observation that he is dead. Does this confirm the hypothesis? In the light of the additional information that he was killed by the bus, Jones' death provides no confirmation. Thus a counterexample to the D-N model of explanation is readily transformed into a counterexample to the hypothetico-deductive model of confirmation.

I believe that the reverse holds true also. The so-called raven paradox is often held to be the main counterexample to the hypothetico-deductive model of confirmation, although Hempel denied this. We are testing the hypothesis that all ravens are black. We see a white object—we deduce from our hypothesis that it is not a raven. Closer inspection shows that indeed it is not a raven, it is a shoe. The hypothetico-deductive model alleges that we have here a confirmation of the hypothesis. Hempel upholds this, claiming that there is indeed some confirmation, albeit a very small degree of confirmation. However, the intuition of many is that a white shoe has no bearing on the hypothesis concerning ravens.

In favour of the later view, it is telling that the raven paradox translates into a counterexample against the D-N model of explanation. Since I can deduce from the law that all ravens are black that this white object (the shoe) is not a raven, I have, according to that model, an explanation of why the shoe it not a raven. Similarly, the law 'all metals at very low temperatures show superconductivity' plus the fact that this piece of metal is not superconducting allows us to deduce that this piece of metal is not at a low temperature. But we do not have an explanation of why it is not at a low temperature.

Let us call such cases 'raven counterexamples' to the D-N model. We shall find that they play an important role in seeing why selection explanations are not particularizable.

3.EXPLAINING INSTANCES OF A GENERALIZATION

Consider any generalization of the form 'all Fs are Gs'. Let the set of Fs that are Gs (i.e. all the Fs) be called the set of *instances* of the generalization. The generalization (A) 'all ravens are black' is logically equivalent to the generalization (B) 'all non-black things are non-ravens. However the two generalizations have different sets of instances. The instances of (A) are all the ravens, whereas the set of instances of (B) is the set of black things.

What the raven counterexamples to the D-N model show is that whereas a nomic generalization such as (A) may explain the properties of it instances, the contrapositive generalization (B) will not explain *its* instances. Similarly an explanation of (A) may be particularizable while and explanation of (B) will not be. We may have an explanation of why (A′) all metals at low temperature are superconducting, and hence was have an explanation of why (B′) all metals that are not superconducting are not at low temperatures. But that explanation will be particularizable with respect to (A′) but not to (B′). (B′) is a non-accidental generalization. It can be explained by reference to the laws of nature—whatever explains (A′) explains its logical equivalent (B′)—and to that extent is quasi-nomic. But that explanation transfers only to the instances of (A′), not to those of (B′).

David Armstrong's account of laws states that the law itself is a second-order relation of necessitation among universals (Armstrong 1983). The law that Fs are Gs may be symbolized: N(F,G). We can use this account to see why explanations associated with a generalization may not transfer to the instances of its contrapositive. For N(F,G) is not the same as N(not-G,not-F). First, there may be no universals not-G and not-F. Secondly, even if there are those universals, they may not be related by N. N(F,G) will explain why cases of F are G—they are necessitated to be. But in the absence of the law N(not-G,not-F) there need be no similar explanation of why some not-G is not-F. So although N(F,G) explains why $\forall x(Fx \rightarrow Gx)$ and thus why $\forall x(\neg Gx \rightarrow \neg Fx)$ it does not explain why some particular non-G is not an F (Armstrong 1983, p. 40-45).

We are inclined to this that it is the generalizations employing positive predicates (such as in (A) and (A′)) that are the ones that genuinely reflect the structure of the law and thus can explain their instances or whose own explanations are particularizable. Correspondingly we think that their contrapositives, employing negated predicates, mislead as regards the underlying law and this is why they cannot explain their instances. However it would be wrong to think that this is always the case. Of course, the easy way to see this is just to employ only predicates that are the negations of those we used originally. There is however a deeper reason, which is that in some cases the laws and explanations do involve absences of properties. The fact that the graviton (if it exists) is *massless* explains why it travels at the speed of light; the camouflage of a stick insect explains why it is *invisible* to predators; the high velocity of a neutrino explains why it does *not* interact with normal detectors.

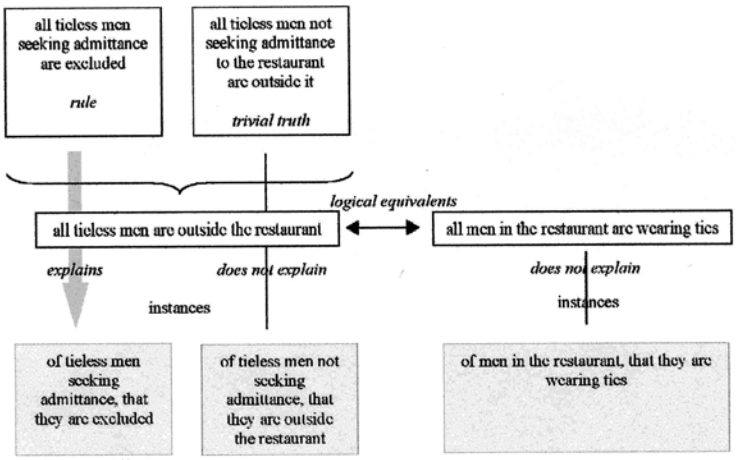
So when presented with two generalizations that are logically equivalent, the one being the contrapositive of the other, we need to be careful in deciding which of the generalizations (if either) may be used in the explanation of its instances. It will not in every case be the generalization expressed employing positive predicates.

4.EXPLANATION AND SELECTION

We have already seen that not all generalizations explain their instances, even if they are not accidental generalizations but one that are the consequences of the laws of nature. Contrapositives of the laws of nature do not always explain their instances, as shown by the raven counterexamples. Similarly the explanation of a non-accidental generalization is not in every case particularizable. If $\forall x(Fx \rightarrow Gx)$ and $\forall x(\neg Gx \rightarrow \neg Fx)$ are non-accidental generalizations, typically the explanation of those generalizations will be particularizable with respect to at most one of them and not both.

We are now in a position to see why the explanations of the generalizations we have focussed on and which arise from selection processes are not always particularizable. Our discussion tells us that the explanation of 'all men in this restaurant are wearing ties' need not also explain the instances of that generalization, even though the generalization is no accidental truth but the consequence of a rule. That this exemplifies the structure I have depicted can be seen by considering the contrapositive: 'all tieless men are outside the restaurant'. This seems rather closer to having explanatory force. For some individuals are outside the restaurant precisely *because* they are tieless. Mr Green tried to get into the restaurant but was turned away for lack of a tie.

Our puzzle would be solved most neatly if we could say that whereas 'all men in this restaurant are wearing ties' does not explain its instances 'all tieless men are outside this restaurant' does explain its instances. For then we could say that our puzzle was generated by focussing on the wrong member of the pair of generalizations. While this is indeed the correct resolution of the puzzle in rough outline, the details require a little adjustment to this response. For it is clear that 'all tieless men are outside this restaurant' or even a stronger statement with modal force 'all tieless men must be outside this restaurant' do not explain all instances of the generalization. Some tieless men, such as tieless Mr Brown who lives 350 miles from the restaurant, have never attempted to gain admittance. Their being outside the restaurant is not explained by the rule excluding them. So we have to regard 'all tieless men are outside this restaurant' as a consequence of the rule 'all tieless men seeking admittance to the restaurant are excluded from it' plus the more-or-less trivial 'all tieless men not seeking admittance to the restaurant are outside it'. It is only instances of the rule that get explained. We may depict the set of relationships between the various generalizations and their instances thus:



5.CONCLUSION

This paper has shown the following:

(a) The raven cases provide counterexamples to the D-N model of explanation, not only to the hypothetico-deductive model of confirmation. Thus not everything deducible from a law is explained by that law. In particular not every non-accidental generalization can explain its instances. If 'all Fs are Gs' is a law, we should not expect it to provide an explanation of why a non-G is a non-F. Consequently, even though 'all non-Gs are non-Fs' is a non-accidental generalization, it cannot explain its instances. Similarly, not every explanation of a generalization is particularizable.

(b) In selection cases the rule or law operating is often negative—men without ties are excluded, gazelles that do not run fast do not survive, etc. It is these negative rules and laws that do explain their instances. Consequently the contrapositives of such rules and laws do not explain their instances. So although it is a non-accidental truth that all men in the restaurant are wearing ties, we should not expect that truth to explain why any individual man in the restaurant is wearing a tie.

We may further conclude:

(c) Non-accidental generalizations that are true in virtue of selection processes seemed to have an unusual feature, that their explanations did not transfer to their instances. This feature was not shared by typical explanations in the physical sciences. That might suggest that selection explanations are somehow different from explanations in the physical sciences and thus fuel the view that Darwinian explanations in terms of natural selection are a new kind of explanation, somehow irreducible to the normal nomic or causal explanations of the physical sciences. This paper has shown that the non-particularizability of an explanation is not limited to selection explanations but is a consequence of the nature of explanation in general.

Explanations of many non-accidental truths in the physical sciences will also be non-particularizable (e.g. of ‘all non-hard objects are non-diamonds’, and of ‘all non-superconducting metals are not at low temperature’). However, in the physical sciences we tend not to focus on such negative general truths, focussing instead on their (particularizable) contrapositives. All that is different about selection explanations is that they themselves employ negative properties. Consequently in their cases it is the negative generalization that has a particularizable explanation while it is the logically equivalent positive generalization that is non-particularizable. Selection explanations do not appear, as far as this issue is concerned, fundamentally different from other nomological explanations.

6.REFERENCES

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