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Explanatoriness and evidence: A reply to McCain and Poston

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ABSTRACT: We argue elsewhere that explanatoriness is evidentially irrelevant (Roche and Sober 2013). Let H be some hypothesis, O some observation, and E the proposition that H would explain O if H and O were true. Then O screens-off E from H: Pr(H | O & E) = Pr(H | O). This thesis, hereafter "SOT" (short for "Screening-Off Thesis"), is defended by appeal to a representative case. The case concerns smoking and lung cancer. McCain and Poston grant that SOT holds in cases, like our case concerning smoking and lung cancer, that involve frequency data. However, McCain and Poston contend that there is a wider sense of evidential relevance—wider than the sense at play in SOT—on which explanatoriness is evidentially relevant even in cases involving frequency data. This is their main point, but they also contend that SOT does not hold in certain cases not involving frequency data. We reply to each of these points and conclude with some general remarks on screening-off as a test of evidential relevance.

1 Introduction

We argue elsewhere (Roche and Sober 2013) that explanatoriness is evidentially irrelevant in the following sense:

> *Screening-Off Thesis* (*SOT*): Let H be some hypothesis, O some observation, and E the proposition that H would explain O if H and O were true. Then O screens-off E from H: Pr(H | O & E) = Pr(H | O).

SOT is intended to reflect the idea that explanatoriness is evidentially irrelevant in the context of a Bayesian account of confirmation, which says that O confirms H precisely when Pr(H | O) > Pr(H). According to SOT, explanatoriness, as represented by proposition E, adds nothing to the increment in H's probability that O by itself affords.[1]

We argue for SOT by considering a representative case, of which the following is a simplified version. Suppose you observe a large group of people who are more than 50 years old and see what percentage of them were heavy smokers before they reached that age. You also observe what percentage of the people who got lung cancer after age 50 were heavy smokers before that age. These two observed frequencies allow you to estimate two probabilities:

Pr(S was a heavy smoker before age 50)

and

Pr(S was a heavy smoker before age 50 | S gets lung cancer after age 50).

You notice that the second probability is substantially greater than the first. Then you learn that Joe Camel, who was not in the group of people you observed, got lung cancer after age 50. Given the inequality between the two probabilities displayed above, you should increase your credence in the proposition that Joe was a heavy smoker before age 50. So far the word "explanation" has not entered into our narrative. But then you learn something else: If Joe was a heavy smoker before age 50 and Joe got lung cancer after age 50, then his smoking would explain his lung cancer. If, contra SOT, explanatoriness were evidentially relevant, this new bit of information would mean that you should *further* increase your credence in the proposition that Joe was a heavy smoker before age 50. But it seems clear that you should do no such thing.

McCain and Poston (2014)[2] grant that SOT holds in cases, like the one just described, that involve (sufficient) frequency data. However, they contend that there is a wider sense of evidential relevance—wider than the Bayesian definition of confirmation that is used in SOT—according to which explanatoriness is evidentially relevant even in cases

[1] A screening-off thesis similar to SOT but concerning explanatoriness and *probabilistic measures of coherence* is defended in Roche and Schippers (forthcoming).
[2] Henceforth we will refer to McCain and Poston (2014) as M&P.

involving frequency data. This is their main point, but they also contend that SOT does *not* hold in certain cases *not* involving frequency data.[3]

We will address both of these points. We start with the second (Section 2) and then turn to the first (Section 3). We conclude with some general remarks on screening-off as a test of evidential relevance (Section 4).

2 Cases not involving frequency data

As before, we will consider three propositions: H, O, and E. H is a hypothesis, O is an observation, and E is the following proposition: If H and O were true, then H would explain O. In their response to our argument for SOT, M&P write:

> Before we turn to the screening-off argument, we note that Roche and Sober's argument is argument by a single case. That is, they argue that explanatoriness is *never* evidentially relevant because it is screened off when there is good observational data concerning the non-epistemic, objective chances relating smoking to cancer. We fail to see how this argument generalizes to *every* case. … For example, the ability of Newton's theory to explain the orbits of the planets is evidence that Newton's theory is true, even if we lack observational evidence regarding the non-epistemic, objective chance that Newton's theory is true. Similarly, the discovery that Einstein's theory of general relativity explained the precession of the perihelion of Mercury increased the probability of Einstein's theory. So, in these cases $Pr(H \mid O \,\&\, E) > Pr(H \mid O)$. (p. 146, emphasis original)

We believe M&P's argument fails.

Suppose you know that a theory H (e.g., Newton's) logically implies O (given the background information codified in Pr) and so you realize that $Pr(O \mid H) = 1$. You then work out the value of $Pr(H \mid O)$ by first obtaining values for $Pr(H)$ and $Pr(O)$. It follows (if neither H nor O has a probability of 1 or 0) that $Pr(H \mid O)$ is greater than $Pr(H)$. You then learn O and as a result increase your credence in H. Suppose you later learn E. M&P's view entails that upon learning E you should *further* increase your credence in H.[4] It seems clear, however, that you should not do this.[5] E is screened-off from H by O,

[3] M&P (Sec. 2) make a few additional points. Due to space considerations we leave discussion of those points for another occasion.

[4] This is true on a straightforward reading of the passage above. However, it might be that M&P intend a different reading. Perhaps M&P have in mind cases—unlike the case

so learning that E is true should occasion no change in your credence in H. Notice that there is no mention of frequency data in this story.

Similar comments apply to cases of probabilistic explanation (assuming, as we do, that there is such a thing). Here is a case adapted from Salmon (1971, p. 63). Consider a penny-making machine that sometimes produces fair pennies and sometimes produces crooked pennies whose probability of landing heads when tossed is 0.95. You randomly take one of the manufactured pennies and flip it; it comes up heads. Let H be the hypothesis that the coin is crooked. Let O be the observation that on the first flip the coin comes up heads. Suppose you work out Pr(H | O) in part by noting that Pr(O | H) = 0.95. Is Pr(H | O & E) > Pr(H | O)? Clearly not. What is true is an equality: Pr(H | O & E) = Pr(H | O).

It is important to note that our defense of SOT is based on the assumption that rational agents are *logically omniscient* so that all purely logical and mathematical facts are codified in Pr. This assumption is standard in Bayesian confirmation theory. The assumption, of course, is an idealization if probability means rational credence. It is far from clear, to say the least, exactly how to do away with the assumption of logical omniscience without at the same time doing away with probability entirely.[6] Suppose, though, that the assumption is dropped. Let I be the proposition that H logically implies O. Then, plausibly, there can be cases where Pr(H | O & I) > Pr(H | O) and Pr(H | O & I & E) > Pr(H | O). Perhaps there can even be cases where Pr(H | O & E) > Pr(H | O). This would be especially plausible if E were in some way indicative of I. But then the point would be that Pr(H | O & I & E) = Pr(H | O & I). Explanatoriness has no confirmational significance, once purely logical and mathematical facts are taken into account.

It might help to consider an analogy. Suppose you ask a friend "What caused the lemonade to be cold?" and your friend answers "Adding a cube of ice to the lemonade is what caused the lemonade to be cold." Even if your friend's answer is correct (despite the fact that it mentions a causal irrelevancy, viz., the ice's cubical shape), it remains true that what does all the causal work is the ice's iciness. The situation is similar with respect to the evidential significance of explanatoriness. Even if (dropping the assumption of logical omniscience) there can be cases where the conjunction I & E confirms H (given O), and even if there can be cases where E by itself confirms H (given O) by indicating

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under discussion—where you do *not* already know that H logically implies O, but learn that H logically implies O upon coming to know that E. If so, then our reply is this: E is screened-off from H by the conjunction of O and the proposition that H logically implies O. See our discussion below of logical omniscience.

[5] Cf. Douven (2013).

[6] See Garber (1983) for exploration of this project.

that I, it remains true that what does all the evidential work is the logical/mathematical relationship of O and H.[7]

We turn now to M&P's thesis that explanatoriness is evidentially relevant even in cases involving frequency data.

3 Cases involving frequency data

M&P defend the evidential relevance of explanatoriness by invoking the concept of "resilience." Their view can be understood as having two main parts. First, there is the claim that an agent's evidential situation with respect to a hypothesis H depends in part on how much her credence in H is "resilient in the face of future information" (hereafter simply "resilient"). Second, there is the claim that explanatoriness increases the extent to which an agent's credence in a particular proposition is resilient. Their view, in short, is that the Bayesian definition of confirmation needs to be supplemented and it is within that supplementation that explanatoriness plays an evidential role.[8]

M&P provide an example meant to support and illustrate their position. There is an (opaque) urn containing one thousand x-spheres. Sally and Tom both know this. But Sally knows something Tom does not: the atomic structure of an x-sphere is such that if blue and red x-spheres are stored in unequal numbers, then the atoms of the x-spheres will spontaneously decay resulting in an enormous explosion. Sally and Tom observe a random drawing of ten x-spheres (without replacement) from the urn. Five are blue and five are red. The ten x-spheres are then put back in the urn. M&P write:

> Given the data both Sally and Tom should assign Pr(blue | random draw) = 0.5. Sally has a very good *explanation for why the probability of drawing a blue x-sphere at random is .5*, but Tom only has the frequency data to go on. Yet this evidential difference does not show up given the initial data. Suppose, however, that 10 more x-spheres are drawn at random and they are all blue. Sally's rational credence in blue given a random draw remains the same. … Yet Tom's rational credence changes significantly. (p. 149, emphasis added)

[7] We return to this issue in Section 4.

[8] M&P, drawing on Joyce (2005), develop their view in terms of a distinction between *balance* of evidence and *weight* of evidence. We ignore this distinction in explaining M&P's view because considerable space would be needed to explain it and because their central point is that explanatoriness increases resilience.

We have some concerns about the description of the case, but we set them aside here. The question is whether the case supports M&P's position that explanatoriness increases resilience.

We believe the answer is negative. Let's suppose that (i) Sally and Tom have a credence of 0.5 in proposition H (that the x-sphere drawn on the next random draw will be blue), (ii) Sally's credence is more resilient than Tom's, (iii) Sally but not Tom knows that if blue and red x-spheres are stored in unequal numbers, then there will be an enormous explosion, and (iv) Sally but not Tom has an explanation of why the probability of a blue x-sphere on a random drawing from the urn is 0.5. Given Sally's knowledge as described in (iii), her credence in H should remain at 0.5 even if the observed frequency of blue x-spheres on random drawings from the urn were to deviate from 0.5. By contrast, given Tom's lack of knowledge as described in (iii), and given, thus, that all he has to go on is the observed frequency, it follows that if the observed frequency of blue x-spheres on random drawings from the urn deviates from 0.5, then his credence in H should *not* be 0.5. This is a case where differences in credences are dictated by differences in *background knowledge*. It is true that Sally but not Tom has an explanation of why the probability of a blue x-sphere on a random drawing from the urn is 0.5, but this difference between Sally and Tom is doing no work.[9]

It might be countered that (iv) is true because (iii) is true and that, thus, explanatoriness is still in play.[10] We are not denying that explanatoriness is in play. In fact, we are supposing for the sake of argument that explanatoriness *is* in play in that (iv) is true. Our point is that (ii) is true because (iii) is true, and (iv) does nothing to make (ii) true once (iii) is taken into account.[11] We see no plausibility in M&P's claim about the evidential relevance of explanatoriness.

It is important to note that M&P's discussion (of resilience as it relates to the evidential relevance of explanatoriness) in effect changes the conversation in three (nontrivial) respects. First, SOT concerns evidential relevance in the sense of *Bayesian confirmation* (where evidential relevance is a matter of probabilistic support), whereas

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[9] There is nothing new in the idea that your background knowledge can be such that the observed frequency does not provide the best estimate of a probability. See Roche and Sober (2013, p. 663) for an illustrative example.

[10] This potential counter was suggested by an anonymous reviewer.

[11] It could be argued that explanatoriness plays a role in Sally's coming to have the knowledge described in (iii) and thus is indirectly responsible for the fact that Sally's credence in H is more resilient than Tom's credence in H. See M&P (Sec. 2.1) for relevant discussion. We are skeptical. But, for reasons of space, we leave discussion of the issue for another occasion.

M&P's discussion concerns evidential relevance in the sense of *playing some evidential role or other*. Second, SOT concerns explanatoriness in the sense of *the counterfactual proposition* that H would explain O *if* H and O were true, whereas M&P's discussion concerns explanatoriness in the sense of *a subject's having an explanation* (where this requires at least that the subject *believe* the putative explanans). Recall that Sally but not Tom has an explanation of why the probability of a blue x-sphere on a random drawing from the urn is 0.5. Third, SOT concerns whether H's being explanatory is evidentially relevant with respect to *H itself* as opposed to some other hypothesis H* (by increasing H's probability given O), whereas M&P's discussion concerns whether H's being explanatory is evidentially relevant, not with respect to H itself, but with respect to *some other hypothesis H** (by increasing the resiliency of the subject's credence in H*). SOT, when properly understood, is neutral on M&P's thesis regarding explanatoriness and evidential relevance. This means that even if M&P were right in their thesis, this would in no way touch SOT.

There is a further question to consider: Does explanatoriness (in the counterfactual sense) increase resilience? We believe the answer here is negative as well. Return to the Joe Camel case. You know that Joe (who was not in the group of people you observed) got lung cancer after age 50. Let H = Joe was a heavy smoker before age 50, O = Joe got lung cancer after age 50, and E = if Joe were a heavy smoker before age 50 and Joe got lung cancer after age 50, then the smoking would explain the lung cancer. Given your frequency data, and given O, it follows that E has no impact on the probability of H. The same is true with respect to observations you could come to have in the future. Let O* be a proposition to the effect that everyone in a new group of ten people was a heavy smoker before age 50 but did not get lung cancer after that age. The same considerations that tell in favor of the equality Pr(H | O & E) = Pr(H | O) also tell in favor of the equality Pr(H | O* & E) = Pr(H | O*).[12] But, then, since the degree to which your credence in H is resilient is a matter of the credences in H you would have on the basis of future observations, it follows that learning E would in no way change the degree to which your credence in H is resilient.

The Joe Camel case involves frequency data. But it should be clear (from what we argue in Section 2 and from our analysis of cases like the x-spheres case) how to extend our point about Joe to cases not involving frequency data.

4 Conclusion

[12] M&P grant that SOT holds in cases involving frequency data. So, presumably, they should also grant that Pr(H | O* & E) = Pr(H | O*) holds in the Joe Camel case.

It may seem odd that we have proposed SOT as a good explication of the evidential irrelevance of explanatoriness. After all, this morning's barometric pressure screens-off the barometer reading from a storm this afternoon, and yet the barometer reading is evidentially relevant to there being a storm. Our reply is that the theory of inference to the best explanation is supposed to provide a *fundamental* epistemology. The idea is that explanatoriness is evidentially relevant *in itself*; the claim is not that explanatoriness is sometimes correlated with other, more fundamental, properties of a hypothesis that are doing all the epistemic work. If people who wear red vests happen to get the right answers to questions more often than people who do not, then wearing a red vest is evidentially relevant. But no one would propose a theory of inference that has wearing a red vest as its foundational concept.

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