

Difference-Making, Closure and Exclusion*

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I Introduction

Consider the following two causal exclusion principles:

EXC-SUF If a property N is causally sufficient for a property B, then no distinct property M that supervenes on N is a cause of B.

EXC-DIF For all distinct properties M and N such that M supervenes on N, M and N do not both cause a property B.

I use these labels for properties because of the relevance of these principles to the debate over mental causation: N for neural property, M for mental property and B for behavioural property. For the remainder of the paper, I will assume that M supervenes on N.

What is it for a *property* to be a cause of, or causally sufficient for, another *property*? These notions are best introduced by example. Suppose I place two pounds of green French pears on the scales, which subsequently reads two pounds (Honderich 1982). On this occasion the property *weighing two pounds* caused, and was causally sufficient for, the property *reading two pounds*. The property *being green* did not cause, and was not causally sufficient for, the property *reading two pounds*.

Opinion divides on how to further analyse these notions. Kim (2005, p. 35, 39) and List and Menzies (2009, p. 475, fn. 2) treat this sort of talk as elliptical for property instances causing, or being causally sufficient for, other property instances. On this view it is strictly speaking the particular instance of *weighing two pounds* that caused, and was causally sufficient for, the particular instance of *reading two pounds*. More common has been to take causation to be a relation between events, and to understand this sort of talk as elliptical for properties of the cause being relevant to its causing, or being causally sufficient for, an effect with other properties (Braun 1995; Lepore and Loewer 1987). On this view it is strictly speaking that the property *weighing two pounds* was relevant to the event of the pears being placed on the scales causing, and being causally sufficient for, the event with the property *reading two pounds*. The examples are more compelling than the analyses, and my discussion will not depend on which is correct.

How should we determine whether EXC-SUF and EXC-DIF are true? Many philosophers have supposed that we should do so by reflecting on our concepts of causation and supervenience. Jaegwon Kim (1998), for example, has famously argued that EXC-SUF and EXC-DIF are analytically true. List and Menzies (2009), on the other hand, have argued that EXC-SUF and EXC-DIF are analytically false (see also Menzies and List 2010; in what follows I will refer to these papers together as LM). The explanation

for these philosophers reaching contradictory conclusions is that their arguments presuppose different conceptions of causation. Kim assumes a conception of causation as something like production or generation and shows that this notion entails that EXC-SUF and EXC-DIF are true. LM, on the other hand, assume a conception of causation as difference-making, and show that there are possible situations in which EXC-SUF and EXC-DIF are false.

These arguments are illuminating, as they show that different theories of causation generate different implications concerning the possibility of supervenient causation. But we should not lose sight of the fact that there is an alternative way to determine the truth of these principles. Instead of approaching the question analytically, we can see whether there is evidence for or against the principles provided by actual examples. For example, we have good evidence that all actually caused events have causally sufficient physical conditions (Papineau 2001), and also good evidence that some actual events are caused by properties that are distinct from and supervene on those conditions. So we have good evidence that EXC-SUF is false, evidence that does not depend on being able to articulate a theory of causation. Call this *the argument from example against EXC-SUF*. The argument from example against EXC-SUF in turn provides evidence against the notion of causation as production presupposed by Kim, and for the notion of causation as difference-making presupposed by LM.

It appears straightforward to extend this line of argument to EXC-DIF. For the evidence that all actually caused events have causally sufficient physical conditions also appears to be evidence that all actually caused events have physical causes, and therefore evidence that EXC-DIF is false. Call this *the argument from example against EXC-DIF*. Moreover, extending the argument in this way is warranted by an independently plausible principle:

CAU-SUF If a property N is causally sufficient for a property B, then N is a cause of B.

Indeed, it is tempting to regard CAU-SUF as analytic. What could discriminate between, say, nomological and causal sufficiency, if not that causal sufficiency is a variety of sufficiency possessed by causes?

It is therefore surprising that according to LM, the argument from example against EXC-DIF is unsound. LM do agree that EXC-DIF is false. However, they show that it follows from their conception of causation as difference-making that “the systems that falsify it are very special” (2009, p. 500), in a way that I will describe below. And as it happens, many of the examples that seem to support the argument from example against EXC-DIF do not fall within this special class. Instead it turns out that, according

to LM, they are examples where causally sufficient physical conditions are not causes, and therefore where CAU-SUF is false. In other words, LM may endorse the first of the following causal closure principles, but are committed to rejecting the second:

CLO-SUF Every event for which there exists a causally sufficient property has a causally sufficient physical property.

CLO-DIF Every event that has a cause has a physical cause.

In sum, LM are committed by their difference-making conception of causation to rejecting the argument from example against EXC-DIF, rejecting CAU-SUF, and rejecting CLO-DIF. In what follows, I will argue that we should accept all three. I begin, in §§2–3, by presenting the LM conception of causation as difference-making. In §2, I describe the account LM give of our causal judgements concerning two examples. In §3 I describe the account LM give of causation as difference-making, and present some of the results concerning exclusion principles that they prove from the account. I then turn, in §§4–6, to criticism of the LM account. In §4 I argue that their notion of difference-making is not well motivated by their own examples, describe a better-motivated notion, and show that both notions are inconsistent with an alternative account of difference-making. I then argue that the alternative account is to be preferred. In §5, I present an independently plausible conception of causal sufficiency, and argue that it entails that CAU-SUF is true. In §6 I argue that the judgements appealed to by LM are best accounted for pragmatically rather than semantically. I conclude in §7.

2 List and Menzies on Causal Judgement

The account of difference-making endorsed by LM is motivated by two examples with a common structure. First is an example introduced by Woodward (2008, p. 238), idealised from the work of Musallam et al. (2004). Musallam et al. (2004) showed that in macaque monkeys, intentions to reach for particular goals are highly correlated with the aggregate firing rates of neurons in the parietal reach region of the posterior parietal cortex. However, conditional on those aggregate rates, the specific firing rates of the relevant individual neurons are not correlated with those intentions. Suppose that on a particular occasion, Sylvester the macaque monkey reaches for a goal after his parietal reach region neurons fire with particular pattern N_i and aggregate pattern I_i (where N_i entails I_i). Second is an example introduced by Yablo (1992b, p. 257). Sophie the pigeon pecks at all and only the red things. Conditional on whether a

presented object is red, the specific shade of the object is not correlated with pecking. Suppose that on a particular occasion, Sophie pecks at a crimson thing. In what follows, I follow LM in supposing that it is a harmless idealisation to model these cases deterministically, in the sense that Sylvester reaches when and only when his neurons fire with pattern I_i and Sophie pecks when and only when the object is red.

Now consider the following candidate explanations:

SYLV₁ Sylvester reached because his neurons fired with pattern N_i .

SYLV₂ Sylvester reached because his neurons fired with pattern I_i .

SOPH₁ Sophie pecked because the object was crimson.

SOPH₂ Sophie pecked because the object was red.

A natural reaction to these examples is that there is a respect in which SYLV₂ provides a better explanation than SYLV₁, and in which SOPH₂ provides a better explanation than SOPH₁. Moreover, a natural hypothesis for what makes this explanatory difference is that in each case, there exist alternatives to the lower level property, consistent with the higher level property, that would have led to the same effect. That is, Sylvester would have reached had (for example) his neurons fired with pattern N_j (where N_j entails I_i), and Sophie would have pecked had (for example) she been presented with a scarlet object. I will argue in §6 that this reaction and hypothesis are both correct.

Do these differences in explanatory status reflect a difference in causal status? According to LM, following Yablo (1992a,b, 1997, 2003, 2005), they do. Consider the following propositions concerning causation:

SYLV₃ Sylvester's neurons firing with pattern N_i caused his reaching.

SYLV₄ Sylvester's neurons firing with pattern I_i caused his reaching.

SOPH₃ The object being crimson caused Sophie's pecking.

SOPH₄ The object being red caused Sophie's pecking.

And consider the following propositions concerning difference-making:

SYLV₅ Sylvester's neurons firing with pattern N_i made a difference to his reaching.

SYLV₆ Sylvester's neurons firing with pattern I_i made a difference to his reaching.

SOPH₅ The object being crimson made a difference to Sophie's pecking.

SOPH₆ The object being red made a difference to Sophie's pecking.

We are more inclined to assert SYLV_4 than SYLV_3 , and SOPH_4 than SOPH_3 . According to LM, this is because SYLV_4 and SOPH_4 are both true, while SYLV_3 and SOPH_3 are both false. In a term introduced by Yablo (1992a), their claim is that causes must be *proportional* to their effects. This in turn is supposed to be explained by the fact that there is a notion of difference-making relevant to analysing causation on which SYLV_6 and SOPH_6 are both true, while SYLV_5 and SOPH_5 are both false.

3 List and Menzies on Difference-Making

LM propose an account of difference-making that is intended to make sense of the causal and explanatory judgements prompted by examples such as those involving Sylvester and Sophie. They then prove that the account entails a number of very interesting results concerning EXC-DIF. In this section I present the account and the results.

LM present two formulations of the intuition that causes should make a difference to their effects. The two formulations are as follows:

TRUE-DIFF₁ The presence of F makes a difference to the presence of G in the actual situation just in case (i) if any relevantly similar possible situation instantiates F, it instantiates G; and (ii) if any relevantly similar possible situation instantiates $\neg F$, it instantiates $\neg G$.

TRUE-DIFF₂ The presence of F makes a difference to the presence of G in the actual world if and only if it is true in the actual world that (i) F is present $\Box \rightarrow$ G is present; and (ii) F is absent $\Box \rightarrow$ G is absent.

LM prove a number of very interesting results concerning TRUE-DIFF₂. Their proofs depend on a possible worlds semantics for counterfactuals that is similar but not identical to the semantics developed by Lewis (1973), and I recommend their paper to readers who are interested in the details. Here I wish to highlight the most important results. The first concerns situations in which EXC-DIF is false:

Compatibility result M and N both make a difference to B iff (i) B is present in all closest M-worlds; (ii) B is absent in all closest $\neg M$ -worlds; and (iii) B is absent in all closest $\neg N$ -worlds that are M-worlds.

It is this result that shows that EXC-DIF is not true in general, if causation is analysed in terms of TRUE-DIFF₂. Call a causal relation between M and B *realization-sensitive* iff in all those M-worlds that are closest $\neg N$ -worlds, B is no longer present. Then this

result is equivalent to the proposition that EXC-DIF is false whenever some higher-level property stands in a realization-sensitive causal relation to another property.

It is an immediate corollary of this result that:

Incompatibility result EXC-DIF holds if and only if either (i) B is absent in some closest M-worlds, or (ii) B is present in some closest \neg M-worlds, or (iii) B is present in some closest \neg N-worlds that are M-worlds.

If conditions (i) or (ii) are met then M is excluded (*upwards exclusion*) while if (iii) is met then N is excluded (*downwards exclusion*). Note that condition (iii) obtains *iff* the relation between M and B is not realisation-sensitive. We may therefore conclude that if causation is analysed in terms of TRUE-DIFF₂, then “if there exists a higher-level causal relation, it excludes a lower-level one if and only if it is realization-insensitive” (p. 496).

This is a very important result. For as LM argue, it is plausible that in science we frequently seek realisation-insensitive causal relations. If so, and if they are right that TRUE-DIFF₂ is relevant to the analysis of causation, then many causal relations discovered in science exclude their realisers—including those motivating the argument from example against EXC-DIF. This is why LM must reject the argument from example against EXC-DIF.

4 An Alternative Conception of Difference-Making

As I noted above, a natural hypothesis for the basis of our explanatory judgements in cases like Sylvester and Sophie is that there are alternatives to the lower level properties that would have led to the same effect. TRUE-DIFF₁ provides a natural formulation of this hypothesis as a principle concerning difference-making. Notice however that TRUE-DIFF₂ is different, instead requiring the truth of a counterfactual concerning what would have happened, had the candidate difference-making property been absent. Now there is something strange about the appeal to such counterfactuals in the cases that motivate the appeal to proportionality¹. Take the case of Sophie. According to TRUE-DIFF₂, whether or not crimson is a difference-maker depends on whether the nearest worlds in which the patch is not crimson are ones in which it is still red. But this cannot be responsible for our causal or explanatory judgements, for in the description of the example offered by both Yablo and LM, it is *underdetermined* whether this counterfactual is true or false. Regarding the example, LM write: “It is

¹I develop the same line of criticism against Yablo in Weslake (*forthcoming*).

natural to interpret these counterfactuals in terms of a similarity relation that makes the closest worlds in which the target is not crimson ones where it is some other shade of red”. But this is not natural at all, for in the story as told by both Yablo and LM, we are told *nothing* about the way in which the patch came to be crimson².

LM might reply that even though the truth of the relevant counterfactual is underdetermined by the description of the example, we naturally assume that it is true nonetheless. But this cannot be right, for I claim that our causal and explanatory judgements are robust across variations of the example in which the truth-value of the counterfactual is explicitly varied. Consider the following two variations of the example. In the first, we stipulate that had the patch not been crimson it would have been some other shade of red. In the second, we stipulate that had the patch not been crimson it would not have been some other shade of red. I claim that our causal and explanatory judgements are identical across these examples. If so, then the LM formulation of difference-making in terms of these counterfactuals is mistaken. I conclude that TRUE-DIFF_2 is inequivalent and inferior to TRUE-DIFF_1 , as a conception of difference-making responsible for our causal judgements³.

Here is an alternative formulation of difference-making that is immune from this line of argument, and is therefore better suited to play the role in our causal judgements demanded by LM:

TRUE-DIFF_3 The presence of F makes a difference to the presence of G in the actual situation just in case (i) for all relevant ways F could have been instantiated, G would have been instantiated; and (ii) for all relevant ways $\neg F$ could have been instantiated, $\neg G$ would have been instantiated.

Since it does not appeal to counterfactuals concerning what would have happened had the candidate difference-making property been different, but rather to counterfactuals concerning what would have happened had relevant alternatives obtained, TRUE-DIFF_3 is more plausibly equivalent to TRUE-DIFF_1 . However as I will now argue, the problem with TRUE-DIFF_3 is that it is inconsistent with an alternative, and more plausible, account of difference-making.

LM introduce their conception of difference-making by suggesting that it is compatible with a range of different theories of causation: “Since a conception of this kind

²This is also noted by Shapiro (2012), though he seems to think that it is natural in the neural rates cases though unnatural in other cases.

³LM might reply that the similarity metric governing our causal judgements is not the same as the similarity metric responsible for our ordinary counterfactual judgements. In that case, since TRUE-DIFF_1 is supposed to be equivalent to TRUE-DIFF_2 , my criticism of TRUE-DIFF_3 below also amounts to a criticism of TRUE-DIFF_2 .

is common to several different theories of causation—for example, counterfactual, interventionist, and contrastive ones—our use of it in investigating the exclusion principle should be congenial to a broad range of such theories” (p. 476). They also restrict their discussion in a number of ways, claiming that it does not affect the generality of their conclusions. Most important for present purposes is the following: “[...] we discuss causal relations involving properties. Causation is best understood, we believe, as a relation between variables. So causation involving properties is a special case in which the variables are binary. A more general treatment would handle causation involving many-valued variables” (p. 478). However, it turns out that the more general treatment suggested by their account is importantly different from an alternative account of difference-making.

This is most easily seen by situating the difference-making principles within the interventionist theory of causation, with which I assume readers are familiar⁴. Suppose we make the natural assumption that in an appropriate causal model, all possible alternative variable values are relevant alternative possibilities. Then TRUE-DIFF₃ can be reformulated as follows:

TRUE-DIFF₄ Variable value $F = f$ makes a difference to variable value $G = g$ in the actual situation just in case (i) an intervention setting $F = f$ would result in $G = g$; and (ii) for all variable values $F = f'$ (where $f \neq f'$), an intervention setting $F = f'$ would result in $G = g'$ (where $g \neq g'$).

This contrasts with the following difference-making principle:

TRUE-DIFF₅ Variable value $F = f$ makes a difference to variable value $G = g$ in the actual situation just in case (i) an intervention setting $F = f$ would result in $G = g$; and (ii) for some variable value $F = f'$ (where $f \neq f'$), an intervention setting $F = f'$ would result in $G = g'$ (where $g \neq g'$).

While TRUE-DIFF₄ requires that *all* interventions would make a difference, TRUE-DIFF₅ requires merely that *there exist* an intervention that would make a difference⁵. This difference between TRUE-DIFF₄ and TRUE-DIFF₅ is obscured by a focus on causal models with binary variable values, where they collapse.

⁴For a comprehensive philosophical overview see Woodward (2003), for a more technical presentation see Pearl (2009), and for brief introductions see Hitchcock (2001, 2007) or Weslake (under review).

⁵The difference between these principles is also noted by Marras and Yli-Vakkuri (2010).

Now it is principles such as TRUE-DIFF₅ that have played a role in all theories of causation that have been proposed in the interventionist literature⁶. The interventionist theories of causation proposed by Hitchcock (2001), Woodward (2003, §2.7) and Halpern and Pearl (2005) all require merely that there exist an intervention that makes a difference, not that all interventions make a difference. According to all of these theories, if there is an appropriate causal model in which there is an alternative to crimson that would not have led to Sophie's pecking, then crimson caused Sophie to peck. According to TRUE-DIFF₄ however, since there is an appropriate causal model in which there is an alternative to crimson that would also have led to Sophie's pecking, crimson did not make a difference to Sophie's pecking.

In the remainder of this section I present three reasons to prefer TRUE-DIFF₅ to TRUE-DIFF₄, as a conception of difference-making relevant to the analysis of causation.

First, as noted by both Woodward (2003, p. 66) and Shapiro and Sober (2012), TRUE-DIFF₅ delivers better verdicts when the relationship of counterfactual dependence between variables maps multiple values of one variable onto a single value of another variable. Consider for example the relationship between the amount of water given to a plant during a particular period, and whether the plant lives or dies⁷. The plant will die if no water is given, survive if a volume of water within some particular range is given, and die if a volume of water above that range is given. Suppose on some particular occasion, no water is given. One natural way to model this situation is with a three-valued variable representing the volume of water given ($W = 0$ when no water, $W = 1$ when within range, $W = 2$ when above range), and a two valued variable representing whether the plant lives or dies ($P = 0$ when the plant dies, $P = 1$ when the plant survives). In the actual case, $W = 0$ and $P = 0$. According to TRUE-DIFF₅, not watering the plant made a difference to the plant's dying, since had the plant been watered within range, it would have survived. But according to TRUE-DIFF₄, not watering the plant did not make a difference to the plant's dying, since had it been watered above range, it would still have died. An adherent of TRUE-DIFF₄ faces a choice over how to represent the difference-maker in this situation. They might say that models which map multiple values of one variable onto a single value of another are for that reason inappropriate. In this case, the correct model would require a binary variable, one value of which represents the disjunctive property of the plant's either being not watered or watered above range. Alternatively, they might say that while the three-valued variable may appear in the model, the disjunctive difference-maker

⁶I do not claim to have made a complete survey. Both here and below, where I make a similar claim, I support my case by discussing the three most prominent theories in the literature. In Weslake (under review), I show how these theories relate to one another and argue for an alternative.

⁷A similar example is used to make a different point by Woodward and Hitchcock (2003, p. 183).

for the plant’s dying is represented by the disjunction of variable values $W = (o \vee 2)$. Either way, we have a problem. For setting aside worries about the causal status of omissions, it is clear that not watering the plant caused it to die. It is equally clear that the causal status of the disjunctive property is at best questionable. So TRUE-DIFF₅ is preferable to TRUE-DIFF₄.

Second, TRUE-DIFF₅ is better suited to a contrastive theory of causation than TRUE-DIFF₄. One of the central attractions of a contrastive theory is the way it allows us to say, in the plant case, that not watering the plant rather than watering within range was a cause of death, while not watering the plant rather than watering above range was not a cause of death⁸. TRUE-DIFF₅ can be adapted in the obvious and natural way to capture the corresponding claims about difference-making. It is difficult to see how to do the same for TRUE-DIFF₄⁹.

Third, TRUE-DIFF₅ is consistent with CAU-SUF, the empirical argument against EXC-DIF, and CLO-DIF. The evidence for these is also therefore evidence for TRUE-DIFF₅ over TRUE-DIFF₄.

5 Two Definitions of Causal Sufficiency

In this section I argue that CAU-SUF is a consequence of an independently plausible conception of causal sufficiency that can be formulated using the interventionist framework. I will make use of the following definitions and assumptions. I will refer to a possible assignment of values to all variables in a model as a *state* of the model. I will refer to variables that have no parents as *exogenous*, and variables that have parents as *endogenous*. I will refer to a model that has the variables in model \mathcal{M} as a subset an *expansion* of \mathcal{M} . Finally, I will assume that the equations specifying the relations of counterfactual dependence between variables are all deterministic. I first present the conception of causal sufficiency, and then present an argument that it entails CAU-SUF.

First we need the concept of a redundancy range (Woodward 2003, p. 83):

REDUNDANCY For variable values $X = x$ and $Y = y$ in model \mathcal{M} , define $V_1 \dots V_n$ as all other variables in \mathcal{M} . Values $v_1 \dots v_n$ are on the *redundancy range* for V_i with respect to $X = x$ and $Y = y$ iff no intervention setting

⁸See for example Hitchcock (1996, §II) and Maslen (2004).

⁹Contrastive claims of this sort are also hard to square with the claim made by LM that SYLV₃ and SOPH₃ are false. For example, it seems correct to say that the object being crimson rather than black caused Sophie to peck. How then can it also be correct to say that the object being crimson did not cause Sophie to peck? I return to the question of whether SYLV₃ and SOPH₃ are false in §6.

$V_1 \dots V_n$ to $v_1 \dots v_n$ while holding fixed $X = x$ would result in $Y = y'$, where $y \neq y'$.

A natural conception of causal sufficiency can then be defined as follows:

SUFFICIENCY $X = x$ is *causally sufficient* for $Y = y$ in model \mathcal{M} iff (i) Y is an endogenous variable; and (ii) all possible values $v_1 \dots v_n$ for all other variables $V_1 \dots V_n$ in \mathcal{M} are on the redundancy range with respect to $X = x$ and $Y = y$.

This definition is limited in two ways. First, it is a notion of causal sufficiency defined for values of single variables. There is a natural generalisation to values of multiple variables, but I leave this for another occasion. Second, it is a consequence of the definition that only the values of immediate parent variables will be causally sufficient for a given variable value. Again, there is a natural generalisation to permit non-immediate parent variable values to be causally sufficient, but I also leave this for another occasion. Finally, note that this is a model-relative notion of causal sufficiency. A more strict, though still model-relative notion can be defined as follows:

ÜBER-SUFFICIENCY $X = x$ is *über-sufficient* for $Y = y$ in model \mathcal{M} iff $X = x$ is causally sufficient for $Y = y$ in all expansions of \mathcal{M} .

The model-relativity of the first definition is attractive, for it allows that (for example) with respect to one model crimson may be sufficient for Sophie's pecking, while with respect to another model it may not. Suppose for instance that there is a neural property that is required to be instantiated in order for Sophie to peck. Relative to a model that does not include a variable representing this property, crimson may be causally sufficient for pecking. Relative to a model that does include such a variable, crimson will not be causally sufficient for pecking. This flexibility is helpful in making sense of the ways that our judgements of causal sufficiency can be context-sensitive. On this account, this context-sensitivity traces to differences in which alternative possibilities are relevant in a given context. For example, whether crimson is judged to be causally sufficient depends on whether the neural property in question is treated as part of the fixed background or instead as something capable of variation. The notion of über-sufficiency, in turn, is useful for capturing what is meant when we say (for example) that crimson is not *strictly speaking* causally sufficient for pecking. For to speak strictly is to treat *everything* as capable of variation.

I will now argue that by the lights of all theories of causation that have been proposed in the interventionist literature, if $X = x$ is causally sufficient for $Y = y$ in the defined sense, then $X = x$ is a cause of $Y = y$. It follows from the definition of

causal sufficiency that $Y = y$ is an endogenous variable. And as noted above, it is also a consequence of the definition that X is an immediate parent of Y . It follows from Y being endogenous and the equations being deterministic that there is an alternative state of the model in which the immediate parents of Y have values different from their actual values, and in which $Y = y'$, where $y \neq y'$. It follows from $X = x$ being causally sufficient for $Y = y$ that this alternative state must be one in which $X = x'$, where $x \neq x'$. Finally, it follows from the definitions of causation proposed by Hitchcock (2001), Woodward (2003, §2.7) and Halpern and Pearl (2005) that in virtue of the existence of this alternative state, $X = x$ is a cause of $Y = y$ ¹⁰.

I draw two conclusions from this result. First, we have an independent argument for CAU-SUF, and therefore an independent reason to reject the LM conception of difference-making. Second, TRUE-DIFF₅ is consistent with CAU-SUF.

6 Causation and Explanation

I have argued that we should reject the conception of difference-making defended by LM, insofar as it is relevant to the analysis of causation, and instead endorse the conception of difference-making that underlies the theories of causation defended in the interventionist literature. This leaves open the question of what to say about the judgements that motivated LM, introduced in §2. For LM are correct that we are more inclined to assert SYLV₄ than SYLV₃, and SOPH₄ than SOPH₃. According to LM, this is because SYLV₄ and SOPH₄ are both true, while SYLV₃ and SOPH₃ are both false. But according to interventionist theories of causation, this cannot be right. For there are relevant alternatives to crimson that would have led to Sophie not pecking, and relevant alternatives to N_i that would have led to Sylvester not reaching. According to interventionist theories, the truth of these counterfactuals is sufficient for the truth of SYLV₃ and SOPH₃.

This rules out the possibility of explaining our judgements semantically. In the remainder of this section, I argue that they should instead be explained pragmatically¹¹. In particular, I suggest that there is pragmatic pressure to assert only the most explanatory proposition of the pairs SYLV₄ and SYLV₃, and SOPH₄ and SOPH₃, respectively. I will not defend the claim that there is pragmatic pressure to assert only one of each pair, deferring to Swanson (2010). Instead, I will focus on defending the claim that there

¹⁰I will not work through the details here, but the easiest way to see this is to consult the formulations of these theories in Weslake (under review), and to keep in mind that the differences between them only arise when a candidate cause is not an immediate parent of a candidate effect.

¹¹In what follows, I draw on arguments first presented in Weslake (forthcoming).

are important explanatory differences between SYLV₄ and SYLV₃, and SOPH₄ and SOPH₃, respectively.

I will focus on the case of Sophie, and argue that there are three important respects in which SOPH₄ provides a better explanation than SOPH₃. I first present the dimensions of explanation, and then argue that SOPH₄ provides a better explanation than SOPH₃ along each dimension.

A first dimension of explanatory value is identified by Woodward and Hitchcock (2003), who argue that an explanation is better to the extent it specifies more answers to questions concerning how the explanandum would have been different, had the explanans been different. I will call this dimension of explanatory value *dependency*. A second dimension of explanatory value is identified in Weslake (2010), where I argue that an explanation is better to the extent that it would apply to a wider range of possible situations. I will call this dimension of explanatory value *abstraction*. A third dimension of explanatory value, which can be extracted from Woodward (2006), is that an explanation is better to the extent it would continue to obtain under various changes to the actual circumstances. I will call this dimension of explanatory value *insensitivity*¹².

Since on interventionist theories of causation it is TRUE-DIFF₅ that grounds the truth of causal claims, to assert merely that one variable value is a cause of another is not to be especially informative. For it is to assert merely that there exists an alternative to that value would have led to a difference to the effect¹³. It is much more informative to learn the exact nature of the dependency relation between the two variables: to learn the complete mapping from alternative values of the cause to alternative values of the effect (and more generally, to learn if and how this in turn depends on the values of other variables). Since *dependency* is a dimension of explanatory value, to possess this information is thereby to possess a better explanation. Now one way to possess information of this sort is to know that TRUE-DIFF₄ is true of a cause. So on the assumption that when asserting causal propositions one should be maximally informative with respect to factors that make for explanatory differences, if there is a choice between citing two causes, one of which satisfies TRUE-DIFF₄ and one of which does not, one should cite the cause that does. One should therefore assert SOPH₄ rather than SOPH₃. This is not because SOPH₄ is true and SOPH₃ is false, but because asserting a causal proposition conversationally implicates that the cause satisfies TRUE-DIFF₄.

¹²Woodward himself does not explicitly make the connection between insensitivity and explanatory value. Instead, he argues directly for the relevance of insensitivity to our causal judgements.

¹³This is an oversimplification, of course. Interventionist theories of causation agree that this is sufficient for causation, but differ concerning the exact difference-making conditions that are necessary for causation.

And this in turn is not because TRUE-DIFF_4 plays a role in the analysis of causation, but rather because it plays a role in the analysis of explanation¹⁴.

It is straightforward to see that SOPH_4 is superior to SOPH_5 along the dimensions of *abstraction* and *insensitivity*. Any situation in which SOPH_5 applies is also a situation in which SOPH_4 applies, but not *vice versa*. Hence SOPH_4 is better along the dimension of *abstraction*. Likewise, there are a range of changes to the actual circumstances under which SOPH_4 would continue to obtain but in which SOPH_5 would not. For example, had Sophie been presented with a scarlet patch rather than a crimson patch, SOPH_4 would still have been true but SOPH_5 would have been false. So on the assumption that only the most explanatory proposition of the pair SOPH_4 and SOPH_5 should be asserted, both *abstraction* and *insensitivity* demand that it is SOPH_4 rather than SOPH_5 .

I conclude that there are three independent dimensions of explanatory value that speak in favour of asserting SOPH_4 rather than SOPH_5 . We can thereby explain the judgements that motivate the LM account of difference-making without making that account part of the analysis of causation¹⁵.

7 Conclusion

I have argued that the LM conception of causation as difference-making should be rejected. It is not well motivated by their favoured examples, it leads to counter-intuitive results in mundane cases of causation appropriately modelled by variables with multiple values, and it is difficult to square with a contrastive theory of causation. Moreover, endorsing it would require giving up the empirical argument against EXC-DIF , and rejecting plausible principles concerning causal sufficiency (CAU-SUF) and causal closure (CLO-DIF). It is a great virtue of the work done by LM on causation to have made these consequences clear. I have argued too that there is an alternative conception of causation as difference-making that does not have the same problems. This is the conception of difference-making at the heart of all interventionist theories of causation. This conception better handles variables with multiple values, better fits with a contrastive theory of causation, and is consistent with the arguments and principles that the LM conception would require us to reject. Indeed, I argued that CAU-SUF is entailed by the interventionist theory in conjunction with an independently plausible account of causal sufficiency. Finally, I argued that our judgements concerning the examples used to motivate the LM conception should be explained pragmatically rather

¹⁴For a similar diagnosis of the role of proportionality, see Bontly (2005).

¹⁵It is also worth noting that while we are disinclined to assert SOPH_5 , we are not inclined to assert that it is false (Maslen [forthcoming](#)).

than semantically. This does not mean that the difference-making principles proposed by LM play no role in our judgements, but rather that they are best seen as special cases in the theory of explanatory value rather than principles at the heart of the analysis of causation.

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