Australasian Journal of Philosophy

Overlappings: Probability-raising without causation

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OVERLAPPINGS:
PROBABILITY-RAISING WITHOUT CAUSATION[1]

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The leading regularity, counterfactual, and agential accounts of causation converge on the idea that causation is *probability-raising*. While the necessity of probability-raising for causation remains in dispute, the sufficiency of probability-raising for causation is generally assumed, at least in the direct (no intermediaries involved) and precisely described case. I offer a class of counterexamples: *overlappings*.

I. Overlappings

Imagine that Merlin casts a spell with a .5 chance of turning the king and prince into frogs, that Morgana casts a spell with a (probabilistically independent) .5 chance of turning the prince and queen into frogs, and that the king and prince, but not the queen, then turn into frogs.
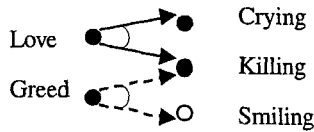
Now consider the relation between Morgana's spell and the prince turning into a frog (a perfectly good event in its own right). I take it as obvious that Morgana's spell is *not a cause* of the prince turning into a frog. Her spell called for the prince and queen to turn into frogs, and the queen didn't, so Morgana's spell demonstrably failed. Rather it is obvious that Merlin's spell caused the prince to turn into a frog, since his spell called for the king and prince to turn into frogs, which is what happened. (And since Merlin's and Morgana's spells are probabilistically independent, Morgana's spell doesn't get to be a cause by helping Merlin's spell succeed).

Morgana's spell, though not a cause of the prince becoming a frog, is a probability-raiser of it. Statistically, p(prince to frog|Morgana's spell present) > p(prince to frog|Morgana's spell absent). Counterfactually, had Morgana's spell been absent, then the chance of the prince becoming a frog would have been less (from .75 to .5). Thus Morgana's spell is a probability-raising noncause of the prince becoming a frog, and thus probability-raising does not suffice for causation. And note (this will become important in section III) that Morgana's spell aims to turn the prince into a frog *directly*, without any intermediaries, and *precisely*, in the exact time and manner it actually occurs.

The general structure that this fairy tale illustrates (the point of fairy tales being to reveal structures by abstracting cleanly away from contingent details) is that there can be direct and precise probability-raising without causation *whenever the projected effects of multiple chancy sources partially overlap*. This can be represented, Lewis-style, by the following systems of neurons (filled circles represent neurons that fire):

C1 (Merlin)

C2 (Morgana)

·5)

·5)

D (king to frog)

E (prince to frog)

F (queen to frog)

In Salmon's terminology:

C1

D

E

and:

C2

E

F

both represent possible *interactive forks*, and overlappings may be said to occur whenever there are two possible interactive forks, one actual, with an overlapping projected tine (E). The nonoverlapping projected effects (D and F) reveal the cause (C1), and the overlapping projected effect (E) and noncause (C2) yield probability-raising without causation.

From the general structure of overlapping it can be seen that there are overlapping cases in actual physics as well as in folk psychology. Here is a sketch of a case from physics.[2] An atom of U-238 and an atom of Ra-226 are placed in a box at t0 (assume for simplicity that the box is otherwise empty). At t1 the box contains an atom of Th-234, an alpha particle, and (still) an atom of Ra-226. The relevant physical laws are: (1) an atom of U-238 has a certain chance per unit interval of producing Th-234 and an alpha particle, (2) an atom of Ra-226 has a certain chance per unit interval of producing Rn-222 and an alpha particle, and (3) these chances are independent. Now the presence of Ra-226 is *not a cause* of there being an alpha particle (rather the U-238 produced the alpha particle independently), but is by law a probability-raiser of it:

U238

Ra226

Th234

Alpha particle

Rn222

And note that the Ra-226 aims to produce the alpha particle directly, since particle emissions from radioactive sources (as standardly understood) occur without hidden intermediaries, and precisely, since if one of the atoms is in a superposition of location 'smeared' over the other (or the two are smeared over a common region), then the projected emission can be indiscernible on either source.

And here is a sketch of a case from folk psychology. The husband kills his terminally ill, heavily insured wife with tears in his eyes and no smile on his lips. Did he kill for love or money? Suppose (as a useful simplification) that the jury believes that mercy-killings are always done while crying, and greed-killings always done while smiling, then they

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[2] Christopher Read Hitchcock has independently discovered a case of similar structure in his 'Do All and Only Causes Raise the Probabilities of Effects?' (forthcoming).

may reason that the husband's greed was, albeit a probability-raiser of the killing, not the causally operative motive (in certain jurisdictions this may mitigate his guilt):

And (for all the folks know or care about how the mind is wired) the greed motive might well aim to produce a killing directly, and precisely, since there need be no difference in how the husband unplugs the respirator on either motive.

Thus there are conceptually clear, empirically possible, and pretheoretically plausible examples of direct and precise probability-raising without causation. These cases will prove to be systematic counterexamples to the sufficiency of the leading probability-raising accounts of causation.

II. Probability-Raising Accounts of Causation

The leading regularity, counterfactual, and agential accounts of causation all converge on the idea that causation is probability-raising, and thereby mishandle overlappings. According to Patrick Suppes's regularity account, C causes E iff (i) C is temporally prior to E, (ii) there is no event B temporally prior to C that screens C from E: $p(E|CB) = p(E|C)$, and (iii) C is positively statistically relevant to E: $p(E|C) > p(E|\sim C)$.[3] But the noncause in overlappings (Morgana's spell, Ra-226, the husband's greed) is temporally prior to the overlapping projected effect (prince to frog, alpha emission, killing), is unscreened (the screening condition is intended to rule out the case of C and E being correlates of a common cause B, which is not the issue between the noncause and the overlapping projected effect, as these are not causally connected in any way), and positively statistically relevant. Thus Suppes's regularity account fails to capture a sufficient condition for causation.

According to David Lewis's counterfactual account, C causes E if (i) C and E are actual, distinct events, and (ii) E is counterfactual-chance dependent on C: had C not occurred then the chance of E would have been less.[4] But the noncause and the overlapping effect are actual, distinct events that stand in the counterfactual-chance

3   Patrick Suppes, *A Probabilistic Theory of Causality* (Amsterdam: North-Holland, 1970).
4   David Lewis, *Philosophical Papers* volume 2 (Oxford: Oxford University Press, 1986). Note that this is only a sufficiency claim ('C causes E *if...*'): Lewis weakens this condition to try to capture necessity (especially in light of preemption) by taking its ancestral, and later by taking the ancestral of counterfactual-dependence or quasi-dependence. These revisions merely allow more things to count as causes, and so couldn't help *dis*count the relevance of the noncause to the overlapping projected effect. Also Lewis actually requires the stronger condition that had C not occurred then the chance of E would have been less *by a large factor*. But set the projected effectiveness of the cause in overlapping cases (e.g., Merlin's spell) as low in the (0,1) interval as you like, and the projected effectiveness of the noncause (e.g., Morgana's spell) as high in (0,1) as you like, and you can get counterfactual-chance dependence to an arbitrarily large factor.

dependency relation. Thus Lewis's counterfactual account fails to capture a sufficient condition for causation.

According to Huw Price's agential account, C causes E iff (i) C and E are actual, distinct events, and (ii) C-ing is an effective strategy for E: $p^{Agent}{}_{C}(E) > p^{Agent}{}_{-C}(E)$ ($p^{Agent}{}_{A}(B)$ is the probability that B given that a free agent As).[5] But the noncause and overlapping effect are actual, distinct events that stand in the effective strategy relation. Thus Price's agential account fails to capture a sufficient condition for causation.

In general, overlappings show that probability-raising, whether analysed in terms of statistical regularities, counterfactual chances, or effective strategies, does not suffice for causation. In what remains I will discuss other challenges to the sufficiency of probability-raising for causation, which will reveal the extent to which overlappings (because they involve direct, precise probability-raising) present a new and especially difficult challenge.

III. Other Challenges

There are two main challenges to the sufficiency of probability-raising for causation in the current literature: *fizzled backups*, in which C is a probability-raiser of E via a projected chain of events that fizzles out before E (some other process reaches E); and *brute causation*, in which C1 and C2 are both probability-raisers of E via separate chains of events that both reach E, but (allegedly) it is a brute causal fact that C1 rather than C2 causes E. A review of these challenges will reveal the extent to which overlappings present a new and especially difficult challenge.[6]
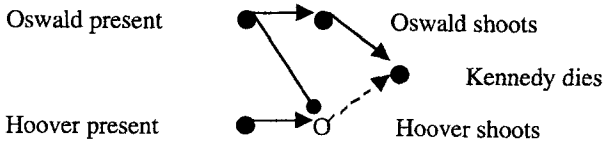
The challenge of fizzled backups, due to Peter Menzies,[7] is that C may be a probability-raiser of E only via a process that fizzles out before E (some other process reaches E). Indeterministic preemption cases are examples: if Oswald shoots Kennedy,

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5   Huw Price, 'Agency and Probabilistic Causality', *British Journal for the Philosophy of Science* 42 (1991), pp. 157–176. Also Huw Price and Peter Menzies, 'Causation as a Secondary Quality', *British Journal for the Philosophy of Science* 44 (1993), pp. 187–203.

6   There are two further challenges to the sufficiency of probability-raising for causation in the literature which are orthogonal to the issues raised here: *causal asymmetry*, in which C is a probability-raiser of E because C is an effect of, or correlate from a common cause with, E; and *trivial relevance*, in which C is a probability-raiser of E because C and E stand in analytic or mereological entailment relations (the trivial relevance challenge is due to Jaegwon Kim, 'Causes and Counterfactuals', *Journal of Philosophy* 70 (1973), pp. 570–572.) The standard reply to the asymmetry challenge is to give an independent account of the causal arrow to conjoin with or integrate into the probability-raising relation (for Suppes, the temporal arrow plus the screening condition; for Lewis, the arrow of overdetermination as it grounds the distinction between standard and backtracking counterfactuals; for Price, the subjective arrow projected from the agent's perspective; a number of other constructions are available. (See Daniel Hausman's *Causal Asymmetries* (Cambridge: Cambridge University Press, 1998) for a comprehensive discussion.) The standard reply to the trivial relevance challenge is to give an independent theory of events designed to rule out these cases. (See Lewis, *op. cit.* for a discussion along these lines.) Thus, strictly speaking, what is assumed in Suppes, Lewis, and Price is that probability-raising *between actual, distinct events, plus causal priority*, suffices for causation.

7   Peter Menzies, 'Probabilistic Causation and Causal Processes: A Critique of Lewis', *Philosophy of Science* 56 (1989), pp. 642–663.

and Hoover holds fire on seeing that Oswald is about to do the dirty work, then the presence of Hoover will count as a probability-raising noncause of Kennedy's death[8]:

Oswald present   Oswald shoots

                                              Kennedy dies

Hoover present   Hoover shoots

There are two standard replies: *factor intermediaries,* and *require precision.*

The intermediaries reply to fizzled backups is based on the natural idea that, since the basis for labelling the probability-raiser noncausal in these cases is that it fizzles out on route to E, these cases must all be cases of *indirect* (via intermediaries, in these cases nonoccurrent ones such as Hoover's shooting) probability-raising. For this reason it is widely concluded that there must be some way to factor intermediaries that will resolve these indirect cases (and many suggestions as to how). For example, Menzies suggested requiring that C and E be connected by a temporally continuous sequence of counterfactual-chance dependent events, which is fundamentally an attempt to reduce indirect probability-raising to continuous direct probability-raisings. D. H. Mellor requires both that $Ch_C(E) > Ch_{\sim C}(E)$ (where $Ch_C(E)$ is, roughly, the chance that C gives E in the circumstances) and that C and E be connected by a spatiotemporally contiguous chain of chance-increasers.[9] Ellery Eells proposes looking to the probability trajectory of E through the (C, E) temporal interval, on which C causes E if (i) p(E) changes at the time of C, (ii) just after the time of C, p(E) is high, (iii) p(E) just after the time of C is higher than it was before C, (iv) p(E) remains at that high value until the time of E.[10] Igal Kvart claims that C is a cause of E iff C has some positive causal impact on E iff there is a strict increaser for C and E, which notion functions to require that none of the intermediaries between C and E reverse the positive statistical relevance of C to E, or if so, that there is a further intermediate which restores that relevance.[11] And Ned Hall recommends assessing the counterfactual-chance dependence of E on C not just after the time of C (as per Lewis), but just before the time of E, so as to factor in any 'fizzlings out' on route.[12]

Overlappings are simultaneous counterexamples to all these intermediary-based proposals, for the simple reason that there are no intermediaries to factor: the probability-raising is direct. Thus neither Menzies's nor Mellor's suggestion will discount the probability-raising of the noncause to the overlapping projected effect because there are no intermediaries (such as Hoover's shooting in the fizzled backup example above) whose nonoccurrence could break the chain of probability-raising. The reader may confirm that all Eells's conditions for causation are met. On Kvart's analysis the noncause

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[8] Note that the backup process need not be cut-off (or otherwise preempted) by the main process. The backup might just fizzle on its own: Hoover might just think better of the whole thing, or fire wide, etc.

[9] D. H. Mellor, *The Facts of Causation* (London: Routledge, 1995).

[10] Ellery Eells, *Probabilistic Causality* (Cambridge: Cambridge University Press. 1991).

[11] Igal Kvart, 'Cause and Some Positive Causal Impact' in James Tomberlin (ed.), *Philosophical Perspectives 11: Mind, Causation, and World* (Oxford: Basil Blackwell, 1997), pp. 401–432.

[12] Ned Hall, 'Two Concepts of Causation' (forthcoming).

will itself count as a strict increaser for the overlapping projected effect, since it is a probability-raiser with no further intermediaries to reverse it. And in the direct case Hall's recommendation collapses into Lewis' original view, since there is no temporal gap between C and E. No surprise that these proposals get overlappings wrong, since they all assume that direct probability-raising is sufficient for causation, and seek only to understand the indirect case on that assumption.

The precision reply to fizzled backups (which may or may not be combined with the intermediaries reply) is based on the idea that, had the backup process not fizzled, it would have either reached 'E' simultaneous with the process that actually reaches E, or not. If not, then the backup process does not raise the probability of E-at-t. If simultaneous, then the backup process does not raise the probability of E-as-mannered, since (allegedly) it would have impacted E and so changed its manner. For related reasons, Lewis considers (though ultimately rejects) taking the time and manner of E to be essential, and Deborah Rosen and Paul Humphreys (for rather unrelated reasons) endorse the more limited thesis that statistical relevance relations that disappear under precision are spurious.[13]

Precision, however required, won't help at all with overlappings, for the simple reason that the overlapping effect might well be projected identically (in time and manner) from either source.[14] Thus overlappings show that *even direct, precise probability-raising does not suffice for causation.*

The challenge of brute causation, due to Michael Tooley,[15] is that C1 and C2 may both be probability-raisers of E via separate chains of events that both reach E, but it (allegedly) may be a brute causal fact that C1 rather than C2 causes E. Suppose that Merlin and Morgana both cast spells with a .5 chance of turning the prince into a frog, and the prince then turns into a frog:

Merl's spell

Morg's spell

Prince to frog
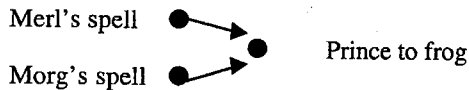
Then both Merlin's spell and Morgana's will count as probability-raisers of the prince turning into a frog, but (allegedly) there might well be a fact of the matter as to *which* spell really did the causing (so that there are worlds which agree in occurrent facts and

[13] Deborah Rosen, 'In Defense of a Probabilistic Theory of Causality', *Philosophy of Science* 45 (1978), pp. 604–613; Paul Humphreys, 'Cutting the Causal Chain', *Pacific Philosophical Quarterly* 61 (1980), pp. 305–314. It is worth asking if there are cases of genuinely causal probability-raising that *disappear* under precision. How about this: I bet you the die will land with 1–3 showing, and slip you a trick die with faces 1,2,2,3,4,6. The die lands 1–3. I win. Intuitively, my giving you the trick die caused my winning, as can be seen probabilistically: p(die lands 1–3|trick die) > p (die lands 1–3|normal die), and as would surely be echoed in your protests. But wait: the die actually landed 1, and p(die lands 1|trick die) = p(die lands 1|normal die).

[14] Even if there were some projected difference in the overlapping effect, it seems to me that we judge that Merlin's spell (and not Morgana's) caused the prince to turn into a frog due solely to what happened to the king (and not the queen), and so whether or not there would have been some differences in how the prince turned into a frog on Morgana's spell plays no role in this causal judgement. Thus even if the precision reply matched our causal judgement (it doesn't), it seems that would be by accident.

[15] Michael Tooley, *Causation: A Realist Approach* (Oxford: Clarendon Press, 1987).

laws, but disagree about causation), in which case the other spell would be a direct probability-raising noncause.

The standard reply, which I endorse, is that the alleged fact that one of the spells *really* did the causing in this case (and generally, that there is brute causation) is simply question-begging. Lewis has pointed out that whatever intuitive appeal the existence of such a brute fact has is at least balanced by the theoretical complications the entailed nonsupervenience induces, and Hitchcock has added the picture of a 'probability pool for E' as an intuitive way to understand the contribution that C1 and C2 make to E in a way that makes it clear that there is no further brute fact of the matter as to which 'really' causes E. Suffice it to say that those attracted to the probability-raising view of causation in the first place have, rightly or wrongly, been unmoved by alleged intuitings of brute causations over and above probability-raising relations.

Overlappings, in contrast, do not beg the question against the probability-raising metaphysic. As can be seen by comparing diagrams, overlappings add the event structure of the nonoverlapping projections (e.g. king to frog and queen to frog). This addition generates a perfectly supervenient fact of the matter as to which spell is a cause, based on which of the nonoverlapping projections occurs. Thus, overlappings show that, *even within a metaphysic that abjures brute causation and recognises only event occurrences/ nonoccurrences and probability-raising relations (perhaps themselves reducible to patterns of event occurrences/nonoccurrences)*, direct, precise probability-raising does not suffice for causation. (And so Humeans like Lewis can shrug away brute causations but not overlappings.)[16]

The fizzled backup and brute causation challenges have together shaped a research program. The fizzled backup challenge has been taken to show only that indirect and/or imprecise probability-raising does not suffice for causation, and the rejection of the brute causation challenge (along with the absence of any further challenges) has been taken to show that there are no non-question begging examples of direct, precise probability-raising without causation. Thus it is generally assumed that direct, precise probability-raising (between actual, distinct events with causal priority: see footnote 6) suffices for causation. The probability-raising research program, based on this assumption, has revolved around various strategies for factoring intermediaries and/or requiring precision so as to handle causation generally. Overlappings show that this foundational assumption is wrong, and to that extent present a new and especially difficult challenge. Back to the drawing board for probability-raising accounts!

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[16] Suppose brute causation possible after all. Call an event C that meets the probability-raising conditions a *perfect probabilistic candidate*, and call an event C that meets every condition for being a cause modulo bruteness a *perfect cause candidate*. Overlappings show that perfect probabilistic candidates are not always perfect cause candidates, and for this reason should be surprising even to the nonreductionist.