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## Causal Relations Among Tokens, Types, and Variables

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There appear to be causal relations among entities of different kinds or at different “levels.” Token-level causal relations link particular events. The shriek of my alarm-clock at 6:30 this morning apparently bore a token-level causal relation to the wounded groan that emerged from me slightly later.<sup>2</sup> There are well-known controversies concerning the nature of events, but there is general agreement that they are particulars occupying spatial-temporal regions, that they can occur only once, and that they are not the sort of thing that has instances or that can be instantiated. I shall refer to event tokens with lower-case italicized letters from near the beginning of the alphabet.

Type-level causal relations in contrast link properties or kinds of events. Consuming too many chocolates unfortunately often bears this kind of causal relation to stomach aches. I shall assume here that event types are properties and shall speak indifferently of properties, kinds of events and event types. Properties are not particulars located in space and time, and they can have many instances. The instantiation of a property at a particular time and place is a “trope.”<sup>3</sup> I shall refer to properties, kinds or types with upper-case italicized letters from near the beginning of the alphabet.

In addition, scientists often speak of causal relations among variables. The current in a circuit bears this kind of relationship to the resistance in the circuit. Scientists also speak of causal relations among the values of variables. Variables appear to belong to the same

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<sup>1</sup> This essay and the sections of *Causal Asymmetry* from which it draws could not have been written without many detailed and helpful criticisms and suggestions from Ellery Eells. Thanks also to Elliott Sober for his comments on a rough draft.

<sup>2</sup> Many philosophers maintain that there are token causal relations among facts in addition to token causal relations among events (see for example Bennett 1988). Some, such as Hugh Mellor (1995) maintain that the relata of causal relations are always facts. In this essay I shall assume that the relata of token causal relations are events. For arguments in defense of this assumption, see for example Hausman 1998, chapter 2.

<sup>3</sup> Since it appears that events stand in causal relations only in virtue of specific properties that they instantiate, it seems that causal relations among tropes are the same sort of thing as causal relations among (token) events.

ontological category as properties or event types, but, as we will see below, matters are complicated. I shall use italicized capital letters from near the end of the alphabet to refer to variables and lower-case letters from near the end of the alphabet to refer to their values.

Since it appears that tokens are not causes of types and types are not causes of tokens, it seems that causal relations among types are distinct from causal relations among tokens. How are these two distinct varieties of causal relation related to one another? Is one of them fundamental? What about causal relations among variables or among the values of variables? Are they the same kind of relations as causal relations among types? Are the different kinds of causal relations dependent on one another, or are there multiple independent sorts of causation?

One finds several views in the literature. Many philosophers maintain that type-level and token-level causation are independent relations. Elliott Sober (1985, 1986) and Ellery Eells (1991) makes the most extensive case for a view such as this, and Eells offers strikingly different theories of type and token causation. Cartwright (1989) and I (Hausman 1998) have maintained in contrast that type-level causal relations depend upon more fundamental token-level relations. Tooley (1987) may be a proponent of the view that type-level relations are fundamental. Hoover (2000) maintains that causal relations among variables are fundamental. In this paper, I am going to defend a position resembling Hoover's as much as my own published views. In particular, I shall argue that causal relations among variables of a particular kind are as fundamental as causal relations among tokens, while causal relations among types should be defined in terms of causal relations among variables or tokens.

## I. Deterministic Causation

Let us begin with Eells' argument that there are two varieties of causation, one relating tokens and the other relating types (see also Sober 1985, 1986). Eells presents his argument for the existence of a distinct type-level causal relation in the context of a theory of probabilistic causation, and some of his concerns will only be addressed in the appendix to this essay. This essay will otherwise consider only deterministic causation. Eells motivates the distinction between type and token causation by pointing out that the surgeon general's type-level claim that smoking is a positive causal factor for lung cancer leaves the facts about the token-level effects of smoking and the token-level causes of lung cancer almost completely open. Indeed he

points out that smoking can be a cause of lung cancer without ever causing any individual to get lung cancer!

Consistent with human physiology being just as it actually is (so that the surgeon general's claim is still true), is the possibility that everybody's causal field happens (improbably enough) to be such that, if they were to become smokers, they would, just before the time lung disease had a chance to develop, die from some other cause that, given the causal field, is deterministically token causally related to smoking. (1991, p. 11)

Eells offers the following arguments against the claim that type-causal claims are generalizations concerning token causation.

First, it is consistent with a type-level probabilistic causal claim, as I understand such claims, that the cause and effect factors involved never in fact happen to be exemplified. Thus, as I understand type-level probabilistic causal claims, they are not generalizations over instances of token causation. Second, . . . I have described examples, possible situations, in which the surgeon general's type-level claim is intuitively true, yet in which there are no cases in which a token of the cause type ever causes, or even would cause, a token of the effect type. In these cases, there are no instances of the relevant kind of token causation to generalize over. Finally, there is a problem for the suggestion that type-level causal claims be understood as generalizations over instances of token causation: What are the formal properties of the generalizations?(1991, pp. 15–16).

One can summarize and extend Eells's case for the existence of a distinct type-causal relation as follows. (1) If  $a$  is a token cause of  $b$ , then (a)  $a$  occurs, (b)  $b$  occurs, and (c) there is in fact a causal connection between  $a$ 's (of some kind) occurring and  $b$ 's (of some kind) occurring. But (2) a type  $A$  may be a cause of a type  $B$  even though (a) no token  $a$  of kind  $A$  occurs, (b) no token  $b$  of kind  $B$  occurs, or (c) tokens of kind  $A$  that do occur are never causes of occurrences of tokens of kind  $B$ . Furthermore (3) the fact that  $a$ , which is of kind  $A$ , is a token cause of  $b$ , which is of kind  $B$ , does not imply that  $A$  is a type-level cause of  $B$ . Eells does not make point 3 explicitly, but it is implicit in his examples. In addition Eells challenges those who hold that type causation derives from token causation to specify exactly what the relationship is.

Eells appears to have a strong case. He is right that the surgeon general's claim does not imply that there are instantiations of smoking that cause instantiations of lung cancer, even though (of course) the surgeon general believes that people smoke and get lung cancer and that instances of smoking token-cause lung cancer in lots of people. (If the surgeon general did not believe these things, it would be more natural to say something like "If anyone were to smoke he or she would be more likely to get lung cancer.") Related considerations support (3). George's smoking might have led him to meet Jim, who found George a job in an asbestos factor, which caused George to get lung cancer. But the fact that his smoking was here an indirect token cause of his contracting lung cancer does not imply that smoking is a type-level cause of lung cancer.

In contrast to Eells, in my book (1998, ch. 5\*) I argue that type-level causal relations are generalizations of causal relations among tokens. In particular, I defended the following thesis:

**CG** (*Counterfactual generalization view*) *A* is a cause of *B* in circumstances *K* if and only if in *K* each event of kind *A* that might occur would cause some event of kind *B* that would bear the right temporal relations to it (1998, p. 87).

**CG** analyzes type-causal claims in terms of causal relations among possible event tokens. The reference to "right temporal relations" is a gesture toward generating the asymmetry of causation from temporal relations, to which I am not in fact committed. But questions about the asymmetry of causation are not germane to the issues under discussion in this essay. Notice that **CG** offers a necessary and sufficient condition for "*A* is a cause of *B* in circumstances *K*", not for "*A* is a cause of *B*" full-stop. The reason for this is that claims about causal relations among types must always be relativized to some set of background circumstances. In the population as a whole, it appears that smoking is a cause of lung cancer, while among those diagnosed with lung cancer during the past six months, lung cancer appears to be a cause of not smoking. Causal claims relating types are not well-defined until the surrounding circumstances are specified.<sup>4</sup>

Eells' arguments do not refute **CG**. What "saves" **CG** is the relativization to the circumstances. Given this relativization, **CG** fits all the facts Eells adduces. In the

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<sup>4</sup>Eells relativizes causal claims to kinds of population rather than to background circumstances, but the basic point is the same.

circumstances described above in which “everybody’s causal field happens (improbably enough) to be such that, if they were to become smokers, they would, just before the time lung disease had a chance to develop, die from some other cause that, given the causal field, is deterministically token causally related to smoking” (1991, p. 11), smoking is not a type-level cause of cancer either. Suppose there are some other circumstances, *K*, in which smoking is a type-level cause of lung cancer. Eells points out that it may nevertheless be the case that nobody smokes or that none of those who smoke get lung cancer. **CG** allows these possibilities. It does not imply that instances of smoking are ever token-level causes of instances of lung cancer, because there may be no instances or the instances may not occur in the right circumstances.

The only sticking point concerns whether it is possible that *a* cause *b* without type-causal relations among the relevant properties or kinds. Given determinism and a sufficiently detailed description of the circumstances *W* on some occasion when *a* is a cause of *b*, **CG** implies that, given *W*, tokens of some kind *A* always cause tokens of some kind *B*. Yet George’s smoking could cause his lung cancer via his meeting with Jim and his consequent employment in an asbestos factory without smoking being a type-level cause of lung cancer. Does it not follow that **CG** is mistaken?

Let *a* be the event of George’s smoking, *b* be the event of his contracting lung cancer, and *W* be the properties (in all relevant detail) of the circumstances in which *a* led to *b* via the unfortunate meeting with Jim. Given a deterministic view of causation, it follows that, given *W*, some property of *a* is a type-level cause of some property of *b*. But this generalization is not what the surgeon general maintains. The surgeon general claims specifically that one kind of event -- smoking -- causes another kind of event -- contracting lung cancer -- and, moreover, that it does so in a different set of circumstances than those in which some property of George’s smoking just then set in motion a chain of events that led to his contracting lung cancer. So one can agree that George’s smoking led to his contracting lung cancer and deny the surgeon general’s claim. Furthermore, the surgeon general’s claim probably suggests that there are exclusively physiological and chemical links in the causal chain between inhaling smoke and changes in the lungs, and in George’s case there are different kinds of links. Although **CG** and a certain kind of deterministic view of causation enable one to deduce from a token causal claim *some* causal generalization, they do not enable one to deduce any causal generalization of interest.

Even if **CG** survives Eells' critique of attempts to reduce type to token causation, it faces other apparent difficulties. For example, token-level causal claims, unlike type-level claims, appear to be extensional. If *a* causes *b*, and "*c*" and "*d*" refer respectively to the same events as "*a*" and "*b*," then *c* causes *d*. On the other hand, even if exactly the same people smoke who have teeth of a particular shade of yellow, one cannot infer that having teeth of a particular shade of yellow causes lung cancer from the fact that smoking causes lung cancer. How then could type-level claims be generalizations of token-level claims? The answer is simple. According to **CG**, token-level claims, unlike type-level claims do not specify which properties are causally relevant. According to **CG**, one can infer from the fact that people with teeth of a particular shade of yellow get lung cancer only that there exists some property of people with teeth of this shade of yellow that stands in a causal relationship to lung cancer.

One might also object that the proposed reduction of type-level to token-level causal claims in **CG** puts things exactly backwards. Regularity theorists maintain that causal relations obtain in virtue of lawful relations among *properties*. How then can one turn around and claim, as I have, that causal relations among the properties are generalizations of relations among the tokens?

This objection rests on an equivocation. As Humeans have demonstrated so poignantly by their valiant efforts to avoid modal notions, causation involves some modal connection. Either one needs an account of modal connections between particulars, such as a theory of counterfactuals, or some link must be established between the individual events that stand in token causal relations to one another and nomic relations among properties of those events. But even if one concludes that token causal relations presuppose *nomic* relations among properties, they do not presuppose asymmetrical *causal* relations among properties. It is these asymmetrical type-causal relations, not the non-asymmetrical underlying laws, that are generalizations of relations among tokens.

For example, consider the causal relations between the temperature and volume of a gas. These relations arguably rest upon laws relating temperature, pressure and volume. Unlike causal relations, those laws are not asymmetrical. If a gas is enclosed in an insulated cylinder and then compressed by a piston, its temperature causally depends on its volume. On the other hand, the volume of the gas in a balloon depends on its temperature. The claim that (in specified circumstances) volume (asymmetrically) *causally depends* on temperature adds something

important to non-asymmetrical nomic relations that may be presupposed by the token causal relations. It is thus consistent both to maintain that token causal relations presuppose nomic relations among properties, as regularity theorists do, and to assert that type causal relations are generalizations concerning the token causal relations that obtain in particular circumstances.

This last example concerning the relations between the temperature and volume of gases, involves causal relations among variables and their values, and I have not yet explained how these link up to type and token causation. But before doing so, something should be said about whether there is any reason to accept **CG**. All I have done so far is to present my response to criticisms of **CG**. Compared to views such as Eells', one can say three things in defense of the counterfactual generalization view.

First, the view that type-causal claims are generalizations of token causal claims is more parsimonious than the view that there are two independent kinds of causal relations. Second, the relata of type-causal claims must, of course, be types or properties. Yet it seems that they are in fact tokens! What Eells calls "type-causal claims" are in fact generalizations of token causal relations, and a thesis such as **CG** is thus unsurprising. According to many construals of causal asymmetry, causal relata must be located in space and time. Otherwise, how could causes precede their effects, and how could causes and their direct effects be contiguous? But properties are not located in space and time. Only their instantiations are. So-called type-level causal claims do not relate types. They relate actual or possible *instantiations* of their types. What distinguishes them from token-causal claims is that they are generalizations rather than singular claims. They do not relate a different category of entity -- a property rather than an event -- or they do so only in virtue of generalizations concerning events.

Eells's response to this difficulty involves defining properties that refer to times (1991, ch. 5). Let  $s_t$  be a temporal "slice" of an individual substance or set-up  $s$  at time  $t$ , and suppose that it is true that  $s_t$  has the property  $A$ . Eells defines the time-dependent property  $A_t$ :  $(x)[A_t(x) \leftrightarrow A(x_t)]$ . George has the property of being-a-smoker-at- $t$  if the  $t$  time slice of George has the property of being a smoker. The asymmetry of causation is secured by stipulating that  $A_t$  causes  $B_{t'}$  only if  $t'$  is later than  $t$ .  $A_t$  remains a property, not a particular, though, unlike ordinary properties that can be instantiated at different times,  $A_t$  can be instantiated only at time  $t$ . As a property,  $A_t$  is not literally located in space and time, and it cannot precede the property  $B_{t'}$ . The temporal asymmetry between cause and effect that Eells insists on instead rests on the time

reference of  $A_t$  preceding the time reference of  $B_{t'}$  (or on the temporal relations between their instantiations).

The new time-dependent properties that Eells postulates are unenticing, and his account of causal asymmetry in terms of the temporal relations among time references in properties is undeveloped. Moreover, suppose that something has the property  $A_t$ . This implies its  $t$ -slice has the property  $A$ . So *if* anything has the property  $A_t$ , then the property  $A$  must be instantiated at  $t$ , and there must be a trope (a property instantiation at a place and time) of kind  $A$ . Unless the properties that stand in type-causal relations to one another have empty extensions, type-level causal relations always imply some sort of token-level relations among tropes, which are the same kind of thing as token events. If extensions of properties include elements of other possible worlds, then type-level causal relations always imply token-level relations among possible tropes. Relations between Eells' time-indexed properties always run in tandem with token-level relations. **CG** explains why.

A further reason for disquiet concerning time-indexed properties is (as Eells notes, 1991, p. 150) that type-level causal claims are not well construed as, for example,  $t$ -Smoking causes  $t'$ -Cancer. Such a claim relates smoking in one particular time period to lung cancer in a later time period. The surgeon general's claim in contrast applies to any time periods (provided that the circumstances are unchanged). It thus seems that type-causal claims involve quantification over the time-indices in properties. So type-causal claims will in any case turn out to be generalizations. Why then should one prefer to construe them as generalizations over relations between time-indexed properties (which seem in any case to involve a surreptitious reference to particulars) rather than as generalizations over possible events.

The third argument in defense of **CG** has nothing to do with the details of Eells's theory. The main point is that without concrete systems, there is no such thing as causation. *The asymmetry and directionality of the causal relation exists only in connection with arrays of tokens.* Whether or not the details of **CG** all withstand scrutiny, it seems that type causation derives from token causation. In making this claim, it is worth pointing out that I am not saying that token-causal claims are more important or more interesting than type-causal claims. In scientific contexts, interest of course usually centers either on laws or on causal generalizations.

What then of causal relations among variables or among values of variables? The simplest view is that the values of variables are properties. Among the properties of a gas are



quantitative ones such as having a temperature of  $20^{\circ}$ .  $T_g = 20^{\circ}$  is just another way of saying that the gas has a certain property. If values of variables are properties, then variables, like their values, appear to be properties, too, although they are determinables rather than determinants. The mass of a brick is like its color. Just as its color is red, so its mass is two kilograms. According to this plausible view, claims about causal relations among variables and among values of variables are simply claims about causal relations among types or properties, and nothing more needs to be said.

But there is more to be said. In his forthcoming book, Kevin Hoover challenges my defense of CG (Hoover 2000, ch. 4).<sup>5</sup> I argued above and in *Causal Asymmetries* that token causal relations are fundamental because causal relations link entities that -- like tokens and unlike types -- are located in space and time. Whether the temperature of a gas depends on its volume or vice versa depends on the specific set-up. In reply, Hoover points out that variables can also be located in space and time. The temperature of the gas in *this* balloon at *this* moment in time is a variable. Yet it is nearly as concrete as a trope, since it has only one real value, and that value *is* a trope. Although in this way “located”, the variable has a range of *possible* values and so, unlike its real value, a variable is not the same thing as a trope. The temperature of the air in this room right now is about  $20^{\circ}$  degrees centigrade, but it could have been hotter or cooler.

Let us call variables such as these -- variables that characterize some concrete particular and that at any specific time have only one real value -- “concrete variables.” Concrete variables need not be quantitative. Whether John is or is not angry at 5:00 on January 1, 2000 is a concrete variable with two possible values, only one of which is real. His anger at 5:00 -- if he is angry -- is a trope. Causal relations among values of concrete variables are thus causal relations among tokens (though these tokens are tropes rather than events). Causal relations among concrete variables themselves, however, are of a different kind. Just as counterfactual dependence involves a family of conditionals, so causal relations between concrete variables

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<sup>5</sup>Although Hoover argues for the thesis that causal relations among variables are fundamental, much of the view that I am attributing to him is only implicit in his remarks. I do not know whether he would agree with the details of the case made here.

involve a family of relations between their possible values.<sup>6</sup> Causal claims of this sort, stating how some of the variables characterizing a particular system at a particular place and time depend on other concrete variables play an important role in science. My arguments for the primacy of causal relations among tokens give one no reason to regard token causal claims as more fundamental than causal claims relating concrete variables. Unlike ordinary properties and other kinds of variables, concrete variables are (via the location of their values) located in time and space, and their causal relations accordingly need not be derivative from other sorts of causal relations.

Hoover maintains that causal relations among concrete variables are in fact fundamental. Since they have both the modal force of type-causal relations, because they relate many possible values, and the concreteness of token-causal relations, because their values have a single spatial and temporal location, they are well suited to be fundamental. When one knows the causal relations among concrete variables and their values, one can deduce the token causal relations. If  $X_{s,t}$  and  $Y_{s',t'}$  with values  $x_{s,t}$  and  $y_{s',t'}$ , are concrete variables and  $X_{s,t}$  causes  $Y_{s',t'}$ , then  $x_{s,t}$  causes  $y_{s',t'}$  and the event  $a$  of which (among other things) it is the case that  $X_{s,t} = x_{s,t}$  causes the event  $b$  of which it is the case (among other things) that  $Y_{s',t'} = y_{s',t'}$  in virtue of  $X_{s,t}$  causing  $Y_{s',t'}$ . Knowing the token causal relations among all the possible values of the variables would, of course, be just the same as knowing the causal relations among the variables, but if  $X_{s,t}$  and  $Y_{s',t'}$  are continuous variables, the causal relation among the variables is equivalent to a non-denumerable infinity of relations among the possible values. So in many cases, it is best to regard token-level causal relations as deriving from causal relations among concrete variables.

One can then continue to assert **CG**, and one can endorse a picture whereby type-level causal relations depend on possible token-level causal relations, which at least in some cases depend on causal relations among concrete variables. But one can just as readily link causal relations among variables in general to causal relations among concrete variables:

**VCG** (*Variable counterfactual generalization view*)  $X$  is a cause of  $Y$  in circumstances  $K$  if and only if in  $K$  each concretization of  $X$ ,  $X_{s,t}$ , which is possible,

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<sup>6</sup>The causal relation between the variables  $X$  and  $Y$  will typically hold only for some limited range of possible values. For example, the relation between the temperature and the volume of gas in a balloon will break down when the temperature is so high that the balloon melts or when the temperature is so low that the balloon loses its elasticity.

would cause some concretization of  $Y$ ,  $Y_{s',t'}$ , that bears the right spatial and temporal relations to  $X_{s,t}$ .

A concretization of a variable is its application to some possible spatio-temporal particular. The mass of my pen right now is a concretization of mass. Since the types or properties mentioned in type-causal claims are values of non-concrete variables, while tokens are values of concrete variables, **VCG** implies **CG**. Causal relations among types or non-concrete variables are generalizations of causal relations among tokens or concrete variables, with the modal vocabulary needed for the circumstances in which nothing can be characterized in terms of the variables that are causally related. Indeed, some unclarity about exactly what variable they are discussing permits scientists to slide harmlessly from claims concerning concrete variables to more general claims. Causal relations between the temperature and volume of the gas of this balloon at different times or of temperatures and volumes of gases in balloons generally are generalizations of causal relations among concrete variables like the relation between the temperature and volume of the gas of this balloon at this time. Lawful relations between temperature, volume, pressure and other things are not causal generalizations.<sup>7</sup>

This picture brings philosophical discussion of causal relations closer to a good deal of scientific practice. The fundamental causal relations are causal relations among variables -- but not among any kind of variables. At the base lie causal relations among concrete variables. These are located by their values; and indeed each has only one real value, which is a trope. Causal relations among the values of concrete variables are implied by causal relations among the concrete variables themselves. The relations among the values are token causal relations, which are not more fundamental than relations among concrete variables. Causal relations between variables in general are generalizations of causal relations among concrete variables, just as type-level causal claims are generalizations of token-level claims. Such a picture is particularly well suited to relate causation to counterfactuals, but it is also compatible with a regularity theory, provided that one distinguishes -- as one must -- between type-level causal

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<sup>7</sup>Regularity theories would, of course, prefer to find the necessary connection between particulars in nomic connections between properties, and they would have less of a reason to prefer a view that takes causal relations among concrete variables to be fundamental to a view that takes as fundamental causal relations among tokens. Indeed, those who deny that counterfactual claims can be true or false might deny that there is anything to concrete variables and their relations apart from relations among tokens. Accepting causal relations among concrete variables as fundamental does not, however, commit one to a counterfactual theory of causation.

relations and the laws which, according to regularity theorists, underlie token causal relations.

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## Appendix: Type and Token Probabilistic Causation

When one turns to probabilistic causation, the case for the autonomy of type and token causation may appear stronger, in two ways. First, the fact that *A* is a type-level probabilistic – rather than deterministic – cause of *B* in circumstances *K*, means that instances of *A* occurring in circumstances *K* do not always succeed in causing instances of *B*. One has what I call “token failures.” Second, there are *token reversals*: cases in which a token *a* of type *A* causes a token *b* of type *B*, even though at the type-level *A* prevents *B*. I. J. Good gives the following example:

Sherlock Holmes is at the foot of a cliff. At the top of the cliff, directly overhead, are Dr. Watson, Professor Moriarty, and a loose boulder. Watson, knowing Moriarty’s intentions, realises that the best chance of saving Holmes’s life is to push the boulder over the edge of the cliff, doing his best to give it enough horizontal momentum to miss Holmes. If he does not push the boulder, Moriarty will do so in such a way that it will be nearly certain to kill Holmes. Watson then makes the decision (event *F*) to push the boulder, but his skill fails him and the boulder falls on Holmes and kills him (event *E*). (1961, p. 318)

It seems that Watson’s decision causes Holmes’s death and lowers its probability. Good argues that one should distinguish between the “tendency” of the decision and its degree of causal influence, rather than between causal relations among types vs. causal relations among tokens. Although both the “tendency” and the “degree of causal influence” appear to pertain to the particular decision, Eells and Sober (1983) interpret Watson’s specific decision as a token cause of a type that prevents events like the one that befell Holmes.

Eells explains the possibility of token reversals by means of an intricate theory of token-level causation (1991, ch. 6), which I shall not discuss here. Good offers a much simpler account (1961, p. 318): since there is a causal chain between Watson’s decision and Holmes’ death, Watson’s decision causes Holmes’ death. Although I cannot argue the point here, this construal of token causation implicitly surrenders any connection between token causal outcomes and probabilities. What makes Watson’s decision a token cause of Holmes’ death is the fact that Holmes’ death traces back to the decision. In this case the tracing back is of course via a chain of probability-increasing causes, and a probabilistic theory of token

causation such as David Lewis' (1986, pp. 175-84) would imply that the Watson's decision causes Holmes' death. But the facts about the probabilities are neither necessary nor sufficient for causation in this (admittedly vague) tracing back sense.<sup>8</sup> Eells maintains that there are two different notions of token probabilistic causation, a probabilistic and a tracing-back sense (1991, pp. 384-86) and that there are token reversals among causes in the probabilistic sense. I too am suggesting that there are different notions of causation, but in my view, token reversals arise from conflicts between causation in its (probabilistic) tendency sense and causation in its outcome (tracing back) sense. I doubt that there is any probabilistic theory of token causal outcomes. Probabilities are relevant to causal tendencies and are only evidence for claims about causal outcomes.

But whether these unargued assertions are correct or not, token failures and token reversals call for a distinction between tendencies and outcomes, not for a distinction between causal relations among properties and causal relations among events.

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<sup>8</sup>Arguments for this bold assertion are implicit in Salmon's (1984) and, from a very different perspective, in Ned Hall's unpublished manuscript.