

# DISSERTATION ABSTRACT

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My dissertation, *Counterfactual Dependence and Causation's Arrows*, delivers three important results:

I begin by highlighting an overlooked limitation of previously-available semantic theories of counterfactuals—those that handle counterlegals cannot handle backtrackers and vice versa. The difficulty here is principled: Roughly, to handle backtrackers a semantics must hold laws (or some general principles) fixed, but to handle counterlegals, some allowance for law-breaking must be made. This work is published in Fisher (2016b). My first result is that both backtracking and counterlegal counterfactuals can be interpreted within a single semantic framework, which I provide. To elaborate, a semantics for counterfactuals should be able to appropriately evaluate conditionals such as:

- (B) If Scotty were in Canberra now, he wouldn't have joined us for dinner this evening (here in California).

and

- (C) Even if the temperature hadn't risen, that bottle containing that beer would have burst had its internal pressure risen above 150 psi.

(B) is a *backtracking counterfactual*—it tells us how an earlier time would be different had a later time been different. (C) is a *counterlegal*—its antecedent is inconsistent with some set of laws. Oddly, for other theories if they can handle backtrackers, they cannot handle counterlegals. The problem is principled: Roughly, to handle backtrackers a semantics must hold laws (or some general principles) fixed, but to handle counterlegals, some allowance for law-breaking must be made.

The semantics I develop interprets a given counterlegal relative to a causal-model,  $M$ , representing the causal system the counterlegal is about and relative to a class of models that are *minimally-illegal* (relative to  $M$ ). Loosely, a causal-model is minimally-illegal just in case it represents a minimal violation of  $M$ 's laws while satisfying the antecedent of interest and maximally preserving  $M$ 's assignment of values to its variables. Non-counterlegals are then treated as degenerate cases of counterlegals—cases in which the set of violated laws is empty. In such degenerate cases, my semantics agrees with Hiddleston's (2005), a semantics that does well with backtrackers. This work is published in Fisher (2016b).

The next two results bear on the validity of Modus Ponens. The first of these results is that, when applied to right embedded counterfactuals, the dominant approach to causal-model semantics—the interventionist approach of, e.g., Pearl 2000; Briggs 2012—succumbs to counterexamples. Consider, for example:

- (M) If the match had lit, then even if it hadn't been struck, it would have lit.

There are natural contexts relative to which this conditional comes out intuitively false. But interventionist theories admit no falsifying model.

I go on to show that the reason interventionist theories cannot adequately handle such conditionals is exactly the reason they cannot handle backtrackers, and, moreover, the reason they invalidate

Modus Ponens. My counterexamples thus provide a route to a philosophical response to the interventionist's proposed counterexamples to Modus Ponens. They also show that the property of interventionist theories that makes them unable to interpret backtrackers and that invalidates Modus Ponens also makes them unable to adequately interpret some non-backtrackers. These points are made in Fisher (2016a).

In the final part of my dissertation, I argue that an apparently valid inference that has guided much theorizing about indicative conditionals is, in fact, invalid. This is the inference from the indicative conditional to its material counterpart. The basic idea is as follows. A semantics *qua semantics* should not encode assumptions that rule out metaphysical views that turn on extra-semantic matters. Whether indeterminism holds or not is an extra-semantic matter. And there are forceful arguments from indeterminism to the failure of bivalence for future contingents. Taking it as a premise now that a semantics should admit models that give rise to truth-value gaps (whether due to vagueness, or indeterminism, or what have you), I give arguments for the conclusion that the indicative conditional does not entail its material counterpart. Here is one:

Consider a case such that laws (invariances if you prefer) guarantee that a photon-emission event at point  $A$  at  $t_1$  would cause a photon-arriving event at  $B$  at  $t_2$  but such that it is indeterminate whether a photon will be emitted from  $A$  at  $t_1$ . There are familiar arguments to the conclusion that both the sentence "A photon will be emitted at  $A$  at  $t_1$ " and its negation lack witnesses for their truth or falsity. The classical connectives are truth functional and, so, have no defined output for cases involving gappy sentences. Hence " $\neg(\text{Photon emission at } A \text{ at } t_1) \vee \text{Photon arrival at } B \text{ at } t_2$ " is neither true or false. Nonetheless, the indicative conditional "If a photon is emitted from  $A$  at  $t_1$ , then a photon will arrive at  $B$  at  $t_2$ " is intuitively true. So the indicative does not entail its material counterpart.

This entailment claim is a crucial, though often ignored, part of the simple and forceful direct arguments for the conclusion that the indicative conditional is truth-conditionally equivalent to the material conditional. I go on to show, against orthodoxy, that the failure of the above entailment is consistent with the validity of Modus Ponens and to defuse the strongest of the direct arguments by showing one can grant the key principles they involve without an attendant collapse of the indicative conditional into the material conditional.

## References

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