Invariance and Explanatory Depth

According to the account of causal explanation developed by James Woodward and Chris Hitchcock (Woodward and Hitchcock, 2003a,b; Woodward, 2003), a generalization of the form $Y = f(X)$ contributes to causally explaining an event of the form $y = f(x)$, where capital letters represent variables and lower-case, particular values taken by these variables, if and only if this generalization is both true of the actual values of X and Y and invariant under at least one conceptually possible intervention on X with respect to Y.

The idea at the root of the account is that invariant generalizations enable us to answer questions about the ways the effect would change under various interventions on its causes. Woodward and Hitchcock call these 'what-if-things-had-been-different' questions (or w-questions), and argue that developing answers to them is what constructing causal explanations consists in.

This account of causal explanation goes together with an accompanying account of explanatory depth, i.e. of the criteria we rely on when making comparisons of explanatory quality between generalizations describing causal relations.[1] Woodward and Hitchcock's claim thus is that there exists a threshold for contribution to causal explanation, namely invariance under at least one conceptually possible intervention, and, above this threshold, a continuum of generalizations of varying explanatory depth, or quality.

The account of explanatory depth defended by Woodward and Hitchcock is summarized by their statement that a generalization "can provide a deeper explanation than another if

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[1]Note that Woodward and Hitchcock take 'depth', 'quality', or 'goodness' as synonyms.

it provides the resources for answering a greater range of what-if-things-had-been-different questions, or equivalently, if it is invariant under a wider range of interventions." (2003b, 198) There are several ways one can understand the expression 'greater range'.

One can first understand it in a purely quantitative way, as meaning that a generalization permits deeper causal explanations the larger the number of interventions it is invariant under. In this case, however, one needs a procedure for counting interventions. I propose such a procedure, and defend it as the only one which fits the needs of the account defended by Woodward and Hitchcock. I then argue, on the basis of this procedure for counting interventions, that Woodward and Hitchcock are committed to the view that every explanatory generalization is invariant under infinitely many interventions. I sketch the argument below.

Woodward and Hitchcock are interested in conceptually possible interventions rather than actual interventions, so the degree of depth of a generalization is determined by the number of interventions it is invariant under, regardless of whether these interventions are actual or merely possible. But, given the plausible assumption of the density of the space of possibility – defended, e.g., by David Lewis (1986, 86) – any generalization that is invariant under one conceptually possible intervention is also invariant under infinitely many very similar interventions.

Consider, for instance, the causal relation between the position of the gear stick in my manual transmission car, X, and the gear my car is in, Y. If a generalization describing this causal relationship is invariant under an intervention which sets $X = 3$ by a movement of my right hand m, then it will also be invariant under infinitely many movements of my hand which are arbitrarily similar to m. This follows from the space of possibility being dense and from the way of individuating and counting interventions I argue best fits the account defended by Woodward and Hitchcock.

The number of interventions a generalization is invariant under thus cannot be part of what determines its explanatory depth, since every explanatory generalization is invariant under infinitely many interventions, and since not every generalization, it is assumed, permits causal explanations which are equally deep. I examine an alternative way in which one might understand the expression 'wider range', hinted at by Woodward in his book (2003, 262). According to this interpretation, a generalization is more invariant the more important the interventions it is invariant under, and thus the more important the w-questions it enables one to answer. What 'importance' amounts to, Woodward claims, is determined by the explanatory context.

To take this dependence on context into account, I develop an example involving two generalizations, G_1 and G_2, purporting to explain the same fact, that a sample of water in a freezer is frozen rather than liquid. I argue that although G_1 is invariant under interventions which are of lesser or equal importance compared to the ones G_2 is invariant under, it nonetheless intuitively provides deeper causal explanations because it cites a cause which is 'proportional' to the effect explained, in the sense of (Yablo, 1992). Because proportionality has been defended as one of the main norms for causal explanation by a number of writers, including Woodward himself (2010), I conclude that the account of explanatory depth advanced by Woodward and Hitchcock is inadequate, since it conflicts with proportionality.

There are several possible avenues of response for Woodward and Hitchcock. I examine the one which I take to be the most immediate. It consists in claiming that what is important for explanatory depth is neither the number nor the importance of the interventions a generalization is invariant under, but their variety. To answer this objection, I go back to the example used in the argument against the criterion of importance, and show that the criterion of variety is equally inadequate, since G_2 answers a wider variety of w-questions,

but G_1 is the generalization which satisfies the requirement of proportionality. I also briefly address objections against the procedure I propose for counting interventions, and against the space of possibility being dense.

The overall conclusion defended thus is that the account of depth in terms of invariance defended by Woodward and Hitchcock is inadequate, and does not appropriately capture the comparative judgments of explanatory depth we seem to make about generalizations describing causal relations.

References

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