GLYMOUR ON THE MARKOV ASSUMPTION AND FAITHFULNESS

FABRIZIO CARIANI

In his paper, Glymour raises a number of issues about the theory of causation which he himself proposed. The project, as Glymour puts it, is not to give a theory that says what causal regularity is, but to capture some connections between causation, probability and action via axioms which turn out to have important practical applications. While I will mostly talk about counter-examples to these axioms, this comment does not contain any objections to the theory. My goal is to ask a couple of questions about what is the right strategy to deal with the counter-examples.

Since we've seen Causal Bayes Nets several times, I will take for granted the definition of a Directed Acyclic Graph, and repeat (somewhat quickly) a couple of essential definitions and the statements of the two assumptions:

Let V be a set of variables with causal relations represented by a DAG:

(1) Given a variable X in V, the set of Parents(X) is the set consisting of all and only the direct causes of X in the graph.

(2) V is *causally sufficient* iff whenever $Y \in V$ and $Z \in V$, and $Z \neq Y$ and X is a common cause of Y and Z, then $x \in V$.

That is to say, V is causally sufficient iff for any two distinct variables Y and Z in V, any common cause X of Y and Z belongs to V) The axioms I would like to discuss are the Markov and the Faithfulness assumptions. These axioms state constraints on the probability distribution over the values of the variables, given a causal structure.

We can state them as follows:

As above, let V be a set of variables with causal relations represented by a graph; in addition, assume that V is causally sufficient:

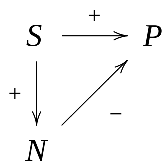
(MA) $\forall X, \forall Y[(Y \neq X \,\&\, Y \notin Parents(X) \,\&\, Y \notin Descendants(X)) \Rightarrow (Y \perp\!\!\!\perp X | Parents(X))]$

The Markov Assumption states that in a causally sufficient system, a variable X is independent of any another variable Y conditional on the set of Parents(X), if Y is not a direct cause of X, and Y is not an effect (either direct or mediated by other variables) of X.

(F) Two variables in the graph are independent conditional on any set of variables, if and only if the Markov Assumption entails that independence.

Now, these assumptions, together with the definition of an Intervention prove very fruitful in grounding methods for gathering information about causal systems. Among the most striking application is that, in cases where we have causal knowledge about a given system, the assumptions can be used to predict the outcomes of experimental interventions.

Both of these axioms have, however, counter-examples. The stock counter-example against the Faithfulness assumption is roughly as follows: Suppose that smoking (S) positively influences my productivity (P), but it also causes me to be more nervous (N) which, in turn has a negative causal influence on my productivity. The causal structure, then, looks somewhat like this:



Applied to this graph, faithfulness entails that the positive influence of smoking cannot be exactly canceled out by the negative influence of nervousness. However, it seems possible, in principle, to have a probability distribution that makes my nervousness and my smoking independent of each other, in spite of the existence of causal connections between the two. In this case, Faithfulness would be violated.

More than in the example, *per se*, I am interested in the defense that Glymour would give of the Faithfulness condition against it. In his entry on Probabilistic Causation in *SEP*, Cristopher Hitchcock discusses a similar counter-example to Faithfulness. He suggests, as a moral, that the Faithfulness condition should be taken as a *methodological* principle. According to Hitchcock, given a probability distribution we should infer to causal structures that satisfy the Faithfulness condition on the basis of considerations of simplicity.

I would like to ask Glymour if he would take this way out of the problem. In personal conversation, I had the impression that he would have a different take. The idea is still to accept the counter-examples as failures of Faithfulness, yet to argue that they should not affect our acceptance of the axiom. As far as I understand, the reason is that the justification of the condition is not a belief in its universal validity; rather we defend the axiom because of its fruitfulness. That is to say, the assumption is heuristically indispensable.

According to this line, we should not believe the assumption refuted by isolated violations, as long as the failures are localized and the assumptions keep having successful applications. Of course, this view is not incompatible with the one that Hitchcock suggests. They are, however, different views, one being about the role and the other about the justification of the assumption. Also, adopting one removes the reason for adopting the other.

I now turn to my second question: whichever strategy we accept in order to defend the Faithfulness condition, can we use the same strategy to defend the *Markov Assumption* also from the problem raised by the Aspect Experiment?

My reason for asking is this: when he states his conclusions about the Aspect Experiment, Glymour insists on an asymmetry between the large and the small:

(1) The Markov Assumption *works* in the "large" world of everyday objects.

(2) The Markov Assumption does not work in the quantum world. Another way of putting my second question is: how are we to understand the word "work" in these two cases?

Should we understand it as meaning “having no counter-examples”, in which case I wonder what evidence we have for (1). Or should we understand it as meaning that the assumptions give us tools to make certain successful predictions about interventions?

In this case I would state my confusion on this point as follows: is the Aspect Experiment simply a localized phenomenon or class of phenomena (like the counter-examples to Faithfulness) or is the failure of the Markov Assumption a completely systematic feature of the quantum world?