Notes and Comment

Causal and conditional inferences: A comment on Cummins (1995)

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Cummins (1995) offers an analysis of causal and truth-functional sufficiency and necessity to predict and explain the effects on conditional inferences of two pragmatic factors: alternative causes and disabling conditions. However, the justification of these predictions is inconsistent. This note offers a modified analysis which puts her predictions on a sounder base: it is proposed that alternative causes and disabling conditions affect judgments of argument validity under three different models for the causal conditional.

Reasoning about causation has, in view of its frequency in everyday thought, received surprisingly little attention, and causal inference itself has attracted less work than causal attribution. Cummins and her colleagues (Cummins, 1995; Cummins, Lubart, Alksnis, & Rist, 1991) have pioneered empirical research in this area in recent years. Cummins has focused on causal necessity and sufficiency and on two factors that appear to mitigate the acceptance of causal inferences: alternative causes and disabling conditions. Alternative causes are held to affect the acceptance of inferences about the necessity of a cause for an effect, whereas disabling conditions are held to affect inferences about the sufficiency of a cause for an effect.

Cummins uses concrete conditional sentences to assess these predictions, and this raises an interesting potential clash between causal necessity and sufficiency, on the one hand, and truth-functional necessity and sufficiency, on the other. In the latter case, the standard logic of the material conditional states that the antecedent is sufficient for the consequent, and that the consequent is necessary for the antecedent. Cummins (1995) provides some important demonstrations of where predictions from either the causal or the truth-functional (or syntactic) perspective cut across one another; the results are held to favor her causal analysis.

In general, we accept Cummins's conclusions and agree that the results support her overall thesis. However, there are some inconsistencies in the way in which the predictions are justified, and that is the subject of the present comment. Because of Cummins's emphasis on the operation of alternative causes and disabling conditions on peo-

ple's representations of *causal* (as opposed to syntactic) necessity and sufficiency, it is important that the analysis be soundly based.

Consider the four basic forms of inference in a conditional syllogism, which Cummins employs in her studies; we shall concentrate mainly on the standard "If cause then effect" statement, using C for "cause" and E for "effect," as in her papers:

			Inference Type
If C then E;	C;	therefore E	Modus ponens (MP)
If C then E;	not C;	therefore not E	Denying the antecedent (DA)
If C then E;	E;	therefore C	Affirming the consequent (AC)
If C then E;	not E;	therefore not C	Modus tollens (MT)

Standard logic states that MP and MT are valid inferences, in that the conclusion necessarily follows from the premises, but that DA and AC are invalid.

It is when we assess Cummins's predictions about what the effects would be of the existence in people's minds of alternative causes and disabling conditions that we run into problems. In Cummins's (1995) general introduction (p. 648), we read that conclusions about the occurrence of an effect will be influenced by disabling conditions, whereas conclusions about causes will be affected by alternative causes. Thus, she continues, MP and DA should be affected by disabling conditions, and AC and MT should be affected by alternative causes. However, the introduction to Experiment 1 (pp. 649–650) and the summary of the predictions given in Figure 2 are inconsistent with this reading. The latter shows that, for "If C then E," it is MP and MT that are supposed to be affected by disabling conditions, and DA and AC, by alternative causes. The examples of MT in adjoining columns on p. 649 make this inconsistency quite clear: in the left-hand column, example (g) is given to show that MT "should be influenced by consideration of alternative causes," while in the right-hand column "these arguments [MP and MT] should be influenced by the number of disabling conditions." Note that it is the second version of these predictions that is supported by the data.

One of the other innovations in the 1995 paper is the use of reversed causal conditionals—those taking the form "If E then C." This manipulation provides a strong test of the effects of alternative causes and disabling conditions, since clearly these factors should affect causal inference irrespective of component order. Once again, however, inconsistent versions of the rationale are offered, and again it is the unsupported predictions contained in Figure 2 that are upheld by the data.

We propose that the resolution of this inconsistency lies in being clear about the distinction between causal ne-

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cessity and sufficiency and syntactic or truth-functional necessity and sufficiency, which Cummins rightly urges on us. The following analysis is an attempt to do this, influenced by the account given in Miller and Johnson-Laird (1976).

Recall that Cummins's predictions for "If C then E" as set out in Figure 2, not the general introduction, were that MP and MT would be affected by disabling conditions, and that DA and AC would be affected by alternative causes. Note also that disabling conditions are said to cast doubt on the sufficiency of C for E, and alternative causes are said to cast doubt on the necessity of C for E. There are three models for a standard causal sentence:

- (i) C is sufficient for E (C suff E)
- (ii) C is necessary for E (C nec E)
- (iii) C is necessary and sufficient for E (C necsuff E)

Argument validity (i.e., the conclusion that must follow, given the premises, under each model) relates to conditional inference patterns as follows:

		(i) C suff E	(ii) C nec E	(iii) C necsuff E
MP	C > E	Valid	Invalid	Valid
DA	not C > not E	Invalid	Valid	Valid
AC	E > C	Invalid	Valid	Valid
MT	not E > not C	Valid	Invalid	Valid

We can therefore see that disabling conditions should affect MP and MT in models (i) and (iii), where these would be the valid inferences; alternative causes should affect DA and AC in models (ii) and (iii) similarly. A consequence of this analysis would be that alternative causes and disabling conditions would vary in their effects, depending on which of these three models was held for a given causal conditional. In other words, alternative causes and disabling conditions will affect their

respective relevant inferences when they are valid, and these are the grounds for Cummins's predictions. There is therefore a clear relation, as well as a distinction, between causal and syntactic conditional inference.

Thus we can support Cummins's predictions, but not the rationale that she offers (in some places) for them; whether a conclusion is "about" C or E is a red herring. We do not consider that the separation of causal and truth-functional necessity and sufficiency is as clear as is claimed. On the other hand, we concur with her that when people are attempting to assess whether a cause is necessary or sufficient to produce an effect, they do so by trying to generate counterexamples that would vitiate the proposition in question. These counterexamples consist in Cummins's alternative causes and disabling conditions. We further agree that a purely syntactic view of causal conditional reasoning would have difficulty in explaining the demonstrated effects of these pragmatic factors in everyday contexts. This suggests that a theory based on mental models (e.g., that of Johnson-Laird & Byrne, 1991; cf. Miller & Johnson-Laird, 1976), which has a central place for the generation of counterexamples, would be a ready alternative.

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