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Issues in Reasoning about Iffy propositions: The Secondary Inference Model of Revising Conditional Beliefs and Inferences

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In the cognitive psychology of human reasoning the belief revision paradigm (Elio & Pelletier, 1997) deals with how people accommodate new information that contradicts previous inferences/beliefs. Let us assume for instance that you believe that 'if an animal is a bird, it can fly' and that we tell you that Tweety is a bird. You will now most likely have the expectation that Tweety can fly. This expectation follows a so-called Modus Ponendo Ponens (MPP) argument: *[if p then q], [p], therefore [q]*. Now imagine that we tell you that Tweety is an ostrich and cannot fly: *[not-q]*. If you accept this new information, you have to alter your belief in one or both of the propositions hitherto accepted as true. Which premise do you revise and how do you do this?

Belief revision studies also confront reasoners with so-called Modus Tollendo Tollens arguments (MTT): *[if p then q], [not-q], therefore [not-p]*, which is contradicted by a new belief *[p]*. A comparison with MPP has shown that the initial logical structure of a defeated argument affects the belief revision process: There exist *'inference contradiction effects'* (ICEs: computed as the difference between rejection rates of the major premise in MPP versus MTT, Byrne & Walsh, 2002). In the following we present the Secondary Inference Model of ICEs, which we support with some new evidence.

The Secondary Inference Model

The secondary inference model (SI) is based on the idea that the contradicting premise grounds an inference that leads to (and justifies) the rejection of the major or minor premise of the contradicted argument. People can combine the contradicting premise with either the major or minor premise to resolve the inconsistency (there is no logical ground on which one should be preferred over the other). Take the contradicted MTT. First, combining the contradicting *[p]* with the *[if p then q]* yields the inference *[q]*. This *conditional inference (CI)* argument marks the categorical premise *[not-q]* as false. Second, combining *[p]* with *[not-q]* forms the basis of a *counterexample (CE)* argument that marks the conditional as false because *[p and not-q]* cases would be impossible if the conditional were true. Now take a contradicted MPP. The contradicting *[not-q]* grounds a secondary MTT, which yields *[not-p]*. This secondary *CI* argument again marks the categorical premise as false and revisable. The alternative secondary *CE* argument again results in marking the conditional as false.

In summary, revising the minor of a contradicted MPP is based on a secondary MTT, while revising the same categorical premise in a contradicted MTT is based on a secondary MPP. Since we know that MPP is easier than MTT, we can predict and explain a positive ICE (more revisions of the conditional in MPP vs. MTT). Indeed, because it is easier to revise the minor in MTT (since it is based on a secondary MPP) people will be more likely to revise it than in MPP. This means that people will be less likely to revise the conditional in MTT vs. MPP: People exhibit a positive ICE. The SI model yields the general prediction that any factor that influences the relative difficulty of MPP versus MTT will affect the ICE size.

Table 1: Revision rates of the major conditional premise as a function of the type of conditional and argument type.

	Diagnostic Rules			Definitional Rules		
Study	MPP	MTT	Z	MPP	MTT	Z
Exp. 1	69	50	1.92	54	63	-0.88
Exp. 2	47	.30	1.91	41	54	-1.65

To test the SI model we ran two studies that compared diagnostic and definitional conditionals: respectively, 'if the product contains Celerin, then it is a Type-A product' and 'if it is a Type-B product then it contains Erinantium'. Participants were presented with both contradicted MPP and MTT arguments and were given the option to revise either the major conditional or minor categorical premise. Table 1 presents the proportion of revisions of the conditional premise as a function of the type of conditional. The results show clear crossover interactions between problem type and the type of conditional (Z = 1.96 and 2.88, respectively). While diagnostic rules yield positive ICEs, definitional rules tend to result in negative ICEs. This finding supports the SI model. Indeed, definitional rules facilitate MTT. Participants in Experiment 2 first evaluated the arguments based on definitions (N = 91) or diagnostic rules (N = 73): MTT with definitions were accepted more frequently (.89 vs. .62; U = 2412.5, Z = 4.11, p < .05). The secondary CI argument on a contradicted MPP thus becomes easier. Conversely, the secondary CE argument on a contradicted MTT becomes easier with diagnostic rules that are less certain than the definitional rules.

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