Counterfactual 'only if ' conditionals

Ruth M.J. Byrne (rmbyrne@tcd.ie), Suzanne Egan (smegan@tcd.ie)
Psychology Department, University of Dublin,
Trinity College, Dublin, Ireland

Juan A. García-Madruga (jmadruga@psi.uned.es)
Developmental and Educational Psychology Department,
UNED, Madrid, Spain

'If ' and 'only if'

People understand a conditional, 'if A then B', such as 'if Peg went swimming then she felt well' by keeping in mind only true possibilities, e.g., A and B, not-A and not-B, not-A and B (Johnson-Laird & Byrne, 2002). Initially they think about only a few of them, e.g., A and B, because of working memory limitations. As a result, they make some inferences readily e.g., modus ponens (MP), given A, therefore B. But they find other inferences difficult, e.g., modus tollens (MT), given not-B, therefore not-A. The information does not correspond to their initial possibility and they must think about other true ones, e.g., not-A and not-B.

Counterfactual conditionals, such as 'if Peg had gone swimming then she would have felt well' are different. 'If A had been then B would have been' conveys a conjecture, A and B, but it also conveys a presupposition that the facts are the opposite, not-A and not-B. Reasoners keep in mind two possibilities from the outset. As a result, they make more of the inferences that depend on access to the negative possibility, e.g., MT, and the denial of the antecedent (DA), given not-A, therefore not-B (Byrne & Tasso, 1999).

An 'only if' conditional, e.g., 'Peg went swimming only if she felt well' is logically equivalent to an 'if' conditional. 'If A then B' and 'A only if B' are both false in the same situation, A and not-B. However, their everyday interpretations have long been debated. Reasoners make more MP than MT from 'if' but the difference disappears with 'only if' (Evans, 1993). We suggest that reasoners keep more possibilities in mind to understand 'only if' then 'if' (Johnson-Laird & Byrne, 2002), and they prefer to process them in the direction B to A (Evans, 1993).

Counterfactual 'A only if B'

We tested the idea that reasoners keep in mind two possibilities, B and A, and not-B and not-A for factual and counterfactual 'only if'. We predicted there would be the same frequency of inferences from them, unlike for 'if'. We gave problems based on either factual or counterfactual conditionals to 40 students from Dublin University. Each participant received 'if' and 'only if' problems, based on neutral contents about locations, ingredients, and actions. The problems were presented on Macintosh computers using SuperLab which recorded their endorsements.

The results showed that there was a difference between factual and counterfactual 'if', but no difference between factual and counterfactual 'only if'. Participants endorsed more negative inferences from counterfactual 'if', reliably so for DA (84% versus 63%) although not for MT (71% versus 79%), and there were no differences for the affirmative inferences, as Table 1 shows. As we expected, there were no differences for the negative inferences from counterfactual 'only if', for DA (68% versus 79%), and MT (92% versus 96%), and also no differences for the affirmative inferences.

Table 1: The percentages of inference endorsement

Inference	MP	AC	MT	DA
If				
Factual	100	67	79	63
Counterfactual	100	67	71	84
Only if				
Factual	95	84	96	79
Counterfactual	98	73	92	68

The results support the suggestion that reasoners keep in mind two possibilities to understand factual and counterfactual 'only if'. In contrast, they keep in mind a single possibility to understand factual 'if' and two possibilities to understand counterfactual 'if' (Thompson & Byrne, 2002).

Acknowledgments

References

Byrne, R. M. J. & Tasso, A. (1999). Deductive reasoning with factual, possible and counterfactual conditionals. *Memory and Cognition,* 27, 726-740.

Evans, J.St. B. T. (1993). The mental models theory of conditional reasoning: critical appraisal and revision. *Cognition*, 48, 1-20.

Johnson-Laird, P. N. & Byrne, R. M. J. (2002). Conditionals: a theory of meaning, inference, and pragmatics. *Psychological Review*. 109, 646-678.

Thompson, V. & Byrne, R.M.J. (2002). Making inferences about things that didn't happen. *Journal of Experimental Psychology: Learning, Memory & Cognition.* 28, 1154-1170.