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Authors

Valee-Tourangeau, Frederic
Murphy, Robin A.

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Action-Effect Contingency Judgment Tasks Foster Normative Causal Reasoning

Frédéric Vallée-Tourangeau and Robin A. Murphy

Department of Psychology, University of Hertfordshire
Hatfield, Hertfordshire, UNITED KINGDOM, AL10 9AB
psyqfv, psyqram@herts.ac.uk

Abstract

We report two experiments using an action-effect causal inference task in which subjects were asked to evaluate the importance of an action they performed in producing the effect. In Experiment 1, judgments of positive and zero contingencies were a function of the actual action-effect contingency and they were not influenced by the effect base rate. Experiment 2 replicated this finding but did record a significant influence of the effect base rate on ratings of negative contingencies. We identify a number of research avenues that may elucidate why an inferential context involving instrumental learning fosters causal inferences that approximate so closely the actual degree of contingency.

A reasoner who aims to infer the causal importance of a candidate cause in producing a target effect in a novel domain may be unable to recruit prior knowledge to help her formulate an initial hypothesis as to the causal importance of the candidate cause. In this situation the contingency between the causal candidate and the effect is an informative cue. Research has shown that causal inferences in such situations are significantly determined by the actual level of cause-effect contingency, but they are also significantly influenced by the overall probability of the effect. Thus, if the target effect frequently occurs then subjects are more likely to attribute greater importance to the causal candidate than if the target effect seldom occurs, even if in both cases the actual cause-effect contingency is held constant. In contrast, prior research using an action-effect contingency judgment task has revealed that subjects attribute less causal importance to their action at high levels of the effect base rate. Paradoxically, then, a passive learning procedure fosters inflated causal ratings at high levels of the effect base rate whereas an active learning procedure yields deflated causal ratings at high levels of the effect base rate.

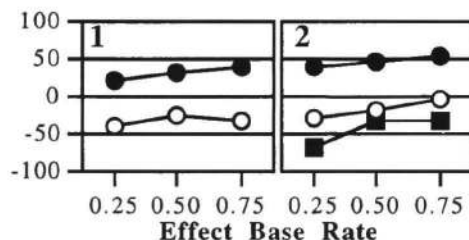


Figure 1. Mean causal ratings in each of the six action-effect contingencies of Experiment 1, and in each of the nine action-effect contingencies of Experiment 2. Black circles correspond to the positive contingency conditions, white circles to the zero contingency conditions, and black squares to the negative contingency conditions.

A careful examination of the previous experimental procedures for action-effect contingency judgment tasks revealed that the contiguity between the action and the effect varied across time intervals. That is, during an interval in which the effect was programmed to occur following an

action, the presentation of the effect was delayed until the end of the one-second interval. As a consequence, if a response was recorded at the beginning of the time-interval then there could be nearly up to a one-second delay before the appearance of the figure. At high levels of the effect base rate this degraded contiguity could suggest to the participants that something other than their behavior is causing the effect to occur and hence attenuate their perception of the causal effectiveness of their action. Hence, high effect base rates might lead to weaker causal ratings. In the experiments reported here we have removed this variability in contiguity by ensuring that during the time intervals in which the effect followed the action, it did so immediately after the action was performed.

In Experiment 1, 26 subjects were exposed to 6 conditions reflecting the factorial combination of two levels of the action-effect contingency (0, 0.5) and three levels of the overall density of the effect (0.25, 0.5, 0.75). Ratings are plotted in the left panel of Figure 1. Subjects easily discriminated between the two levels of contingency, but their ratings seemed generally uninfluenced by the base rate of the effect. A 2-factor repeated measures ANOVA confirmed these impressions: The main effect of contingency was reliable, $F(1, 25) = 65.2$, but neither the main effect of the effect base rate, nor the interaction were reliable, both $F_s < 1$. Experiment 2 replicated these 6 conditions but also included three new conditions in which the actual action-effect contingencies were negative (-0.5). The mean ratings of the 34 participants were plotted in the right panel of Figure 1. Exposure to the negative contingencies helped subjects calibrate their estimates of the positive and zero contingencies better. The effect base rate seemed to have influenced the ratings especially of the negative contingencies. The main effect of contingency was reliable, $F(2, 66) = 95$, as well as the main effect of the base rate of the effect, $F(2, 66) = 6.86$; the interaction was not reliable.

Our procedure maximized the contiguity between the action and the effect. In this respect one could argue that in the positive and zero contingency conditions better contiguity would catalyze the influence of the effect base rate since with high base rates, subjects were exposed to more perfectly contiguous pairings of their action and the effect. Yet causal ratings in conditions with high and low base rates did not differ significantly, a result observed in both Experiments 1 and 2. The stronger contiguity between an action and the effect encouraged better contingency judgments.

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