# What to Infer from an Inference

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***Abstract*—While the literature on human contingency learning has often centered on whether associative or normative models provide better accounts of participants' inferences, the learning tasks themselves are often slow and deliberative, using stimuli from domains with familiar causal structures. Two experiments test the influences of the learning task and background knowledge in learning cue-outcome relationships. In both, half of the subjects were given a causal cover story before beginning the experiment. The findings hint at an interaction between background knowledge and predictive learning in producing these effects.**

***Index Terms*— Learning, causal reasoning**

## I. Introduction

Making inferences about the relationships between different events in the world is an important part of learning how to predict future events. . The experiments presented here test the influence of a causal framing manipulation on participants' inferences in a prediction task and a fast-paced go/no-go task. We were interested in how framing might affect participants' inferences in the two tasks, as well as whether the cue-competition effects observed in the contingency learning literature would generalize to a task in which participants are under very strict time pressure.

## II. Experiments 1 and 2

**Figure 1** shows the general layout of both experiments. **Table 1** gives the trained and tested item-dot relationships.[1] In both experiments, half of the participants were given instructions that "some of the objects you will see have the power to make the dot appear," in order to frame the problem as a single-cause-effect relationship. Participants were also rewarded based on their performance in order to increase attention.

48 adults participated in Experiment 1. Participants were given an unlimited amount of time after the objects appeared to predict whether the dot would appear on that trial. During the training blocks, they were then shown the outcome and given feedback.

46 adults participated in Experiment 2 (23 in each condition). Participants were instructed to respond as quickly as possible to the appearance of the dot. In this experiment, the objects appeared alone for 400 ms, followed by a 500 ms outcome period.[2] During the test phase, all singletons received the dot on 50% of trials, in order to assess learning up to that point.

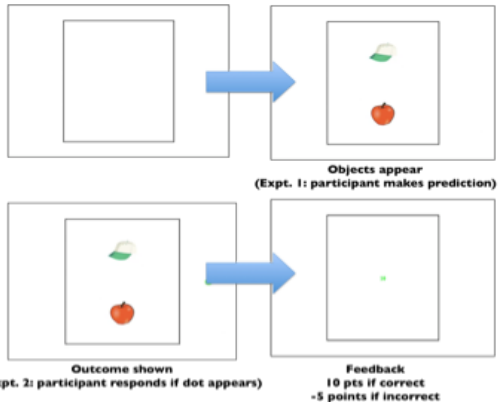


Figure 1: The layout of a trial in the two experiments.

TABLE I
EXPERIMENTAL ITEM SETS FOR EXPTS. 1 AND 2
+ ~ GETS DOT 90%, - ~ 10%

| | Training | Test |
|---|---|---|
| **Blocking** | $B_1B_2$+, $B_1$+ | $B_1B_2$,$B_1$,$B_2$ |
| **Screening** | $S_1S_2$+, $S_1$- | $S_1S_2$,$S_1$,$S_2$ |
| **Control** | $C_1C_2$+ | $C_1C_2$,$C_1$,$C_2$ |
| **Negative** | $N_1N_2$-, $N_1$- | $N_1N_2$, $N_1$, $N_2$ |

## III. Results and Discussion

In Experiment 1, both groups showed a blocking effect [P("yes"|$B_2$) < P("yes"|$C_{1or2}$)], however only those participants given the causal framing showed screening [P("yes"|$S_2$) > P("yes"|$C_{1or2}$)]. Both groups also predicted the dot on $N_2$ trials significantly less often than the other test items. RTs to the $N_2$ item in Experiment 2 were significantly longer than to the other three items for both conditions, but none of the other test items differed significantly from each other.

The absence of cue-competition effects in the go/no-go task was surprising, as these types of effects are ubiquitous to error-driven learning models. Instead, participants appeared to be responding solely based on how often the dot appeared when the item appeared. For the test items, this contingency is based solely on pair trials.

In the prediction task, the causal framing manipulation appears to have induced a screening effect by explicitly framing the problem as one in which on positive pair trials, at least one of the items must be capable of making the dot appear on its own. Taken together, these experiments represent a first attempt to tease apart the influences of multiple learning systems in producing participants' inferences about event relationships.

[1] Two negative singletons and one negative pair were added during training to reduce base rates. These items did not appear during the test block.

[2] The deadline to make a response during this period started at 400 ms and decreased to 275 ms over the first 200 trials. Responses were gathered throughout the outcome period (even if they occurred after the deadline).