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Image Inference - Measuring the impact of priors in event reconstruction (#75458)

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1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?

In a previous study (see pre-registration #26990), we showed that people, when given indirect evidence that an agent was in a certain position in space (shown as a small pile of cookie crumbs in a gridworld), can infer where the agent came from and where they were going. We explained those previous findings through a computational model that generates probable actions under an assumption that agents navigate efficiently in space. In this experiment, we test if people's inferences are sensitive to prior information about what the agent generally does or where they generally enter. We predict that people's inferences will be quantitatively predicted by the same computational model that we used in our previous study (pre-registration #26990) after modifying the prior.

After completing a brief tutorial (see Q8 for tutorial), participants will be presented with two-dimensional gridworlds with three potential goals, up to three labeled doors, and an X over the goals or doors for each time the agent previously traveled there (see Q8 for stimuli). One of the squares in each trial will contain cookie crumbs and participants will be asked to infer (1) the agent's goal (2) the entrance the agent took to enter the room (see Q3 for details on how these are collected). Participants will also have to correctly answer an objective question (Which corner is the farthest walk from Door 1? If there is more than one correct answer, just choose one of them.) on each trial in order to be allowed to continue with the task. Participants will each see 16 trials. (see Q4 for design).

3) Describe the key dependent variable(s) specifying how they will be measured.

Goal inference: participants will rate the probability that the agent was going for each of the three goals using continuous sliders ranging from "definitely not" (coded as 0) to "definitely" (coded as 1).

Entrance inference: participants will rate the probability that the agent was entering through each door using sliders that are identical to those in the goal inference.

4) How many and which conditions will participants be assigned to?

The experiment consists of two experimental blocks (goal prior manipulation and door prior manipulation) containing eight trials each for a total of 16 trials (with four gridworld layouts appearing in both experimental blocks under different priors). Each trial was randomly assigned a prior (per participant) that determined the number of times an agent visited each of the goals (goal prior manipulation; sampled from the set {(3, 3, 3), (6, 2, 1), (1, 6, 2), (2, 1, 6)} or doors (door prior manipulation; sampled from the set {(3, 3, 3), (6, 2, 1), (1, 6, 2), (2, 1, 6)} for trials with three doors and sampled from the set {(5, 4), (7, 2), (2, 7)} for trials with two doors). For the goal prior manipulation block, these priors were assigned such that (1) participants saw a balanced number of each prior and (2) all trial-prior combinations had a balanced number of participant judgments. For the door prior manipulation block, gridworld layouts with three doors were assigned priors like above; gridworld layouts with two doors only had a prior set size of three, so an additional prior of (5, 4) was sampled for the remaining trial in the block. The experimental blocks and the trials within each block are presented in random order.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

We will analyze our data by comparing it to a computational model that infers where the agent entered and what goal they pursued by assuming that the agent was acting efficiently in space. Specifically, our model reconstructs the agent's actions by computing the posterior probability of different sequences of actions given the observed positions of the cookie crumbs, while integrating prior information about the agent's previous entrance or goal states, through Bayesian inference. The prior will be set as a uniform Dirichlet distribution, updated to account for the observed frequency of times that the agent entered through each door (door prior manipulation) or pursued each goal (goal prior manipulation). The agent's entrance and goal are then computed by integrating over the posterior space of inferred actions given the observed world state (i.e., the position of the cookie crumbs).

Our analysis will consist of correlating mean normalized participant responses with the raw predictions from our computational model. Participant responses will be normalized within-participants, within-trials, per inference type, and per prior assignment so that they are valid probability distributions and then they will be averaged across-participants. The model predictions are already valid probability distributions, so they will not undergo further processing. Lastly, we will compute 95% bootstrapped confidence intervals for participant judgments.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

After reading the task instructions, participants will complete a brief, six-question quiz. Participants that fail the quiz once will be redirected to the





beginning of the instructions and asked to read them again. Participants who fail the quiz twice will not be included in the study. The quiz questions are listed below, with the correct answers in parenthesis:

1. How many corners is each person walking to?

(1) 2 3 Not sure

2. Do people always drop their cookie crumbs on their path to/from a corner?

(Yes) No Not Sure

3. Do people get to choose which door they walk through?

Yes (No) Not sure

4. Do people leave the room out of the same door they entered or the door closest to them?

(Same door) Closest Door Not sure

5. Can people move diagonally?

Yes (No) Not sure

6. What color are the walls?

White (Gray) Red Not sure

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.

Our sample size consists of 160 participants, not counting participants who fail the quiz more than once and are thus not eligible to participate. This sample size was determined by multiplying the sample sizes in our previous experiments (40) by the maximum number of priors that each trial can be assigned (4).

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?) See the model predictions, procedure, and stimuli at:

https://osf.io/q3ct5/?view_only=4b9b2c68443e4d91b2fb6cf7544055e5