

Life Sciences Reporting Summary

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► Experimental design

1. Sample size

Describe how sample size was determined.

Both experiments were inspired by the procedure described in Ershman, S.J., Markman, A.B., Otto, A.R. J. Exp. Psychol. Gen. 143, 182-194 (2014), which used a sample size of 60, for which we recruited 69 participants and arrived at n=58 in experiment 1, after excluding participants who did not satisfy minimal learning criteria or did not finish the task. We increased this n by at least 30% in experiment 2, given the choice nature of the task. After recruiting 112 participants and excluding participants who did not satisfy our learning criteria in all conditions, we arrived at n=88 for experiment 2.

2. Data exclusions

Describe any data exclusions.

Experiment 1:
4 out of 69 participants were excluded as they did not learn the task and could not finish the study within the allotted 1.5 hours. 7 were removed from final analysis due to accuracies below 80% in the categorization task (described below), a threshold used as a measure of attention to (engagement with) the experiment, leaving 58 participants.

Experiment 2:
115 participants were recruited to complete the experiment. All participants were required to achieve 100% accuracy on a 9-item instruction comprehension task before beginning the task. 27 participants were excluded for failing to learn the appropriate decision policy at the end of phase 1 training (Preference 1) in at least one of the conditions.

3. Replication

Describe whether the experimental findings were reliably reproduced.

The two experiments take different approaches to get at the same effect, thus they are conceptual replications of one another. However, we did not individually replicate each experimental paradigm.

4. Randomization

Describe how samples/organisms/participants were allocated into experimental groups.

We employed within-subject designs, where each participant underwent equal number of all conditions in within-subject randomized order.

5. Blinding

Describe whether the investigators were blinded to group allocation during data collection and/or analysis.

The order of the conditions was randomized within participants, and determined by the code that produced the experimental task and stimuli during each session.

Note: all studies involving animals and/or human research participants must disclose whether blinding and randomization were used.

6. Statistical parameters

For all figures and tables that use statistical methods, confirm that the following items are present in relevant figure legends (or in the Methods section if additional space is needed).

n/a Confirmed

- ☐ ☒ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement (animals, litters, cultures, etc.)
- ☐ ☒ A description of how samples were collected, noting whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☐ ☒ A statement indicating how many times each experiment was replicated
- ☐ ☒ The statistical test(s) used and whether they are one- or two-sided (note: only common tests should be described solely by name; more complex techniques should be described in the Methods section)
- ☐ ☒ A description of any assumptions or corrections, such as an adjustment for multiple comparisons
- ☐ ☒ The test results (e.g. P values) given as exact values whenever possible and with confidence intervals noted
- ☐ ☒ A clear description of statistics including central tendency (e.g. median, mean) and variation (e.g. standard deviation, interquartile range)
- ☐ ☒ Clearly defined error bars

See the web collection on [statistics for biologists](#) for further resources and guidance.

► Software

Policy information about [availability of computer code](#)

7. Software

Describe the software used to analyze the data in this study.

Matlab, Psiturk software⁵⁵, Julia, R.

For manuscripts utilizing custom algorithms or software that are central to the paper but not yet described in the published literature, software must be made available to editors and reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). *Nature Methods* [guidance for providing algorithms and software for publication](#) provides further information on this topic.

► Materials and reagents

Policy information about [availability of materials](#)

8. Materials availability

Indicate whether there are restrictions on availability of unique materials or if these materials are only available for distribution by a for-profit company.

No unique materials were used.

9. Antibodies

Describe the antibodies used and how they were validated for use in the system under study (i.e. assay and species).

No antibodies were used.

10. Eukaryotic cell lines

a. State the source of each eukaryotic cell line used.

No eukaryotic cell lines were used.

b. Describe the method of cell line authentication used.

No eukaryotic cell lines were used.

c. Report whether the cell lines were tested for mycoplasma contamination.

No eukaryotic cell lines were used.

d. If any of the cell lines used are listed in the database of commonly misidentified cell lines maintained by [ICLAC](#), provide a scientific rationale for their use.

No commonly misidentified cell lines were used.

► Animals and human research participants

Policy information about [studies involving animals](#); when reporting animal research, follow the [ARRIVE guidelines](#)

11. Description of research animals

Provide details on animals and/or animal-derived materials used in the study.

No laboratory animals were used.

12. Description of human research participants

Describe the covariate-relevant population characteristics of the human research participants.

Experiment 1

Human participants were recruited via the Princeton University subject recruitment interface (SONA). 69 (mean age = 22.2, STD = 4.6, 42 female) participants were recruited for the passive learning task, of which 4 participants were excluded as they did not learn the task and could not finish the study within the allotted 1.5 hours. 7 were removed from final analysis due to accuracies below 80% in the categorization task (described in the text) a threshold used as a measure of attention to (engagement with) the experiment, leaving 58 participants.

Experiment 2

This task was run on Amazon's Mechanical Turk (AMT) using Psiturk software. 112 participants (mean age = 33.6, STD = 10.5, 53 female) were recruited to complete the experiment. All participants were required to achieve 100% accuracy on a 9-item instruction comprehension task before beginning the task. 24 participants were excluded for failing to learn the appropriate decision policy at the end of phase 1 training (Preference 1) in at least one of the conditions. Data from 88 participants (mean age = 33.8, STD = 10.8, 45 female) was used for further analysis.