Generalization across conceptual spaces 1.0 (#55391)

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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?
Can humans generalize structural information from existing conceptual knowledge to newly learned concepts? How does the structural similarity between existing concepts and to-be-learned concepts influence the speed of learning?

3) Describe the key dependent variable(s) specifying how they will be measured.
We will measure speed of learning using two dependent variables:

(1) Estimated exponent c of the learning function y = 1 - intercept * e ^ (-c * (t-1)), where y=data, t=trials, c=learning exponent. The function will be fit to participants' performance data consisting of correct/incorrect responses on each trial. The intercept will be set to 0.5 (chance) for both, phase 1 and 2 of learning. A difference in the estimated c between phase 2 and phase 1 will be calculated for each participant to capture "speedup" of learning.

(2) The difference between the average accuracy over the first two sessions of each phase. For each participant, mean accuracy over sessions one and two of phase 1 will be subtracted from the mean accuracy over sessions one and two of phase 2, to capture "speedup" of learning.

4) How many and which conditions will participants be assigned to?
Participants will be assigned randomly to the following conditions:
(1) Congruency: is the arrangement structure of paired-associates identical or different between the two concepts being learned?
(2) Order of concepts: counterbalancing which of the two concepts is used in the first learning phase vs the second learning phase.
(3) Order of arrangement of the paired-associate stimuli in the conceptual space: counterbalancing which of the two arrangements will be used in the first vs the second learning phase.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
Both of the dependent variable data will be transformed to fit a gaussian distribution before analysis.

We will compare the phase 2 - phase 1 difference scores of the congruent group to that of the incongruent group. For each of our two dependent variables, we will run a Bayesian t-test for two independent samples, using the ttestBF function provided by the BayesFactor package in R. Parameters:
- rscale = 'medium' (default).
- Criteria for Bayes Factor in favor of the alternative hypothesis, BF10 will be set to 6.
- Criteria for BF01 in favor of the null hypothesis will be set to 6.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
Recruitment criteria, screened automatically by Prolific.co:
- Age: 18-40.
- Normal or corrected to normal vision.
- Residing in the UK or Ireland. Proficient in English.

Participants will be discontinued during the experiment if they fail one of the following:
- They rush through reading the initial instructions, as measured by the total time spent on any page being less than 500ms.
- They fail to reach at least 50% accuracy on each paired-associate after 3 sessions of learning, within each phase of learning.
- They fail to reach at least 85% accuracy on each paired-associate after 4 sessions of learning, within each phase of learning.
- They miss 15% or more of the trials within any session of learning.
- They respond with the same button on more than 95% of trials within any session of learning.
- They respond with RT < 500ms on more than 80% of trials within any session of learning.

Additionally, after the data are acquired:
- Participants with learning phase-specific mean reaction time data that are three standard deviations away from the corresponding group's (congruent/incongruent) phase-specific mean reaction time, will be excluded.
- Participants that show clear misunderstanding of the task during their debriefing will be excluded. For example: they used the wrong buttons, did not

understand what the task was, did not realize that the same concept exemplars were reappearing on multiple different trials but instead thought that every trial had uniquely new exemplars on the screen, etc.
- Participants who indicate experiencing any technical errors, such as buttons not working properly, stimuli not displaying properly, or anything else that interfered with normal progression of the experiment, will be excluded.
- Participants that indicate during debriefing that they used any mechanical or technical aids to help in memorising paired-associates will be excluded. For example: drawing the paired-associates on a piece of paper, taking pictures or videos, etc.

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.
We will use a sequential Bayesian design with maximal N for data acquisition. We will start with n=24 per group (congruent/incongruent). If BF10>6 or BF01>6 for either of our two dependent variables, we stop data collection. Otherwise, we add 8 more successful participants per group and rerun the Bayes factor analysis. This will continue until we reach a maximum of 136 successful participants per group. Successful participants are defined as passing quality and performance checks.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
We also collect demographic variables such as age, gender, education.
We will run a frequentist version of the t-test on the final data for both dependent variables, with alpha = 0.025 adjusted for two t-tests, just for educational purposes of comparing the Bayesian vs frequentist analysis.
We will explore the speedup in performance between phase 1 and phase 2 collapsing across the congruence conditions.
We will explore if the order of arrangements, or the order of concepts had an impact on performance levels.
We will explore the overall differences in performance between the two concepts, collapsing across other conditions.
We will explore the overall differences in performance between the two arrangements, collapsing across other conditions.
We will explore performance for each specific paired-associate to examine if any effect is driven by any particular one.