Function transformations of contingency components via stimulus-stimulus relations

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Experiment 4 preregistration

Author note

This work was funded by Ghent University grant BOF16/MET_V/002 awarded to Jan De Houwer.

Background

This is the fourth experiment in a set of experiments attempting to establish Crel and Cfunc functions for novel stimuli. The background for these experiments is provided in the preregistration document for Experiment 1 (https://osf.io/na2jp/). Experiment 4 is also informed by the results from the three previous experiments. The results from these experiments are summarized below to provide context for the decisions that formed the procedure for Experiment 4.

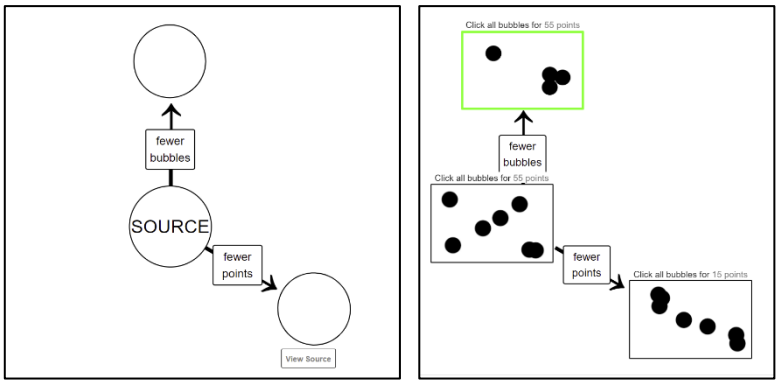
The procedures of Experiments 1 through 3 were highly similar. In each experiment 20 participants completed training and testing of Crel and Cfunc functions in a novel bubble task. Participants were required to select between alternative bubble-clicking tasks that differed in the number of bubbles to be clicked within a time limit and the number of points each task returned for doing so. These between task differences in number of bubbles and points were indicated by four novel stimuli with the objective of establishing Crel and Cfunc properties for these stimuli such that they could indicate task differences involving more points, more bubbles, fewer points and fewer bubbles. Participants received points on any trial during which they successfully completed the bubble-clicking task. Importantly, when participant failed to successfully complete the bubble-clicking task they lost the number of points on offer during that task. For the purposes of monitoring performance, participant responses on a given trial were deemed accurate if they selected the pre-specified optimal task (e.g., more points, less bubbles, or more points and less bubbles than the alternatives) *and* successfully completed the subsequent bubble-clicking task. Experiment 2 differed from Experiment 1 in two respects. To increase the number of successfully completed trials relative to Experiment 1, the number of bubbles to be clicked in each task was reduced by one in Experiment 2. To make changes in the number of points easier to discriminate, the between task differences in the number of points was made larger in Experiment 2. Experiment 3 differed from prior experiments by presenting Crels and Cfuncs drawn from natural language (i.e., "more points", "fewer points", "more bubbles", and "fewer bubbles"), including a post-choice screen indicating the number of points and bubbles each of the three options involved, and by holding the point loss

contingency constant across all tasks. The purpose of Experiment 3 was to discover whether participants would select the options deemed optimal under idealized conditions.

The training criterion (i.e., accuracy $\geq 17/20$ across the previous 20 trials) was met by 11/ 20 participants in Experiment 1, 16/20 participants in Experiment 2, and 20/20 participants in Experiment 3. The testing criterion (i.e., selecting the optimal task and completing the associated bubble-clicking task $\geq 50/60$) was met by 1/20 participants in Experiment 1, 3/20 participants in Experiment 2, and 12/20 participants in Experiment 3. Failure to meet this testing criterion could have resulted from failure to consistently complete the selected bubble-clicking tasks. When accuracy is defined as selecting options with derivation paths including only cues indicating "more points" and "less bubbles" (i.e., "more points", "less bubbles", "twice increased points", "twice decreased bubbles", "increased points and decreased bubbles"). By this metric mean accuracy was 65% in Experiment 1, 75% in Experiment 2, and 91% in Experiment 3.

In examining the so called sub-optimal choices a pattern became apparent. In Experiments 1 and 2 participants were more likely to avoid trials involving more points, than they were to avoid trials involving fewer bubbles. In Experiment 1 an average of 50% of chosen tasks offered fewer points than alternatives, and 31% of chosen tasks involved fewer bubbles than alternatives. In Experiment 2 an average an average of 33% of chosen tasks offered fewer points than alternatives, and 24% of chosen tasks involved fewer bubbles than alternatives. Note that failure to complete a bubble-clicking task resulted in the deduction of the number of points on offer for completing that task. Participants choices reflect the fact that trials involving more points also involved a greater risk of losing points. It seems reasonable then to infer that holding the point loss contingency constant across task options in Experiment 3 had some effect on participants choices. This approach will be taken in Experiment 4.

Experiment 3 also differed from Experiments 1 and 2 by including a post-choice feedback screen during the training phase (see Figure on next page). This screen was presented for between 3 and 10 seconds and could be terminated by participants by



clicking a continue button after three seconds. The screen displayed a miniature version of each of the alternative task options including the number of bubbles and the message indicating the number of points on offer. The task the participant selected on the previous screen appeared within a green border. The purpose of this feedback was to facilitate discrimination between the various task options, and to facilitate discrimination of the relationship between Crel and Cfunc stimuli and particular differences between stimuli. By presenting miniature versions of each task and making their differences apparent, and by presenting germinal Crel and Cfunc stimuli in the context of these differences, the post-choice feedback screen manifests essential methodological features for establishing Crel and Cfunc stimuli. Namely, discrimination of inter-stimulus differences, and discrimination of a relationship between these differences and Crel and Cfunc stimuli. The post-choice feedback screen may aid the establishment of Crel and Cfunc stimuli. Experiment 4 will investigate the impact of this variable.

Experiment 4 will assess whether the procedure employed in Experiment 3 is effective in establishing Crel and Cfunc functions for novel stimuli. Experiment 4 will also assess whether the post-choice feedback screen facilitates the emergence of Crel and Cfunc functions for novel stimuli. The first condition will involve replicating Experiment 3 but with novel stimuli. The second condition will match this condition but will not present post-choice feedback in the training phase.

Method

Sample

Data collection will be conducted online via Prolific Academic. Participants will be paid at a rate of £7.50 per hour.

Planned sample size & stopping rules

Data collection will stop when 20 participants have been exposed to Cfunc training and testing in both conditions (i.e., 40 participants total).

Inclusion criteria. English as a first language, between the ages of 18-65, 90% approval rating for previous studies on Prolific, no previous participation in similar studies from our research group.

Exclusion criteria. Incomplete data, responding "yes, exclude my data" on the self-exclusion question, or failing to complete any trial during the calibration.

IVs.

None.

DVs.

1. Response accuracy
2. Response time

Procedure

The procedure is designed to assess the efficacy of natural language stimuli in specifying derived transformations of functions. The procedure centers on the bubbles task described in the pre-registration document for Experiment 2. This version of the task involves two alterations from that procedure.

1. Failure to complete a bubble-clicking task will result in a loss of 50 points, and this is the same for all bubble-clicking tasks within the procedure.
2. For one condition the training phase of the procedure will involve presenting post-choice feedback for between 3 and 10 seconds after each selection screen. This feedback will not be presented during test phase trials.

Measures

All measures implemented in lab.js (Henninger, Shevchenko, Mertens, Kieslich, & Hilbig, 2019).

Statistics of interest

1. Number of optimal choices selected in training
2. Number of bubbles tasks successfully completed in training
3. Number of trials to complete Cfunc training

4. Number of participants successfully completing training
5. Number of optimal choices selected during testing
6. Number of bubbles tasks successfully completed during testing
7. Number of participants successfully completing the test phase (i.e., selecting the optimal choice in ≥ 50/60 (i.e., 83%) of test trials)

Hypotheses

H1. Both conditions in Experiment 4 will produce accurate responding in the test of established Crels and Cfuncs.

H2. The post-choice feedback screen facilitates the establishment of Crel and Cfunc functions.

Results

Analytic strategy

Data processing and exclusions. Data will be processed and analyzed in R.

Hypothesis test.

H1. The primary hypotheses will be investigated with a one sample t-test with a 50% null and a one tailed alpha of 0.05. We predict that participants responding will be at more than 50% accuracy. Note that the Crel and Cfunc test provides six response options. Thus, 16.7% accuracy is chance level responding. However, this represents a low bar for demonstrating stimulus control via Cfuncs, and so we adopt a higher null.

H2. The secondary hypothesis will be investigated with two independent sample t-tests with a one tailed alphas of 0.05. The first test will assess the difference in the number of training trials completed in each condition. The second test will assess differences in test accuracy defined as selecting options with derivation paths including only cues indicating "more points" and "less bubbles" (i.e., "more points", "less bubbles", "twice increased points", "twice decreased bubbles", "increased points and decreased bubbles"). We predict that participants in the condition with post-choice feedback will require fewer training trials to reach criterion, and will respond with greater accuracy at test.

References

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