NS01: Binary choice vs. strength-of-preference

C. E. R. Edmunds

Notes

People to email results: najmi.husaini@warwick.ac.uk

Rationale

We are interested in the effects of attention (as measured by time spent looking at an object using eye-tracking) and value (as elicited from the subjects directly via ratings) when determining choices between two objects (such as between two bags of chips, or two pictures of nature, or between two fruits). In previous experiments, we have found that choice is predicted by an interaction of attention and value: people attend to objects they like more and are more likely to choose them. However, in other experiments there are only additively separable effects of attention and value on choice: people are more likely to pick the option they value more and/or they are more likely to choose the option they attend to more, but that these effects do not interact (i.e. looking more does not have a bigger effect when the value difference is bigger).

The current experiment will attempt to identify which properties lead to the interactive vs. additive effect of attention and value. Here, we will compare simple binary choice between two pictures (Would you prefer Picture A or Picture B on your wall?) with a strength of preference comparison (By how much would you prefer Picture A over Picture B, or vice versa?). We hypothesise that the size of the interaction term will be greater in the strength-of-preference condition than in the choice condition.

Method

Participants

Data was collected from 67 participants: 2 of these were excluded because the eye-tracker would not initially calibrate and 12 of these were excluded due to a coding error which meant the fixation cross did not work for them. This resulted in data being collected from 53 participants. All participants were recruited from the University of Warwicks volunteer subject pool and paid 10 for their participation.

Apparatus

The participants were tested individually using an EyeLink 1000 Plus (SR Research, Osgoode, ON, Canada) eye-tracker. Monocular eye movements were recorded at 500Hz and fixations were identified by the eye tracker using velocity algorithms. The Areas of Interest were defined as a rectangle around the image position(s) on the screen. The experiment was displayed on a widescreen monitor (1920 x 1080 resolution, refresh). Participants were placed on a chin rest approximately 70cm away from the screen. Stimulus presentation was controlled by MATLAB using Psychtoolbox extensions (Brainard, 1997; Pelli, 1997).

Design

All participants completed binary choice and strength-of-preference tasks in a counterbalanced order, followed by a final valuation task where they had to rate their overall liking for each picture on a Likert scale.

Stimuli and choices

The stimuli were chosen from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). The pictures were all positive in affect (average, male and female ratings between 5=neutral and 7=mildly positive) and had differences in value

ratings of no more than 1.5 between male and female raters. After visual inspection, a further 7 images were removed for containing sexual images and 32 images were removed because they had a portrait aspect ratio. The 200 stimuli for each participant were randomly sampled without replacement from the 253 pictures that met these criteria. The participant's choices were generated by pairing the first stimulus with the hundred-and-first, the second with the hundred-and-second and so forth.

Procedure

The experiment was displayed on a black background with white text and response scales. At the beginning of the experiment the participants were asked to provide their age and gender. Then, participants completed three tasks: the binary choice task, the strength-of-preference task and the valuation task. The order of the binary choice and strength-of-preference tasks were counterbalanced between participants. For each task, the participants were shown the instructions for the task, then the eye-tracker was calibrated and then they were shown a reminder of the task instructions at which point they had to give a left mouse click to start the task. At the beginning of each trial, a fixation cross was displayed in the center of the screen until the participant had looked at it.

In both of the choice tasks, two landscape pictures (each 514 x 384px) were displayed side by side after the fixation cross. The response scale was presented horizontally centered, below the stimuli. For the binary choice task, two labels ("Option A" and "Option B") were shown underneath the appropriate stimuli. The current choice was signified by a red, square marker (30 x 30px) above the label. For the strength of preference task, the response scale was a white bar displayed underneath the stimuli that extended from the middle of one stimulus to the middle of the other. A red marker slid along the bar to signify the amount of preference for each option. The end of the scales were marked "Option A" and "Option B." In this task participants could move the marker to any point along the line using the mouse. In both tasks, the marker was initially

centered equidistant between the two images. To respond in both tasks, the participants had to press the left mouse button. Reaction times were measured from the start of the trial to the beginning of the mouse click (i.e. the program did not wait for the release of the mouse button). A blank, black screen was displayed for $500ms$ between each trial.

In the final, valuation task, participants judged how much they liked each picture on a vertical Likert scale (1=strongly dislike, 7=strongly like). Each of the 200 stimuli were displayed once in a random order. Participants were offered the chance to take a self-paced break every 50 stimuli. A blank, black screen was displayed for $500ms$ between each rating. Throughout the experiment, the eye-tracker was validated every 25 trials.

Analysis

The continuous scale was split into a hundred bins. Areas of interest were defined as the area of the stimulus and a box around the response scales.

Results

Exclusions

One participant was excluded as they spent less than 60% of the time on task during the binary experiment phase.

As pre-registered, participants were excluded on a task by task basis. In previous eye-tracking research, we found that some participants spend a considerable amount of time off task, i.e. not looking at either the stimuli or the response scale. Here, only participant was found to be an outlier in the binary task and their data was removed. An outlier here is defined as the average proportion of time across all binary choice trials was less than the first quartile of all participants minus 1.5 times the interquartile range. This left 53 participants.

We also pre-registered excluding trials for which the reaction time was less than $200ms$ or greater than the mean plus three standard deviations (this boundary was

calculated across all trials). This resulted in 2.04% of trials being removed from the strength-of-preference task, and 1.23% of trials removed from the binary task. The maximum number of trials excluded for a single participant was 15.

Reaction time

We estimated a mixed model, with random intercepts and slopes at the level of participant (Barr, Levy, Scheepers, & Tily, 2013).

Choice

Discussion

Open Practices Statement

The analysis was pre-registered at `AsPredicted.org/19698`. The data and analysis of this experiment is available in the Open Science Framework `https://osf.io/xfc8a/`.

Table 1. Summary of coefficients of model predicting reaction time

	Dependent variable:
	rt
Attention	−65.120
	(−230.327, 100.088)
Value	−1.856
	(−22.950, 19.238)
Task	663.016***
	(598.585, 727.447)
Attention*Value	−178.467***
	(−253.863, −103.072)
Attention*Task	69.555
	(−170.311, 309.420)
Value*Task	2.232
	(−27.677, 32.142)
Attention*Value*Task	−60.022
	(−167.054, 47.009)
Constant	2,500.064***
	(2,251.080, 2,749.048)
Observations	5,115
Log Likelihood	−43,241.430
Akaike Inf. Crit.	86,502.870
Bayesian Inf. Crit.	86,568.270
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 2. Summary of coefficients of model predicting choice

	Dependent variable:
	recodedResponse
Attention	5.677***
	(4.814, 6.540)
Value	0.891***
	(0.769, 1.014)
Task	−0.013
	(−0.178, 0.152)
Attention*Value	0.060
	(−0.281, 0.401)
Attention*Task	0.574
	(−0.242, 1.390)
Value*Task	0.022
	(−0.084, 0.128)
Attention*Value*Task	−0.112
	(−0.618, 0.394)
Constant	0.017
	(−0.115, 0.150)
Observations	5,115
Log Likelihood	−1,881.974
Akaike Inf. Crit.	3,785.949
Bayesian Inf. Crit.	3,857.888
Note:	*p<0.1; **p<0.05; ***p<0.01

References

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013, April). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*(3), 255–278.

Brainard, D. H. (1997). The Psychophysics Toolbox. *Spatial Vision*, *10*, 433–436.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual.* (Tech. Rep.). Gainesville, FL: University of Florida.

Pelli, D. G. (1997). The VideoToolbox software for visual psychophysics: transforming numbers into movies. *Spatial Vision*, *10*, 437–442.