KPU Registry ID Number: 1063 **Date Submitted: 17th Sept 2021**

Study Registration for the KPU Study Registry

The registration information for the study is given below. Each section can be expanded as needed.

1. The title or name of the experiment (for listing the experiment in the registry).

Retrocausal cueing: Investigating retrocausal influences in cued action

2. The name, affiliation, and email address for the lead experimenter(s) for the study.

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3. A short description or abstract of the purpose and design of the experiment.

Investigating whether cueing of an event after said event affects responses. This is termed 'retrocausation:' the effect of the future on the present. Five studies are being conducted. In the first, responses are cued (the letters A or K), in the second, whether or not to respond is cued (a Go/No-Go task), and in the third, when a response imperative will occur (after a short or long time from the start of the trial) are cued (a cued variable foreperiod experiment). In the fourth experiment, participants first perform an unbiased task in which they react as quickly as possible to either an A or K. In the second part of the task, the responses are biased such that one response is more likely than the other at a given target duration. In this case, whether the biasing in the future affects current responses. Finally, in the fifth experiment, response side is cued (as per Wehrman, 2019), however in this case the cue is masked such that participants are not aware of the cue identity. For all studies, the Sheep-Goat scale was also given to each subject. Further, for all studies, cues are either valid or invalid (i.e. correctly or incorrectly indicate the identity of the previous response imperative).

Wehrman, J. J. (2019). No evidence for Retrocausation in Two Classic Cuing Paradigms. *SAGE Open, 9*(2), 2158244019855852.

4. A statement or list of the specific hypothesis or hypotheses being tested, and whether each hypothesis is confirmatory or exploratory. (confirm/explore guidance)

Null hypothesis:

Responses (reaction times and accuracy) are predicted to not be affected by cues when presented after response. Further, the difference between validly and invalidly cued responses will not correlate with total sheep-goat scale responses, nor PK, ESP or LAD subscales.

This is intended as a confirmatory analysis: Both standard and Bayesian statistics will be used to examine the results from each study. The interventions used (cueing) are standard psychological experimental manipulations, and are simple so as to avoid confounds. The sample size was determined based on previous research (Bijl & Bierman, 2014) which similarly used a standard reaction time manipulation from psychology (the Go/No-Go task).

Bierman, D. J., & Bijl, A. (2014). Anomalous 'Retrocausal'Effects on Performance in a Go/NoGo Task. Journal of Scientific Exploration, 28(3), 437-452.

5. The planned number of participants and the number of trials per participant.

Each study will have 50 subjects. Each study consists of between 5 to 7 blocks of between 42 and 54 trials. Responses and times are presented an equal number of times each block, presented in a random order. Cues are between 50% and 75% accurate, depending on the study. The Sheep-Goat scale is administered at the end of the experiment.

In each study, the first block is the standard version of the experiment (i.e. cueing prior to response, not after).

6. A statement that the registration is submitted prior to testing the first participant, or indicating the number of participants tested when the registration (or revision to the registration) was submitted.

This preregistration is submitted after the collection of data, but before the data has been accessed. Data collection is still ongoing for one experiment. Further data collection may be required if subjects are rejected as per section 7.

The following additional information is needed for studies that include confirmatory analyses:

7. Specification of all analysis decisions that could affect the confirmatory results, including: the specific statistical test for each confirmatory hypothesis, whether the test is one-sided or two-sided, the criterion for acceptable evidence, any transformations or adjustments to the data, any criteria for excluding or deleting data, and any corrections for multiple analyses. Checklists and examples for registering classical analyses, permutation and bootstrap analyses, Bayesian analyses, and classification analyses are provided in the statistics registration document. (This information can be included in section 4 above for simple experiments.)

The specifics of analysis are as follows:

Analysis methods

RTs and Accuracy will be analysed using t-tests comparing valid and invalid cuing conditions. Bayesian t-tests will also be used to gather evidence for the null hypothesis.

Correlations will be analysed between both RTs and Accuracy (percent correct), and the four questionnaire indices (total, PK, ESP and LAD). RTs transformations are not planned (measured in ms).

In Experiments 3 and 4, an ANOVA will be used including the foreperiod duration, and the cued duration, rather than a simple t-test. Holm-corrections will be used for post-hoc t-tests. These will be done for both RTs and accuracy data. For Experiments 1 and 2, paired t-tests will be used for both RT and accuracy data.

Bayes factors will be assessed using the BayesFactor package in R, and ttestBF is the function intended to be used. This function uses a flat prior for evaluation of evidence.

Inference criteria

p-values (alpha = 0.05) and Bayes factors (>3 in favor of rejecting, or <1/3 in favor of the null) will be used. Two tail tests will be used for all analyses. Correlation will be analysed using p-values and r-squared.

Data exclusion

Trials with RTs faster than 100 ms (considered preemtive) and slower than 700 ms (considered a lapse of attention) will be excluded.

If a subject has less than 60% accuracy (i.e. incorrect responses on more than 40% of trials, including trials in which RTs fall outside of threshold), that subject will be replaced.

Subjects which have not performed the questionnaire will also be replaced (i.e. have not made any judgments).

If missing data is present (i.e. all of a single condition are missing for a subject), that subject will be replaced.

Exploratory analysis

A combined analysis of retrocausation across all experiments may also be performed.

8. The power analysis or other justification for the number of participants and trials.

As mentioned above, the number of subjects is based on Bijl and Bierman (2014), however the correlational aspect of the study, with a power of 0.9, should be able to detect a correlational co-efficient of 0.42. The t-tests should be able to detect an effect size of 0.47, with a power of 0.9.

9. The methods for randomization in the experiment. If a pseudorandom generator is used, specify how and when the seed(s) will be obtained.

The order of trials is randomized, however there is a controlled number of each trial type in each block. The randomization is controlled by Gorilla.sc, however how the seed is generated for randomizing the order of trials is unknown.

10. A detailed description of the experimental procedure.

Because these experiments have already been performed, the full details will be given in the published article:

Experiment 1: Response cueing. Cueing as to which cue is likely to occur (75% validity) are presented after a participant responds. The cues are the letters A or K in lower case, red lettering. The response target are the letters A and K in upper case, green lettering. Responses are made by the pushing of the button A and K. No feedback is given. 50 subjects have been collected for this experiment.

Experiment 2: Go/No-go cueing. Cueing as to whether a response will be required (75% validity). Responses are initiated by a green square, and performed using a spacebar. A No-go is a red box. Responses are cued by the words go or stop in black font. 50 subjects have been collected for this experiment.

Experiment 3: Foreperiod cueing. Cueing as to when a response imperative will appear (66% validity). Cues are the word short and long, indicating after what gap from the start of a trial the response imperative would appear. These are presented in black font. The timing is 300 and 900 ms for the two foreperiods. 50 subjects have been collected for this experiment.

Experiment 4: Foreperiod cueing in a separate task. In this experiment, a replication of Experiment 3 is performed, however no cue is given. In the first half of the experiment, the probability of each response (A/K) will be even. However, in the second half of the experiment, the A/K will be preferentially presented at either the short or long foreperiod. This is counterbalanced between subjects. 50 subjects have been collected for this experiment.

Experiment 5: Masked Cueing. In this experiment cues will be to whether a response will be required on the left or right (75% valid) after a response has been made. The presentation of the experiment will be similar to Wehrman (2019), however, the cue will be masked so that the subject cannot see the cue. Data collection has not yet started for this experiment.