Individual differences in elasticity of control estimation and psychopathology (#151100)

Author(s)
This pre-registration is currently anonymous to enable blind peer-review.
It has 3 authors.

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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?
The amount of control we possess over our surroundings often depends on the resources we are capable or willing to invest. In such environments, controllability is not fixed. Rather, it is elastic to invested resources.
We hypothesize that individual differences in how people estimate the elasticity of control in their present environment is correlated with inherent agency beliefs and related psychopathological traits

3) Describe the key dependent variable(s) specifying how they will be measured.
The full task description is available https://github.com/lsolomyak/human_inference_of_elastic_control/blob/master/task_description.docx.
We designed a novel task in which participants play a treasure-hunt game, where they can attempt to travel from an initial location ('desert' or 'fountain') to a treasure (located in either the 'desert' or the 'mountain') by taking one of two actions: boarding the train or the plane each of which travels to a distinct destination. If participants fail to board their selected vehicle they walk to the nearest location. Participants can choose whether to purchase a single ticket or to invest additional resources (up to two additional tickets and a cognitive task) to board their vehicle of choice. Overall controllability is instantiated as the probability of boarding the vehicle, whereas elasticity is instantiated as the degree to which additional resources affects the likelihood of successfully boarding the participant's preferred transport.
Trait-level sense of agency and psychopathology is measured using a series of questionnaires. Each questionnaire's score is computed as per its respective scoring manual. The full list and description of questionnaires is available at
https://github.com/lsolomyak/human_inference_of_elastic_control/blob/master/Questionnaires_list.docx

The dependent variables are:
1) How many tickets subjects on all trials. This includes the possibility of subjects opting out of purchasing any tickets.
2) Whether subjects purchase any number of tickets (opt-in, coded as 1, opt- out coded as 0).
3) Whether subjects invest additional resources (2nd and 3rd tickets) (coded as 1 for two tickets, and 2 for three tickets) or not (coded as 0).
4) Questionnaire scores.

4) How many and which conditions will participants be assigned to?
Each participant will be assigned to three conditions of varying levels of elastic and inelastic control such that investing minimal resources (i.e., one ticket), investing maximal resources (i.e., three tickets), and not investing any resources are each optimal once. Furthermore, all participants will complete an initial block where no strategy is distinctly optimal (ambiguous block).

All participants will complete the same set of questionnaires specified in the above (question 3) link.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
Note- full model specification used in analysis 1 is available here:
https://github.com/lsolomyak/human_inference_of_elastic_control/blob/master/model_specification.docx

Analysis 1
Model Fitting: Subjects' choices will be modeled to assess the presence of control and its elasticity level (elastic vs. inelastic environments), as detailed in the above link and pre-registered (#133857). Within this model, we will extract several key parameters. These include the 'inverse temperatures' (betas) which quantify the stochasticity in subject's decision-making process with higher beta values making the choice more deterministic, favoring the highest valued option. Additionally, we will extract those parameters that relate to subjects' initial biases related to environmental controllability and elasticity. These include the γs which range from 0 to 1, with higher values indicating stronger biases toward controllability/elasticity and and εs which quantify the strength of these priors.

Canonical Correlation Analysis (CCA): A CCA will be performed between the model-derived parameters and questionnaire scores to identify the relationship strength. Significance will be tested through permutation testing (≥1000 permutations), aiming for a significant canonical correlation ($p < .05$).

Analysis 2
Composite Score calculation: Using the CCA results, a composite score for psychopathology will be constructed for each subject, calculated by multiplying

each subject's score on each questionnaire by the respective loadings obtained from the CCA, signifying the subject's position on the psychopathology spectrum.
Regression Analysis: The composite score will serve as a predictor (β_composite) in a regression model to forecast task behavior. We hypothesize that higher composite scores will predict a tendency to over-allocate resources ineffectively, observable through the purchase of additional tickets under high inelastic compared to high-elastic conditions ($p < .05$).

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
The following participants will be excluded based on task measures:
•Participants who make more than 8 mistakes on quizzes during the instruction phase
•Participants who display less than 90% accuracy in selecting the correct vehicle corresponding to its pre-learned destination.
•Participants who choose not to purchase any tickets in 90% of trials across all experimental conditions.

The following participants will be excluded based on questionnaire measures:
•Participants who fail either of the 2 attention checks in the questionnaire forms
•Participants whose responses, before reverse scoring, fall more than 2 standard deviations below the mean will be considered as exhibiting straight-lining behavior.
•Participants who leave the computer for more than 5 minutes.

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 collect data from 250 valid participants. We derived this sample size using a power analysis aiming for 95% power to detect a significant ($p <.05$) canonical correlation between the model-derived parameters and questionnaire scores. We sampled with replacement from previously collected data ($n=264$, see 8 for details) which had showed a significant canonical correlation ($p=.01$), and calculated the p-value of a CCA in the subsample. We repeated this procedure for 100 iterations, each time recording the calculated p-value.
To examine whether this sample size is sufficient to detect significant effects via the regression models from the composite psychopathology score with over 95% power (analysis 2), we sampled 250 subjects with replacement each time calculating the composite score and ran the regression analyses on that score, repeating this procedure 100 times. We found that β_composite was significant ($p<.05$) in 95% of iterations (95% power)

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
In the context of our previous pre-registered dataset (#133857), we conducted exploratory data analysis using the specified Analysis 1 and Analysis 2 methods, as outlined in detail above. This analysis led to the findings we mentioned above. Consequently, our current experiment is a replication study that employs the same task, model, and analysis procedure.