

BRSM Project Proposal

Team TA

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Selected Behavioral Paper/Dataset

[Predicting Outcomes in a Sequence of Binary Events: Belief Updating and Gambler's Fallacy Reasoning \(Paper\)](#)
[Dataset](#)

This paper is an experimental study that aims to understand how people predict the outcome of binary events, such as coin flips, and how their predictions are influenced by their beliefs and previous outcomes. The authors hypothesise that the Gambler's Fallacy and Hot Hand judgement patterns arise from the observer's mental models of the sequence-generating mechanism (random mechanical generator, intentional goal-based actor or social processes), moderated by the strength of belief in an a-priori base rate. Their experiments showed that the most common predictions for subsequent events were best described as pragmatic belief updating, expressed as an increasingly strong expectation that a streak of identical signals would repeat as the length of that streak increased, i.e, the Hot Hand Belief. The exception to this pattern was for sequences generated by a random mechanical device with a fixed base rate of 0.5 in which case participants exhibited a bias toward reversal of streaks, i.e, Gambler's Fallacy.

Objectives

Through this project, we aim to analyse the dataset provided as part of the paper and answer some new questions that the authors have not looked into. The paper looks into how the predictions of binary outcomes are influenced by the prior information and feedback provided regarding the sequences and the generators (conditions) by conducting various experiments.

Firstly, we aim to replicate the results of the authors' tests in our project. We will also conduct certain tests to validate the results and measure the parallel-form reliability of the paper. We will use correlations and permutation tests to infer and verify the existence of any relationships between the groups across the studies. We plan to use the datasets provided in the paper to answer some additional questions such as the effects of demographics such as age, gender, education and qualitative strategies on the predictions made as well as the effects of changing conditions and feedback on the rate of change in predictions made. If time permits, we will also collect new data using a small sample size and check if there are any differences from the published results using t-tests.

Data

We will not be collecting any data as such. Instead we will be using the dataset provided within the paper that we have selected.

There are three studies which are further divided into two parts each. The three studies are as follows:

1. Study 1 - Participants are given no information about any of the generators' base rates
2. Study 2 - Participants are provided a stationary base rate of .50 for all three generators
3. Study 3 - Specified the same distribution of possible base rates for all three generators

The two subparts within each study are as follows:

1. Part A - Each participant is allowed to make predictions on a continuous probability scale
2. Part B - They made a dichotomous/binary choice

We have three excel sheets comprising different aspects of the experiments for all three studies and two subgroups within each study. We describe the structure of the dataset below:

- PredictingOutcomes_ParticipantDemographics
 - This dataset describes participant's answers to some probability questions and financial literacy questions and their score on how correct their answers were.
 - It includes the personal details such as age, gender, highest degree of the participants.
 - It also includes the participant's personal rating on understanding of stocks and frequency of gambling.
- PredictingOutcomes_ParticipantPredictions
 - This dataset describes each participant's prediction across 18 sequences of 8 binary outcomes, and asks to predict the direction of the 9th (next) outcome in each sequence. Among 18 sequences, 12 sequences were filler and other sequences ended in one of the following continuous/repeating streak lengths: 2, 3, 4, 5, 6, and 7.
- PredictingOutcomes_QualitativeStrategyRatings
 - This dataset describes the strategy each participant used to make their predictions.
 - It includes data from 3 raters who categorised the strategy of each participant into one of 8 broader strategy categories.

If time permits we will try to perform data collection using the code provided by the paper. The data would be focused on trying to answer some additional questions such as the effect of time and previously seen sequences on consequent sequences' predictions by the participants as well as verifying the original results on a smaller scale.

Methodology

We will be We will divide our goals into the following set of tasks:

1. **Replication:** We will replicate the original paper's results. The authors primarily made use of variations of the t-test and ANOVA for their analysis and for verifying their hypothesis of the effect of generator models, base rates and streak lengths on

participant predictions. They also verified their inter-rater reliability using Cohen's kappa. We will be reproducing all of these results under this task.

2. **Demographic Effects:** We will be checking the effect of various demographic variables such as age, sex, probability knowledge, etc. on predictions using techniques similar to those used in the original paper, i.e, t-tests and ANOVA. This will also help us better understand and account for such variables as potential confounds to the original studies.
3. **Correlations and Relationships:** We will be conducting correlation tests on the dataset to analyse the relationship between various variables such as between binary and continuous groups' predictions, streak length and predictions, age and predictions, sex and predictions, prior knowledge of probability theory and predictions, and so on.
4. **Verification of Results:** We also plan to employ permutation tests and bootstrapping techniques to verify the correlations and relationships obtained from the previous tasks as well as the original relationships hypothesized by the authors such as between generator models and susceptibility to Gambler's Fallacy and/or the Hot Hands Belief.
5. **Data Collection and Verification (if time permits):** We have access to the website and setup used by the authors for data collection. If we have sufficient time towards the end of the project, we plan to use this setup with the addition of a few questions to collect our own data on a small scale. The additional questions will be designed to account for additional variables/confounds such as the effect of time and previously seen sequences on consequent sequences' predictions by the participants.

Expected Outcomes

Through this project, we wish to replicate and verify the results of the authors in addition to finding new information regarding the relationships between variables and groups and answer some questions based on the tests conducted. The analysis done on the results based on the methodology mentioned above should provide valuable information about the impact of various variables present in the study. We hope that this project will shed new light on the existing framework used to explain the belief updating and Gambler's Fallacy by using new information about the demographics of the participants used in the study.

By conducting tests and correlations, we can substantiate and potentially strengthen the arguments and inferences made by the authors using their results. Additionally, using a dataset based on a small sample size could also serve as a check for any differences with the authors' results and answer questions regarding the existence of any artefacts or confounds in the experiment.