Understanding the nature of cognitive biases underlying rejection of mixed gambles

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INTRODUCTION

Background

- People do not prefer gambles that can result in gain or loss (called mixed gambles).
- Psychological mechanisms causing this are not well-understood.
- This phenomenon is usually explained by loss aversion: people give more subjective weight to losses as compared to gains.
- Recent studies using drift-diffusion model have suggested that another bias, favouring rejection prior to gamble valuation, might be more important in understanding this phenomenon[1].

Objectives

- Using a neurally plausible computational model and data from two studies, we developed a better understanding of how various potential cognitive mechanisms[1] (viz. loss aversion, starting bias towards rejection and fixed utility bias) affect aspects such as choices and reaction times of participants' behaviour.
- We compared another mechanism, one which biases decision-makers to pay more attention to the potential loss while evaluating the gamble, to the above mentioned biasing mechanisms.

METHODS

Data

- Previously published studies:
  - Dataset 1: Zhao et al., 2020[1]
  - Dataset 2: Konovalov & Krajbich, 2019[2]
- Participants were shown possible outcomes (gain and loss) of gambles, both were equally likely.
- Choices (accept/reject) and reaction times (RT) were recorded.
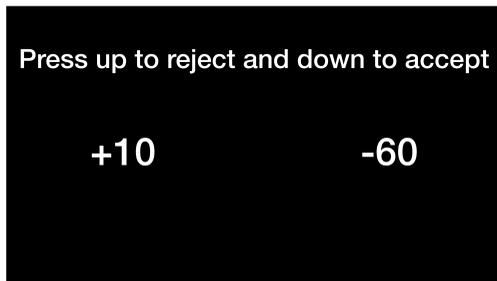

Press up to reject and down to accept

+10   -60

Figure 1: Sample experimental stimulus.

Model

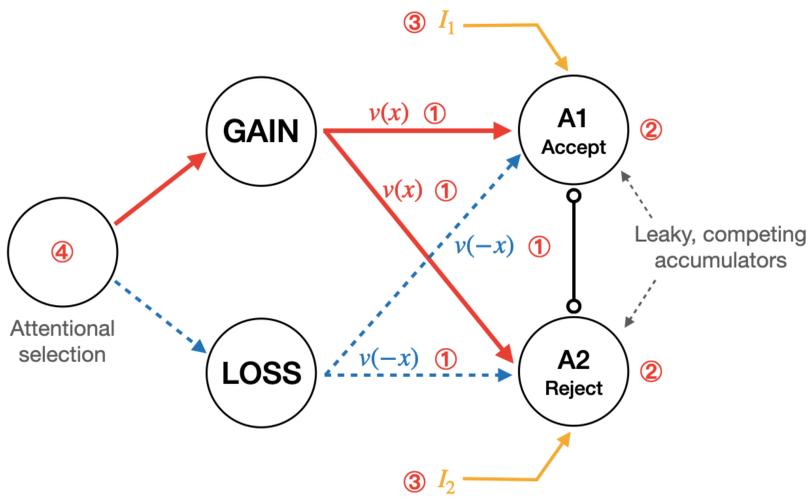- Leaky, competing, accumulator[3] (LCA), fitted on choice and RT data.

Figure 2: Leaky, competing, accumulator model.

- Implementation of biasing mechanisms in the LCA framework:
- Loss Aversion: $v(x) = x$ for $x \geq 0$ and $v(x) = \lambda x$ for $x < 0$ ①
- Predecisional bias: starting activation of A2 > starting activation of A1 ②
- Fixed utility bias: $I_2 > I_1$ ③
- Apart from these mechanisms, we consider an additional mechanism:
- Attention bias: switching mechanism more likely to focus on loss than gain ④

RESULTS

Choice as function of gain/loss ratio

- Loss aversion has the largest contribution to the model's ability to capture choice patterns in the data.
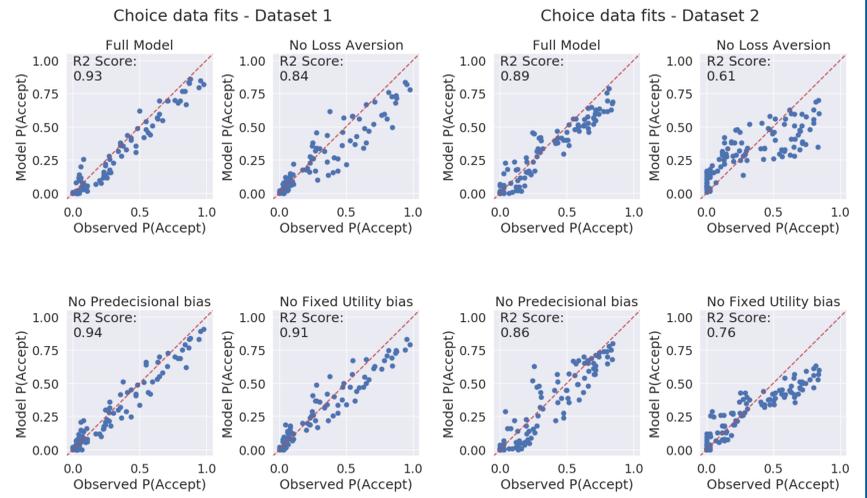

Figure 3: Choice data fits for full model and constrained models. Models without loss aversion have significantly smaller R^2 values than other models in both datasets.

Acceptance rate vs. reaction time

- LCA Model without pre-decisional bias could not capture the increasing relationship between acceptance rates and RT.
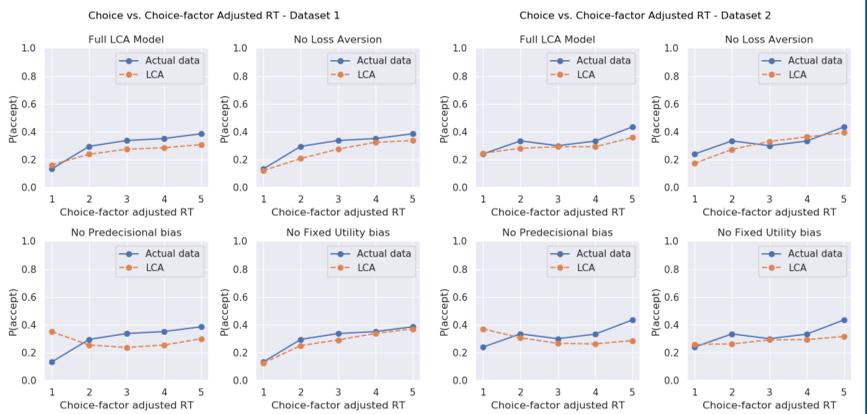

Figure 4: Acceptance rates vs. reaction times (adjusted for choice factor). Models without pre-decisional bias are not able to capture the increasing trend in either dataset.

Attention bias and Loss aversion

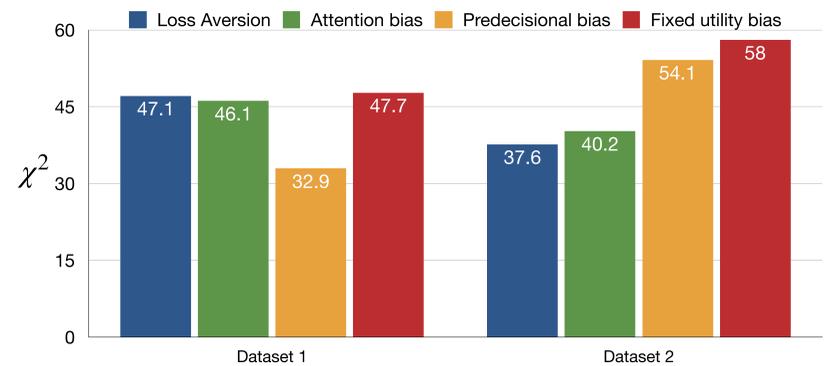- Substantial mimicking between loss aversion and attention bias.

Figure 5: Fitting five LCA models, each with only one mechanism of bias. In both datasets, the χ^2 statistics of models with loss aversion and attention bias are similar.
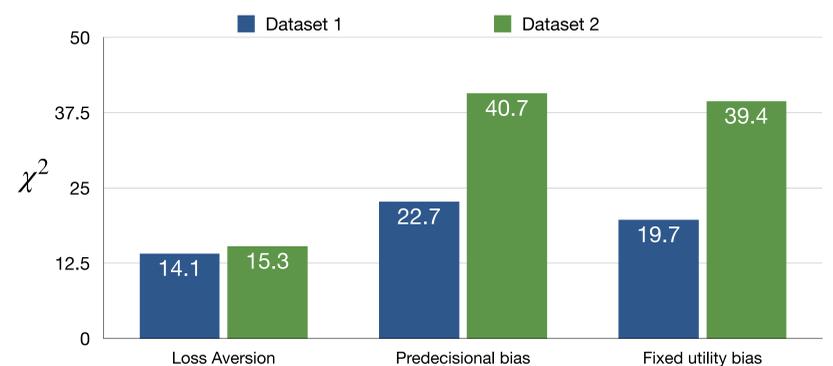

Figure 6: Fitting LCA models with loss aversion, predecisional bias, and fixed utility bias to data generated using LCA with attention bias. In both datasets, LCA with loss aversion generates best fits to this data.

DISCUSSION

Consistent with previous studies[1], we found that a pre-decisional bias towards rejection of gambles is required to capture the relationship between acceptance rates and reaction times (Figure 4). However, we found that loss aversion is still essential to capture choice preferences as a function of gain/loss ratio of gambles (Figure 3). Finally, we found that loss aversion and a bias towards paying more attention to losses make empirically similar predictions about the data in these experiments (Figures 5 and 6). Hence, behaviours attributed to loss aversion may actually be arising due to a bias in the relative attention paid to losses and gains.

REFERENCES

1. Zhao, W. J., Walasek, L., & Bhatia, S. (2020). Psychological mechanisms of loss aversion: A drift-diffusion decomposition. *Cognitive psychology*, *123*, 101331.
2. Konovalov, A., & Krajbich, I. (2019). Revealed strength of preference: Inference from response times. *Judgment & Decision Making*, *14*(4).
3. Usher, M., & McClelland, J. L. (2004). Loss aversion and inhibition in dynamical models of multialternative choice. *Psychological review*, *111*(3), 757.

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