

Epiphany learning, attention and arousal

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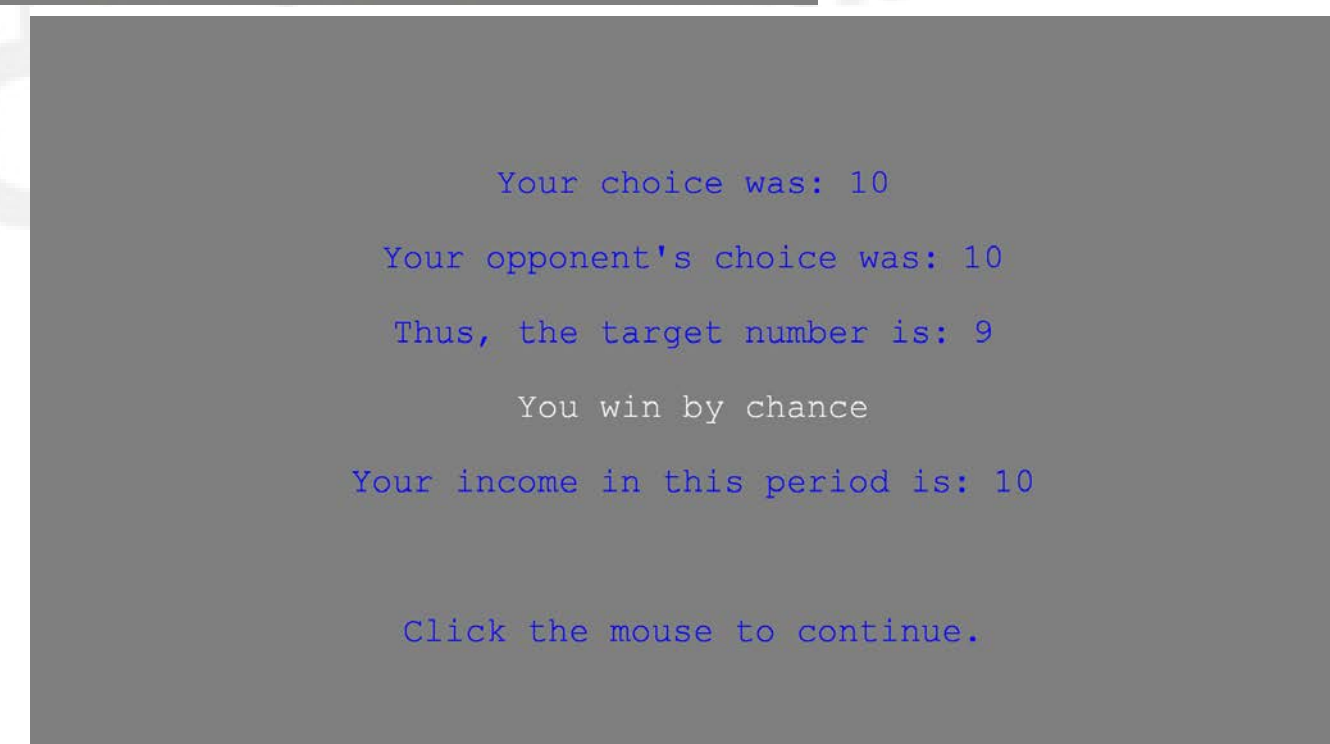
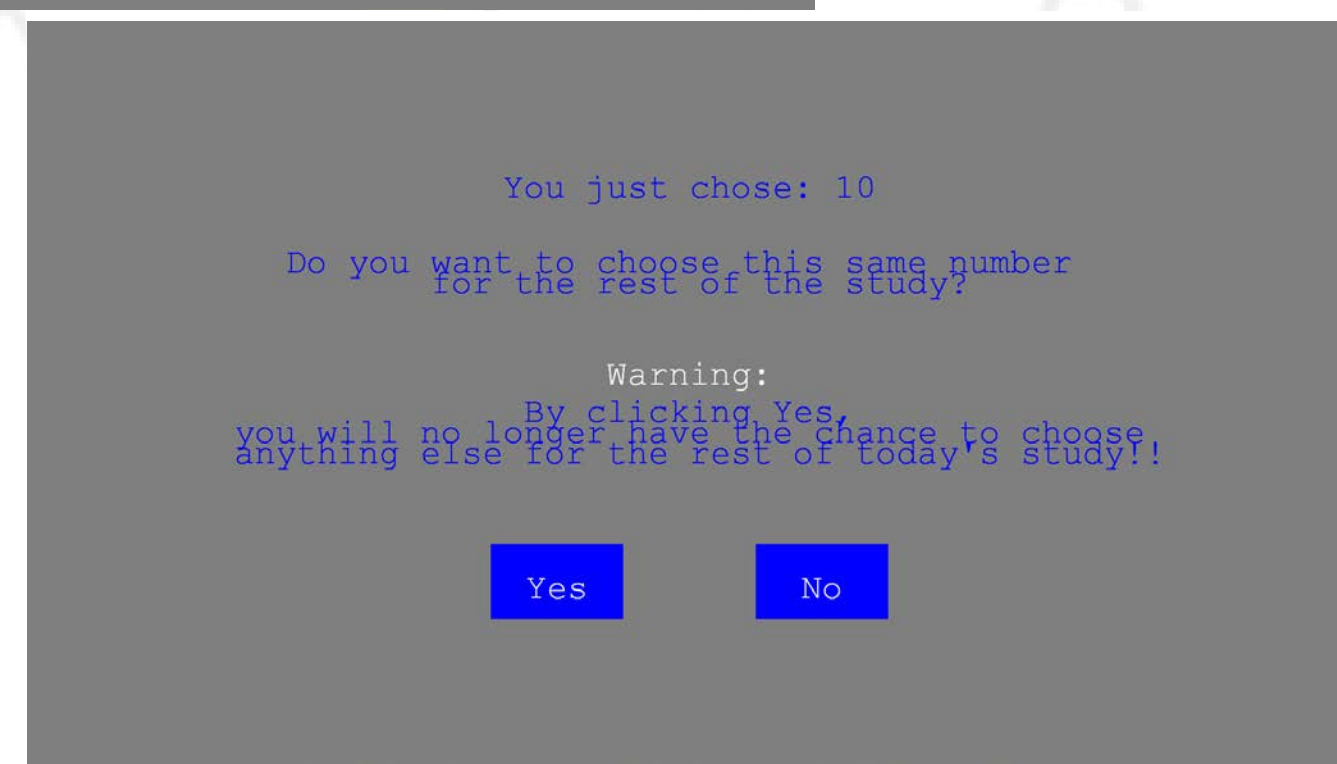
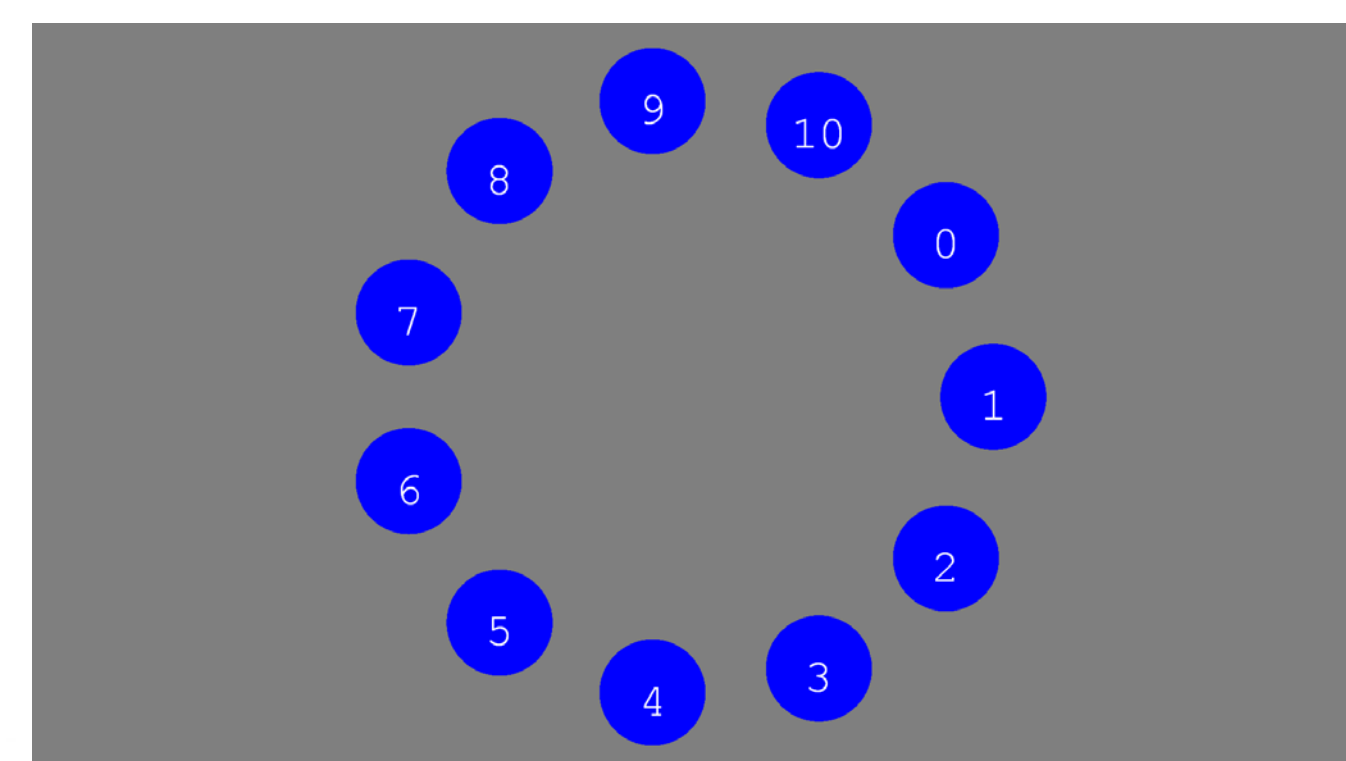
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Introduction and Aims

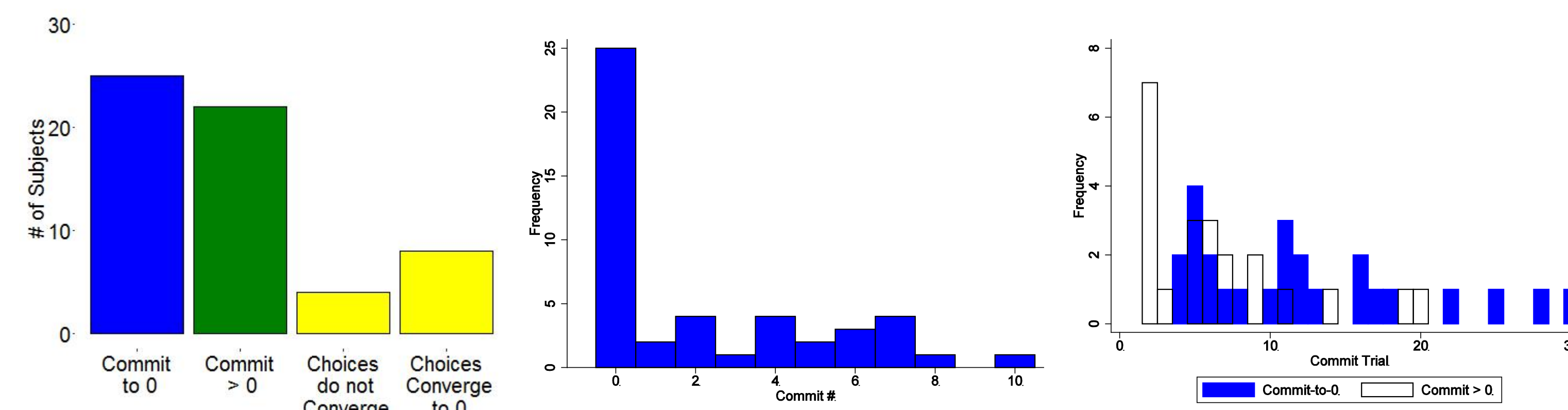
- Models of reinforcement learning are prevalent in the decision-making literature
- Not all behavior appears to conform to gradual behavioral convergence predicted by reinforcement learning model
- Some learning appears to happen all at once
- Prior research on these “epiphanies” only shows evidence of sudden changes in decision behavior, so it remains unclear how such epiphanies occur and whether they can be predicted from non-choice data
- We tested an evidence-accumulation account of epiphany learning using behavioral and eye-tracking data

Methods

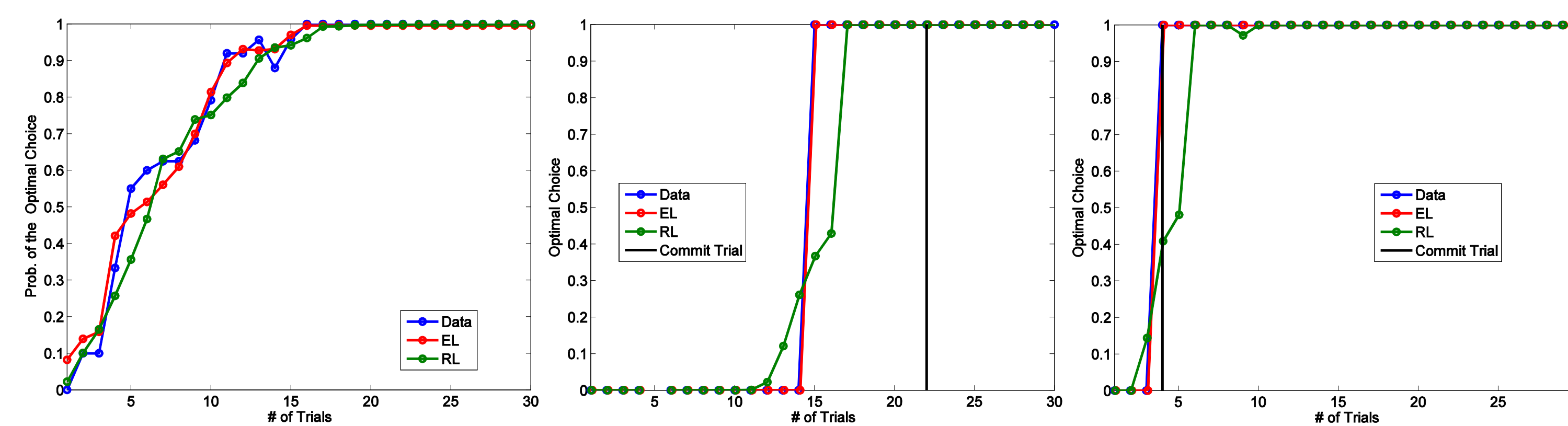
- Subjects (N = 59) played a 2-person variant of the p-beauty contest with $p = 0.9$, for 30 trials against a database
- In the p-beauty contest subjects pick a number, trying to get closest to p times the average number chosen by the group. The optimal strategy is to pick 0.



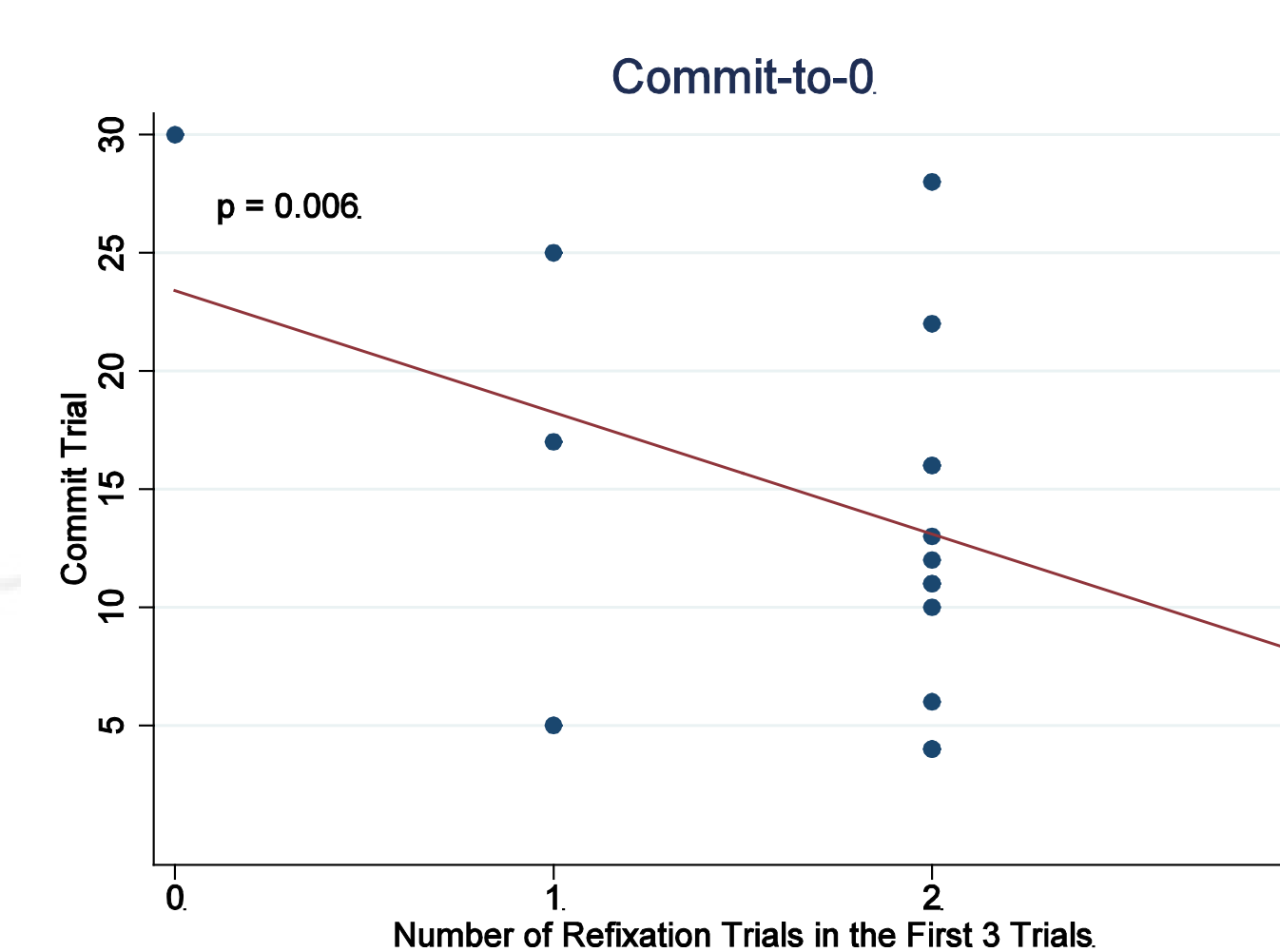
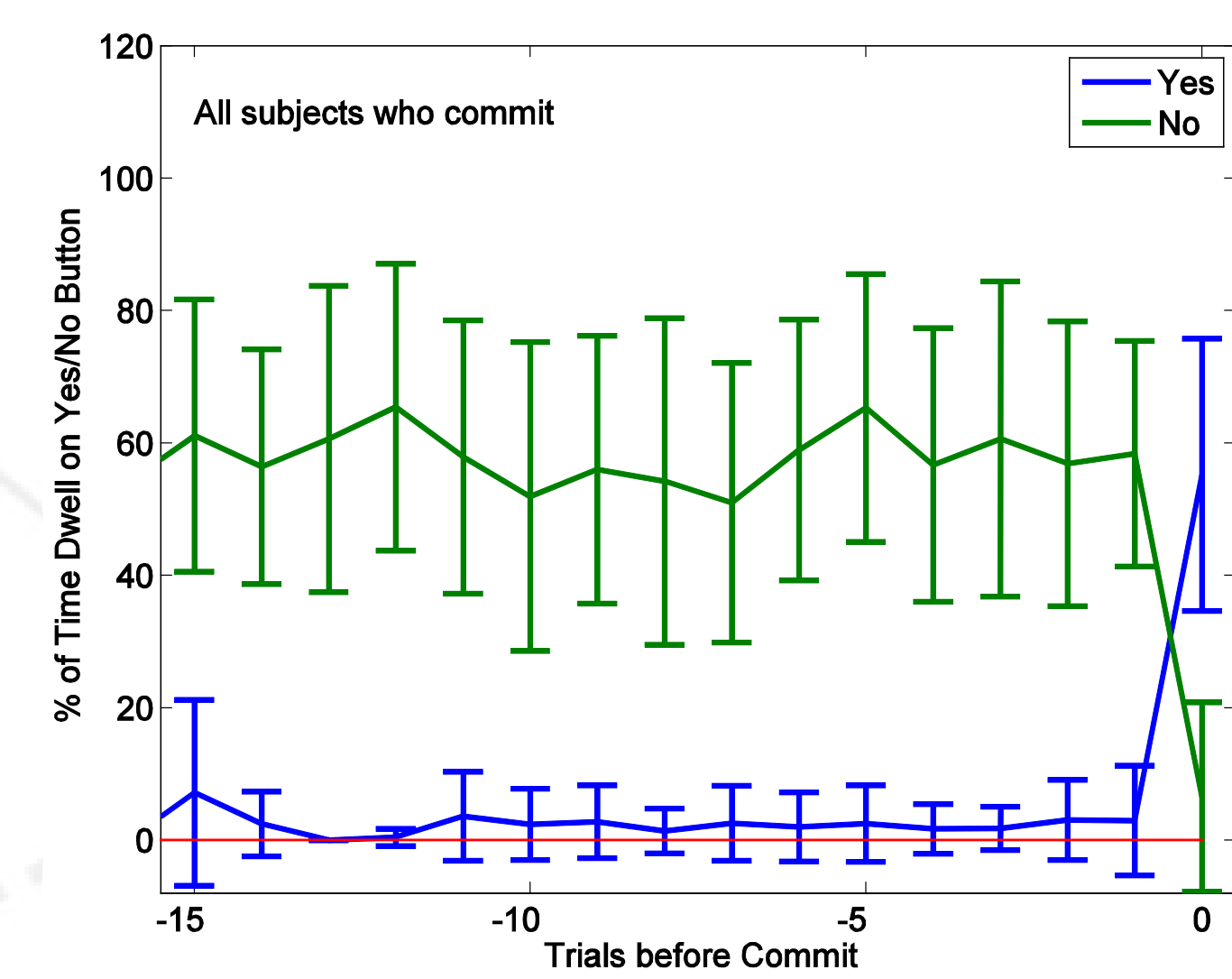
Results: Commitment Behavior



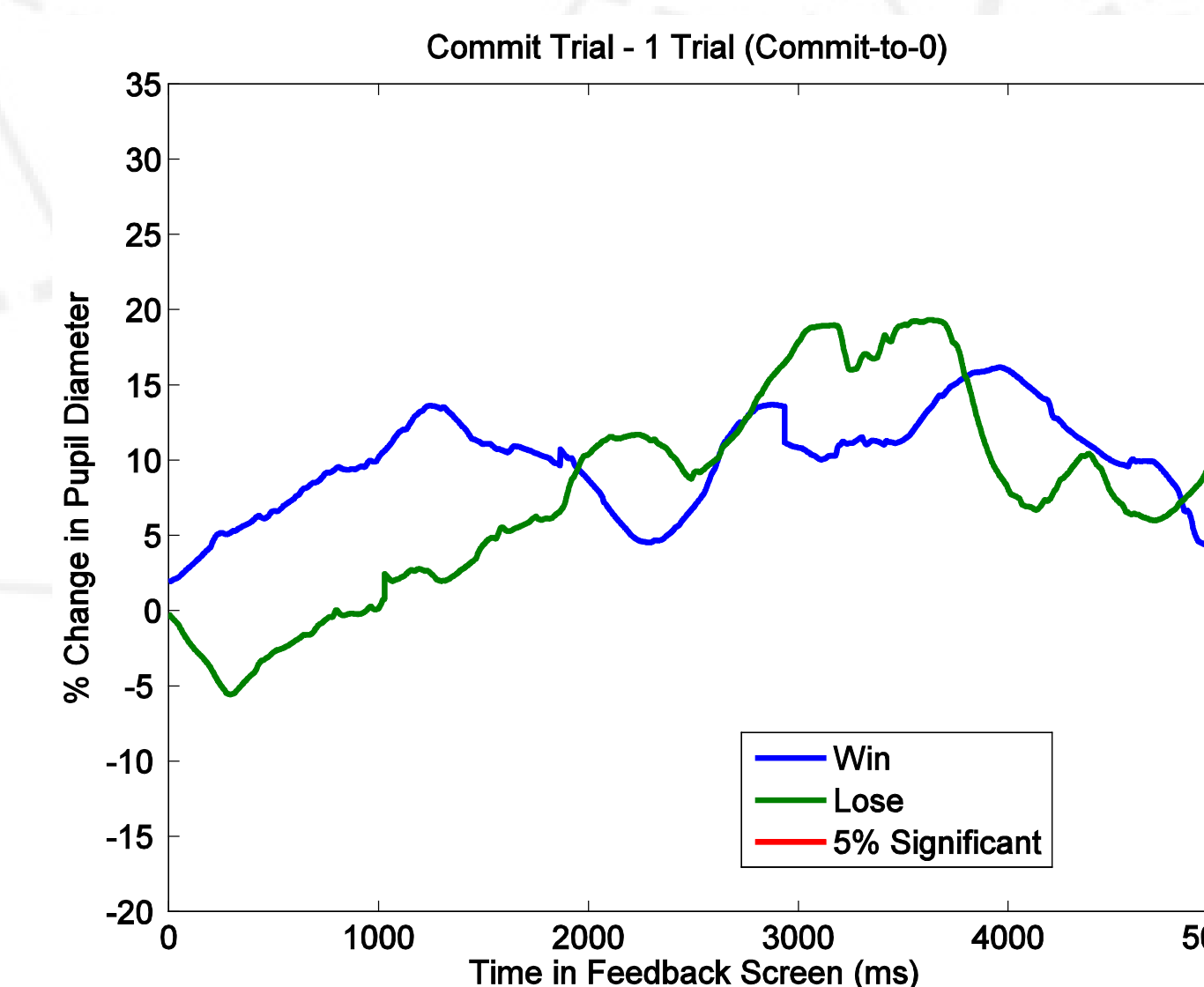
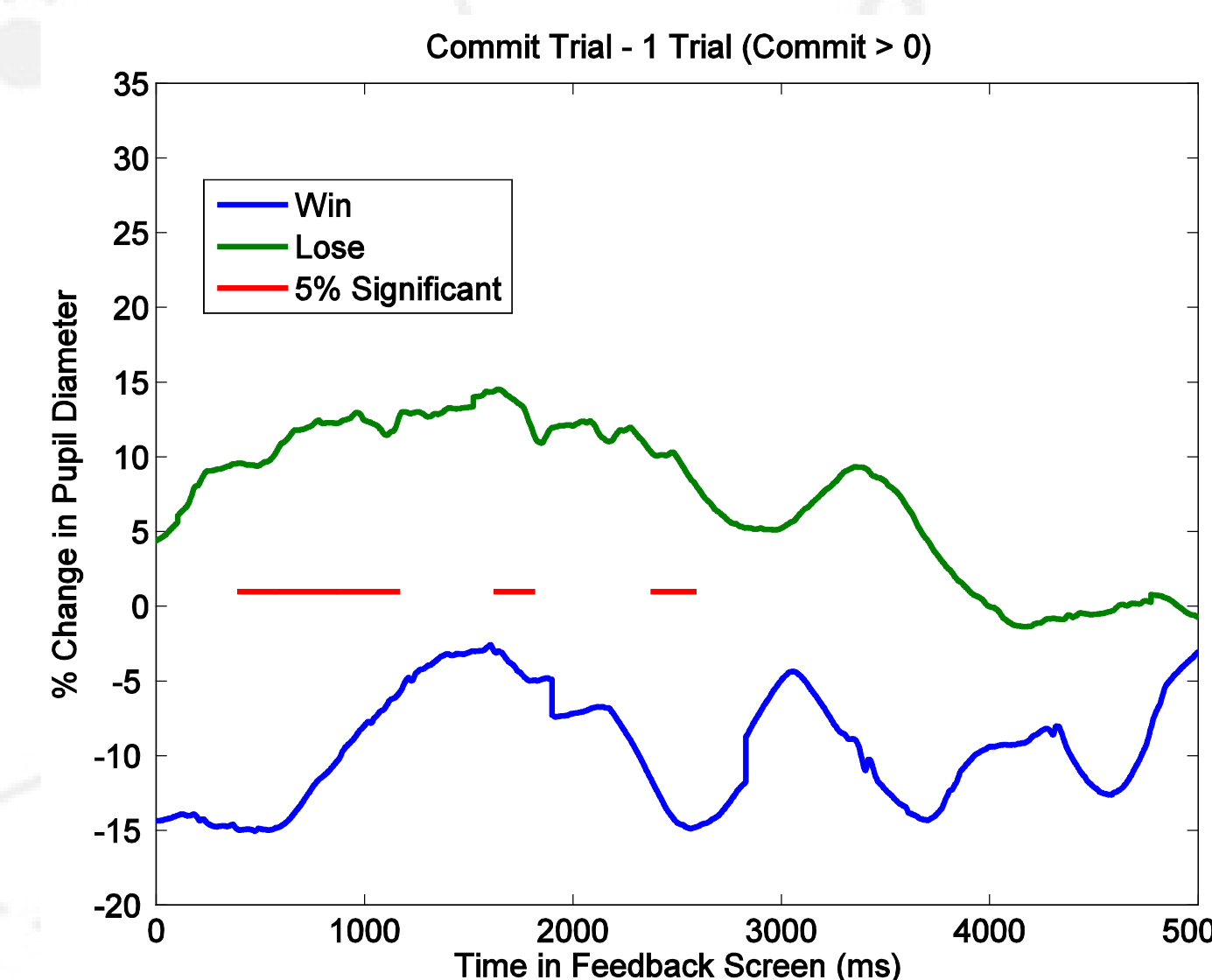
Results: Comparing EL and RL



Results: Predicting epiphany



Results: Pupillary responses



Research Question

- Can we find behavioral evidence of epiphany?
- What can we learn from non-choice data, such as gaze position and pupil size?
- Can we predict the occurrence of epiphany?
- Can we distinguish correct epiphanies from those incorrect ones?

Conclusion

- 61% of the subjects were identified as epiphany learner by the EL model
- In each Learning happens all at once as seen in a sudden shift in behavior, which the RL model cannot capture
- The time subjects spent on the yes button exhibited a sudden jump in the round before commitment, corresponding to the EL curve
- Only commit-to-0 subject's commitment trial is predicted by the refixation behavior in the first few trials
- Pupil dilation behavior can distinguish between subjects who commit to 0 and those who do not

Bibliography

- The model that we've presented in this paper bears some resemblance to what has been referred to as model-based learning
- More general version of the EL model were tested with the same data set
- Previous research have shown that EL occurs in other games, such as the game of 21 and Nim
- Other forms of the RL model share a fundamental feature: the predicted choice probabilities gradually change over time, so they cannot capture EL without additional assumptions

Reference

- Dufwenberg, Martin, Sundaram, Ramya, Butler DJ (2010) Epiphany in the game of 21. *Journal of Economic Behavior & Organization* 75(2):132–143.
- McKinney CN, Van Huyck JB(2013) Eureka learning: Heuristics and response time in perfect information games. *Games and Economic Behavior* 79:223–232.

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