Scarcity & the Brain: Does Financial Deprivation Affect Learning & Memory in Adolescents?

Gabriel Reyes, M.S. Candidate & Karen Froud, Ph.D.
Teachers College, Columbia University | Department of Biobehavioral Sciences

INTRODUCTION

Neuroscience research has highlighted the importance of the hippocampus, a brain region integral in memory (Davidow et al., 2016). However, studies have shown that children in poverty have reduced hippocampal volume (Noble et al., 2005), and that adolescents that experience significant life adversity had reduce learning accuracy on a reward task compared to those without (Hanson et al., 2017). However, the causal mechanisms for such differences are not known.

PURPOSE

My thesis aims to elucidate if financial psychosocial stressors affect reward learning and memory. By creating novel scenarios for adolescents, I plan to explore if significant behavioral differences emerge *only* when low-income participants are exposed to financially difficult scenarios. If my results are consistent with previous studies (Mani et al., 2013), this will lay ground for future research that investigate the neural development of learning & memory systems.

METHODS & EXPERIMENTAL DESIGN

Financial Scenarios

Your school lends you a laptop and you spill water on it. It can no longer be used and you need to purchase them a new one for $2,000 ($200) or they will sue you. Can your family cover this? How? Will this affect paying for other necessities such as rent or food?

Participants will review a series of hypothetical financial scenarios. Hard scenarios are aimed to trigger stress only in participants where finances are scarce. Values in easy scenarios are in parenthesis. Each participant will review 4 hard or easy scenarios and provide a stress rating afterwards.

Reward Learning Task
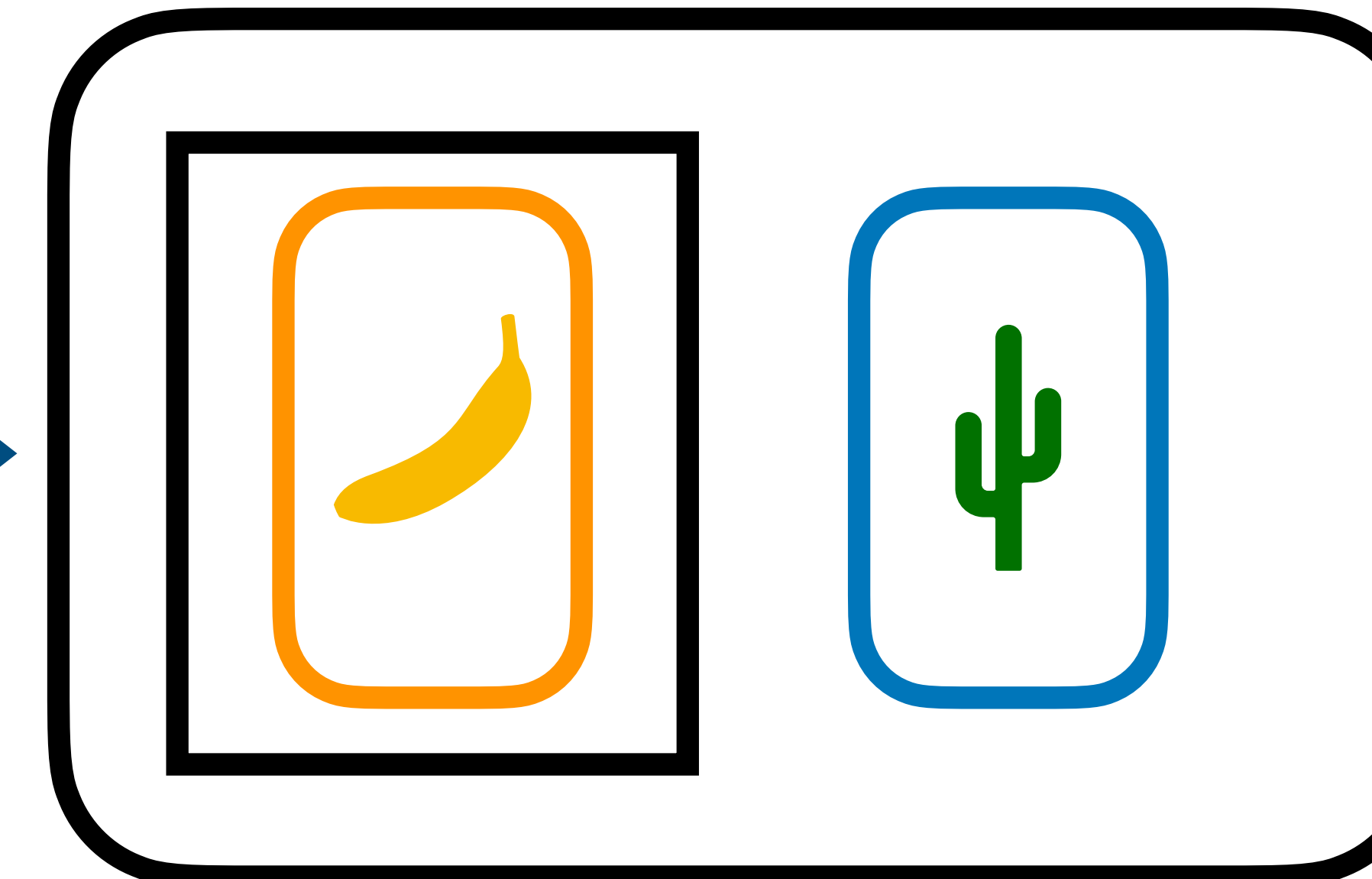
Afterwards, participants will engage in a probabilistic reward learning task. Participants must choose one of two objects, each with a reward ($.00 - $1). They must learn the value of each object and try to choose which of the two they think is the most rewarding. They will be instructed to get as much money as possible.
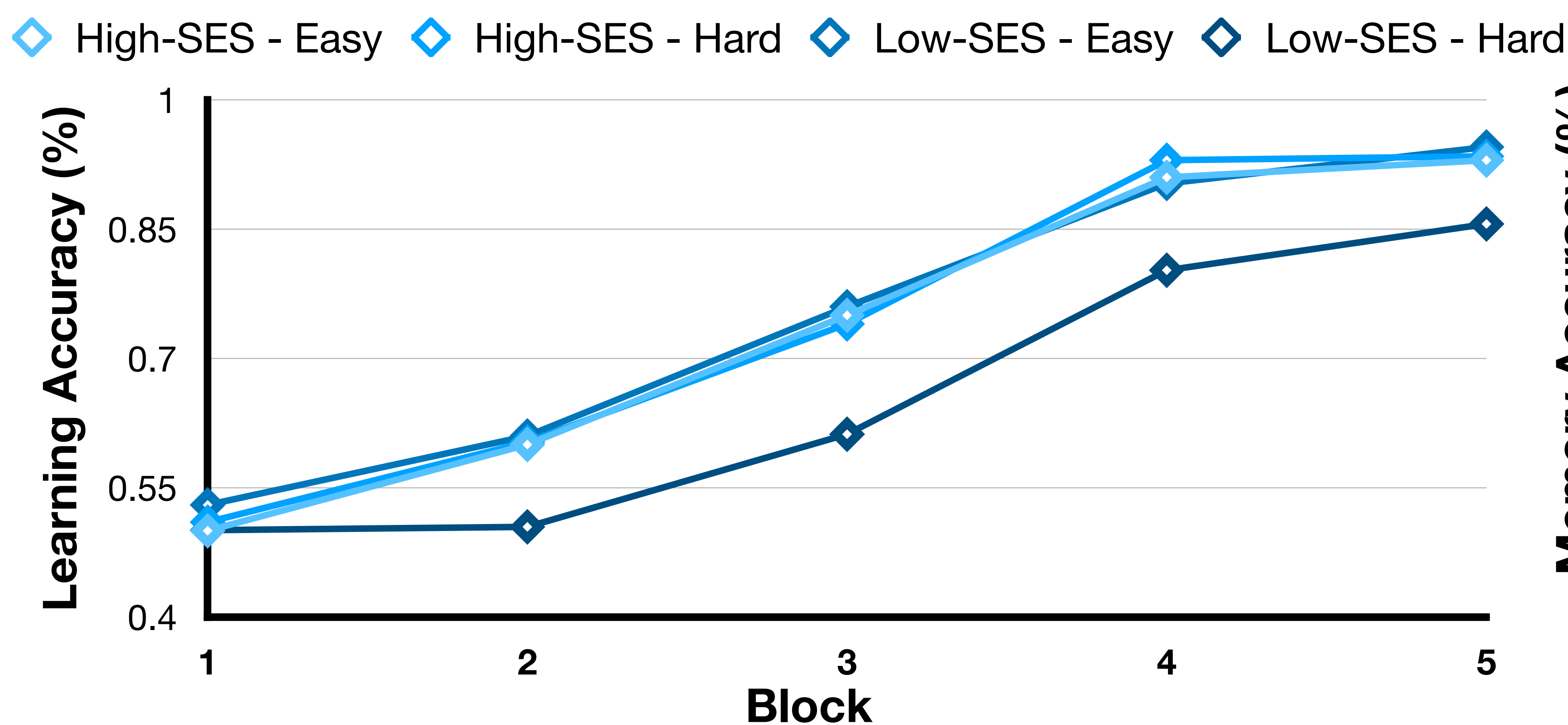
Surprise Memory Test

OLD   NEW

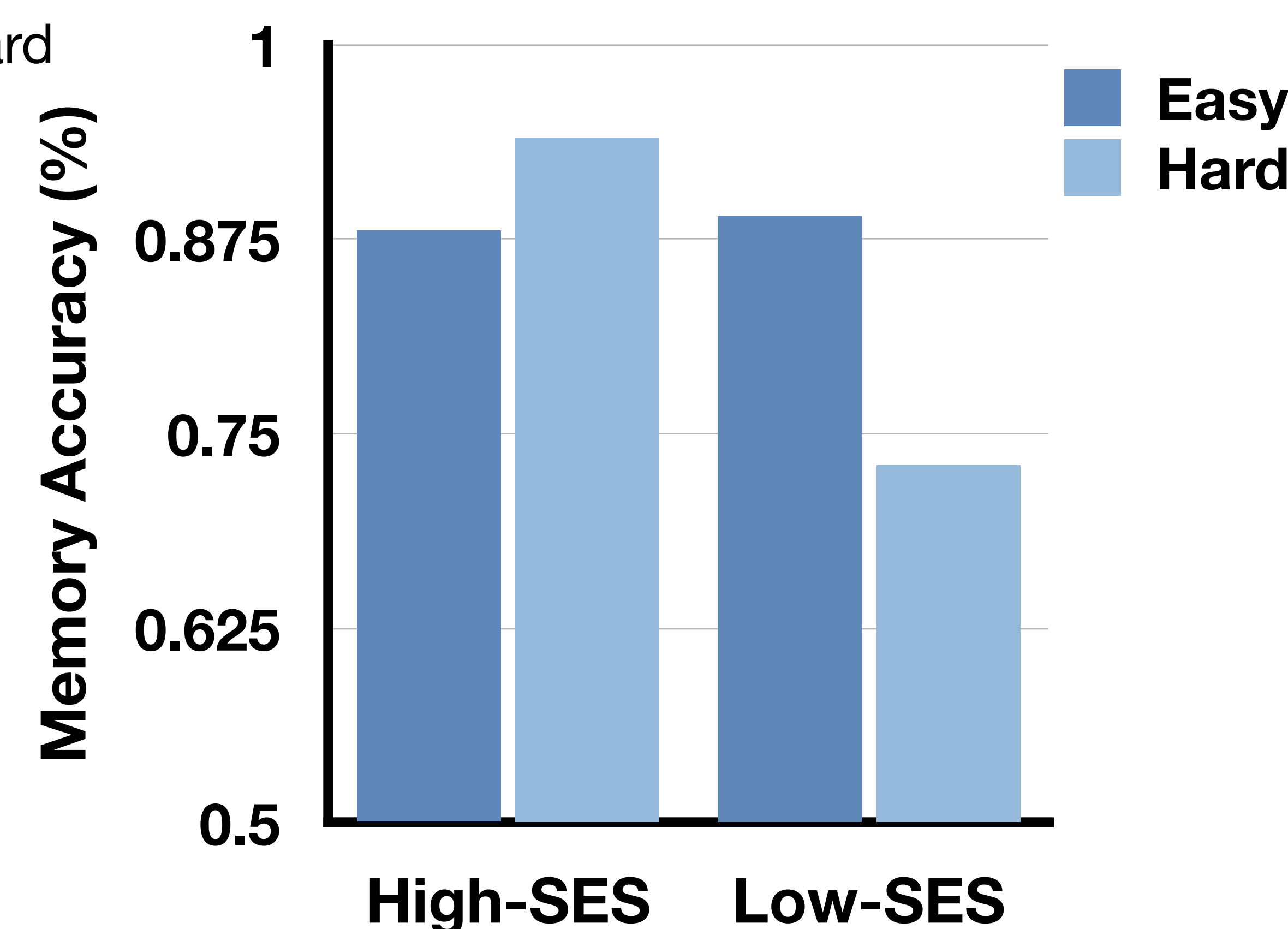How confident are you?

1   2   3   4   5
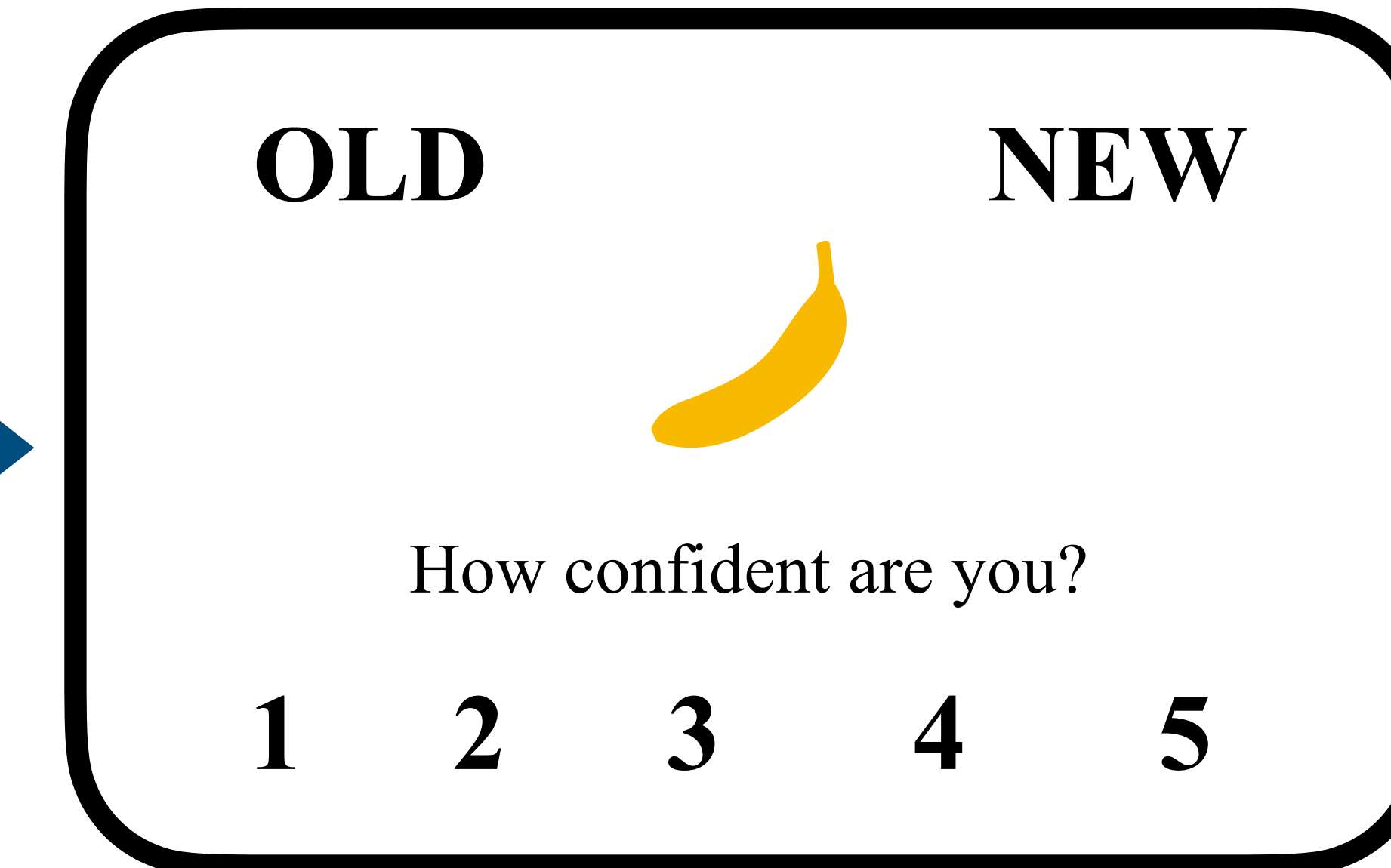
Following the learning task, participants will take a surprise memory test, with a mix of objects. They will see them one at a time and asked whether the object is old (i.e., seen during the learning task) or new (i.e., not seen in the task). Additionally, they will provide a confidence rating on a Likert scale where 1 = Not at all and 5 = very confident.

EXPECTED RESULTS

Anticipated Reinforcement Learning Results

Legend: High-SES - Easy, High-SES - Hard, Low-SES - Easy, Low-SES - Hard

Learning Performance: The above figure illustrates hypothetical results from my learning task in support of my hypothesis. With learning accuracy defined as the percentage of optimal choices made between the two objects, we anticipate finding that accuracy is affected *only* in adolescents from low-income backgrounds. These results would suggest that optimal decision-making and the use of prior experience is disrupted by poverty. No differences in our three other groups are expected.

Anticipated Memory Results

Legend: Easy, Hard

Memory Performance: This figure highlights expected results in support of my hypothesis. Performance is determined by accurately detecting old and new objects. Similar to the learning task, only low-income participants should exhibit a significant difference in performance. These results would suggest that scarcity is interfering with episodic memory consolidation.

DISCUSSION & CONCLUSION

This results of my thesis could provide novel evidence to suggest that poverty disrupts reward processing and memory. This is critical evidence in support of an adaptation framework (Raver & Blair, 2020), suggesting that **behavioral differences between socioeconomic groups are a result of exogenous factors and not due to an individual's cognitive ability.** Future studies should complement these (potential) findings with neuroimaging and physiological measurements. Nevertheless, if the results of my work materializes successfully, this could have many educational implications with regards to student learning and performance.

ACKNOWLEDGMENTS

REFERENCES

[1] Davidow, J. et al. (2016). *Neuron, 92*(1), 93-99.; [2] Noble, K. et al (2005). *Developmental Science, 8:* 74-87; [3] Hanson, J.L. et al. (2017), *Journal of Child Psychology and Psychiatry, 58*(7), 770-778.; [4] Mani, A. et al. (2013). *Science, 341*(6149), 976-980.*;* [5] Raver, C. & Blair, C. (2020). *Inf Child Dev., 29*:e2175.