Debriefing statement

Main questions and hypotheses

Our primary question in this study was: Do natural fluctuations in attention affect learning? We are interested a specific type of learning called "reinforcement learning," which involves using feedback to maximize reward. We will use the computational framework associated with reinforcement learning to investigate how lapses in attention might affect using feedback to learn or interfere with making choices that optimize reward. Attention could affect learning or choice processes, or both. Previous work has implicated other facets of attention in reinforcement learning (Niv et al., 2015) and indicates that natural fluctuations in attention do influence other cognitive capacities (deBettencourt et al., 2019), however the relationship between reinforcement learning and natural fluctuations in attention has not been addressed.

How was this tested?

Our task essentially combines a sustained attention task and a bandit task. For the attention task, you responded to the color of the shapes. One color was frequent (~90% of trials) and the other was infrequent. Because the task is so simple, and one response is highly frequent, your attention waxes and wanes throughout the task. This task allows us to track your attention on a trial-by-trial basis through errors and changes in reaction time. The choice task that occurred when the shapes were black was our reinforcement learning task. In this task, each shape was associated with a probability of reward such that one shape had a very high likelihood of yielding a reward if chosen (~80%) and the other two had much lower chances of being rewarding. We can use your responses (reaction times and whether you got a reward or not) in this task to study how you are learning about the reward probabilities of the shapes. The combination of these tasks allows us to track your attention and study the relationship between attentional state and your performance on the bandit task with computational models and other types of analyses.

Why is this important to study?

Reinforcement learning is broadly studied in behavioral, neural, and computational brain sciences, and used in other computational work such as computer science and the development of artificial intelligence. Understanding the factors that influence this process and natural limitations of reinforcement learning in humans has implications for all of these fields.

More information:

If you are interested in reading more about similar work, here are some related papers:

DeBettencourt, M. T., Keene, P. A., Awh, E., and Vogel, E. K. (2019). Real-time triggering reveals concurrent lapses of attention and working memory, Nature Human Behavior, 3(8), 808-816. https://doi.org/10.1038/s41562-019-0606-6.

Niv, Y., Daniel, R., Geanna, A., Gershman, S. J., Leong, Y. C., Radulescu, A., and Wilson, R. C. (2015). Reinforcement learning in multidimensional environments relies on attention mechanisms, Journal of Neuroscience, 35(21), 8145-8157. DOI: 10.1523/JNEUROSCI. 2978-14.2015.

If you are interested in learning more about this study or the research we do in this lab, you can contact Juliana Trach (Juliana.trach@yale.edu).

If you have concerns about your rights as a participant in this experiment, please contact the Human Subject Committee, (203) 785-4688, human.subjects@yale.edu.

Please do not disclose research procedures and hypotheses to anyone who might participate in this study as this could affect the results of the study. Thank you for your participation!