Using a Reinforcement Learning Model and Bayes Factors to Study Gender Differences and Personality Correlations in Reward Prediction Errors

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We used a dynamic reward task to study gender differences in reward prediction errors in college students. Experimental data were fit by a reinforcement learning model using the Bayesian estimation approach. We also correlated subjects' performance with their personality traits assessed by the Tridimensional Personality Questionnaire (TPQ). Matching law analysis revealed that males are more sensitive than females, meaning that males are better than females in choosing the advantageous card. Model fitting together with Bayes factors revealed that females update their values slightly faster than males, indicating that females have the tendency to give the trial-by-trial prediction error more weight. Further, females showed less perseveration than males, indicating that females tend to explore the uncertainty of future events more often. We also found that females' learning rate is negatively correlated with their task performance, whereas both males and females' degree of perseveration is positively correlated with their task scores. These results indicate that on average, males have a more 'optimal' learning rate and a larger degree of perseveration than females, providing a plausible explanation of why males performed slightly better than females in the task.

Regarding the relation of task performance and personality traits, correlational analysis revealed that females with higher scores in "extravagance" (which is in the novelty-seeking dimension of TPQ) have lower value-updating rates. Moreover, females with higher scores in "attachment" (which is in the reward-dependence dimension of TPQ) have lower degrees of perseveration. No such findings were found in males. Further work is needed to verify the findings.

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