Individual differences in extrastriatal dopamine D2-like receptors shape strategic social learning

Introduction

In competition, success depends on the ability to learn from an opponent's actions and consider the actions one should have taken in the past to inform future decisions. This belief-based learning engages cortical brain regions that receive dopaminergic projections. While dopamine's role in non-social learning is well established, it is unknown whether individual differences in dopamine function relate to belief learning in a social context. We hypothesized that individual differences in cortical dopamine relate to strategic decision updating in a social context.

We used PET and patent race game behavior to examine the link between cortical dopamine D2R levels and strategic social decisions.



Over 80 rounds, participants competed to develop a new product. If the participant spent more than the competitor, the participant won the product and their remaining endowment and vice-versa for the competitor. If the participant spent less than the competitor, then they lost their endowment.

Analysis

Task and ROI data were analyzed using mixed-effects models with random intercepts for participants for the effect of payoffs and regret. Choices were fit to an experienceweighted attraction (EWA) model with a softmax slope and correlated with D2Rs from ROIs and voxelwise maps.



foregone payoff and received payoff

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N = 37 (20 females), ages 26-79 (iii) Feedback pponent invests 2 Opponent Subject wins prize Pavoff

PET Scanning

PET w/[11C]FLB-457 to label D2Rs. Mean D2R availability was derived from bilateral ROIs in amygdala, hippocampus, insula, and cortical (frontal, parietal, temporal) regions.

$$if s_i^k = s_i(t)$$

$$p_i^k(t+1) = \frac{e^{\lambda \cdot V_i^k(t)}}{\sum_{l=1}^L e^{\lambda \cdot V_i^l(t)}},$$

if
$$s_i^k \neq s_i(t)$$
,

Results





Above, Left: Participants with lower D2R levels in the cortex were more motivated by own payoffs & regret in the immediately prior round to stay with a current investment strategy. D2R levels in the cortex and insula were positively correlated with a discounting parameter for past round interactions (ϕ). Above, Right: Voxelwise analysis indicated regions associated with higher ϕ . Yellow areas indicate p<0.05, red areas indicate p<0.01.

Conclusion

Individuals with lower D2R levels were more sensitive to Our results indicate that individual prior round own payoff & regret in strategy choice & placed differences in cortical & insula a greater weight on only the most recent competitions. dopamine shape aspects of strategic decisions. Lower D2R availability was related to higher sensitivity to prior round payoffs & regret. Participants with higher D2R levels depreciated past values more slowly, indicating a greater belief their opponent is a slow adaptor whereas participants with lower D2R levels concentrated only on the most recent experiences. Together, these results could indicate that higher D2Rs support more fictitious play by retaining more values from past competitions. NIA R00-AG042596 NIH

Above: Participants with **lower** D2R levels in the **insula** were **more** motivated by own payoffs in the immediately prior round to stay with a prior investment strategy and by regret to switch from a prior investment strategy. Z-statistics are for the interaction between D2R availability & prior trial payoff or regret.

