Ready, set, explore! Event-related potentials reveal the time-course of exploratory decisions

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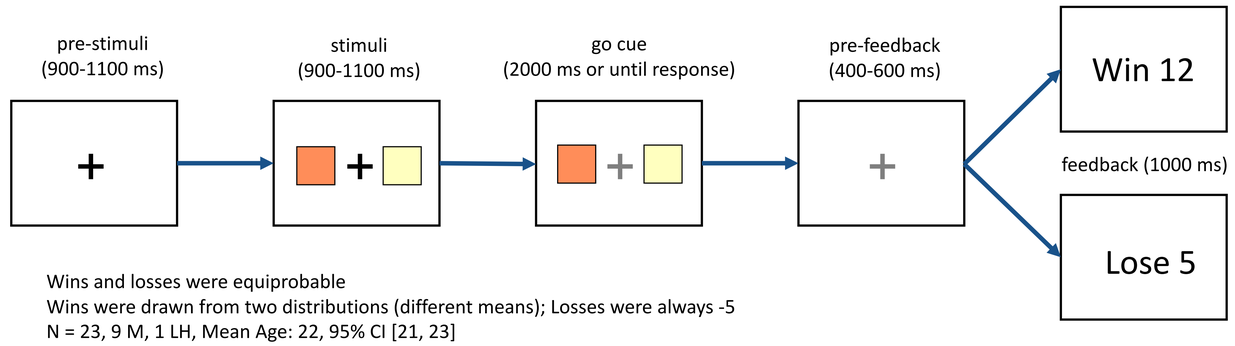
INTRODUCTION

When do we *exploit* previous learning, and when do we *explore*?
Which neural systems are involved?

Neurotransmitter	Source	Target	Event-Related Potential	Function
Dopamine	SN, VTA	ACC	reward positivity[1]	reinforcement learning[1]
Norepinephrine	LC	Various	P300[2], N200[3]	neural interrupt[4], response conflict[5]

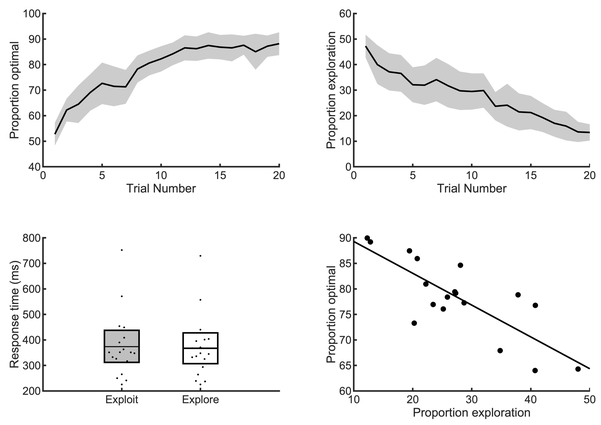
Decision making and EEG data → Computational model → Trial classification (explore/exploit) → Event-related potentials pre-explore pre-exploit

METHODS

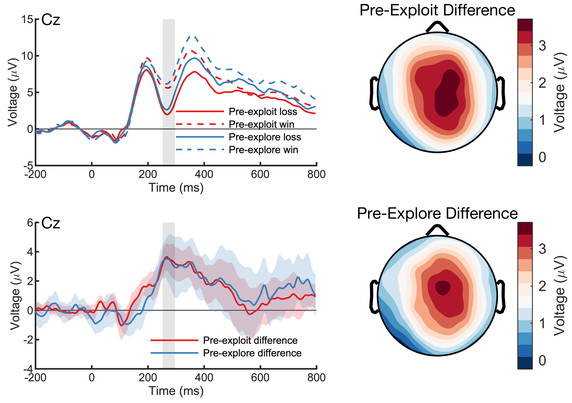


Wins and losses were equiprobable
Wins were drawn from two distributions (different means); Losses were always -5
N = 23, 9 M, 1 LH, Mean Age: 22, 95% CI [21, 23]

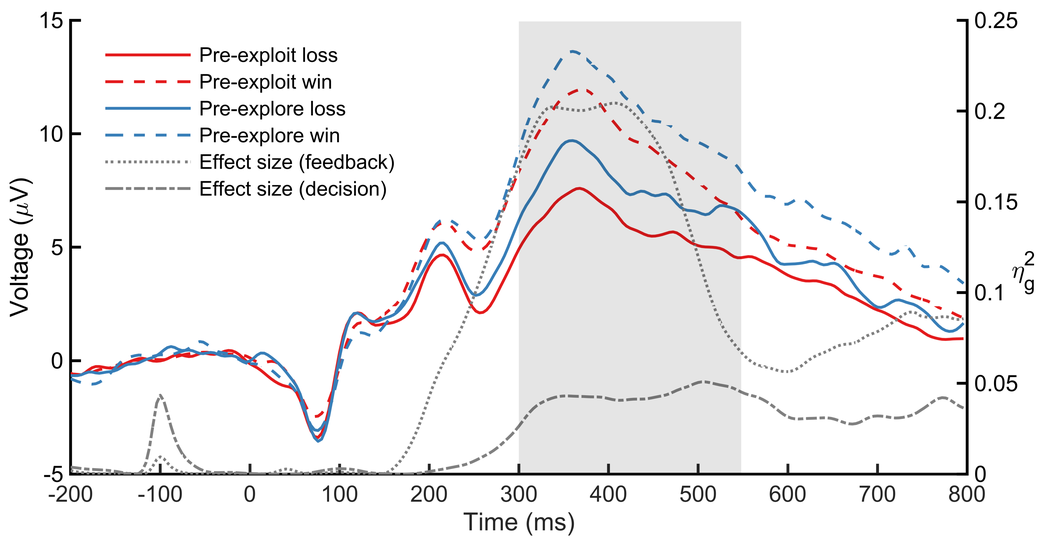
RESULTS

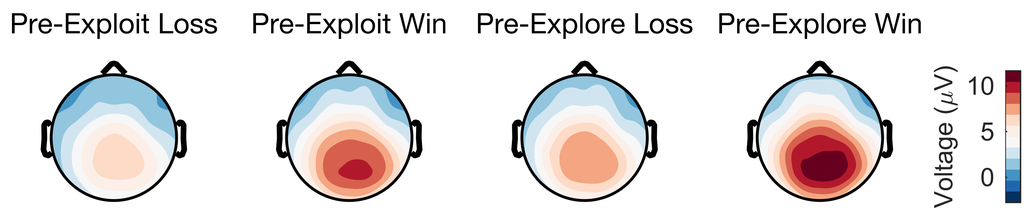


Behavioural data

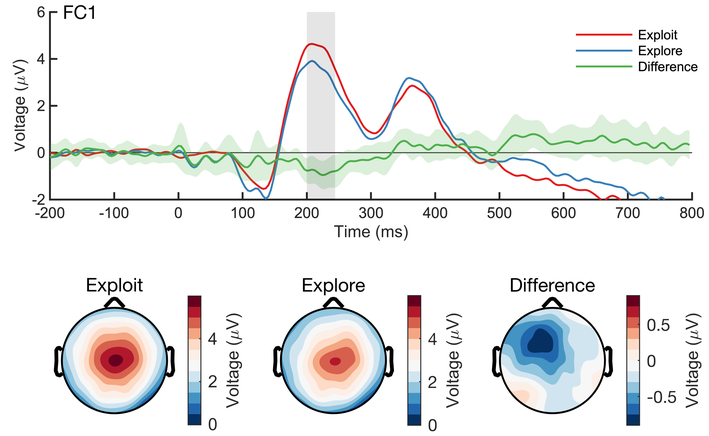


Reward positivity (no effect of decision type)





P300 (main effect of decision type)



Stimulus-locked N200

CONCLUSIONS

- Phasic activity of the LC-NE system, as indexed by a feedback-locked P300, plays a critical role in triggering a switch from exploitative to explorative decision making
- Phasic midbrain dopamine does not appear to play this same role
- The period just prior to a decision to explore involves response conflict

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