

Cortical mechanism for value-to-action transformation during economic choice

Oliver M Gauld, Chaofei Bao, Joseph Tutt, Yang Pan, Jingjie Li, Joseph Warren, Jeffrey C Erlich & Chunyu Ann Duan



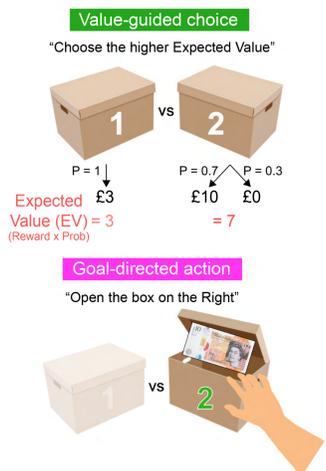
1 Introduction

Economic decisions are multi-attribute choices guided by subjective value and individual preferences e.g. would you choose a small guaranteed reward over a 'risky' lottery?

These decisions can be formed in **value space** while spatial choices are planned in **action space** before enactment in the physical world.

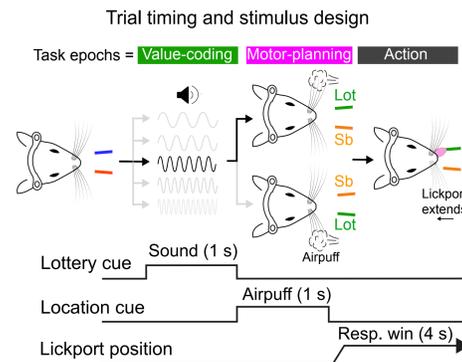
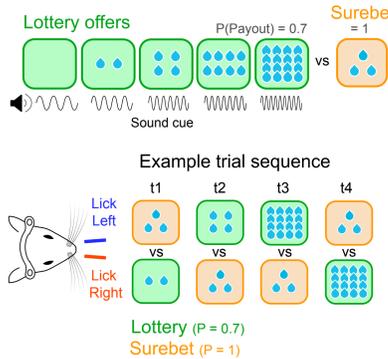
Dissecting the neural mechanisms that delineate these processes is challenging as value signals can be correlated with other preparatory (e.g. motor) signals.

Our experiments aim to delineate value and action coding in the brain and identify the neural mechanisms involved in transforming value-guided decisions into behavioural output

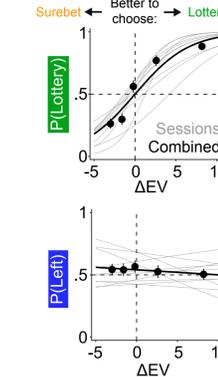


2 A novel task to separate value and action during economic decision-making

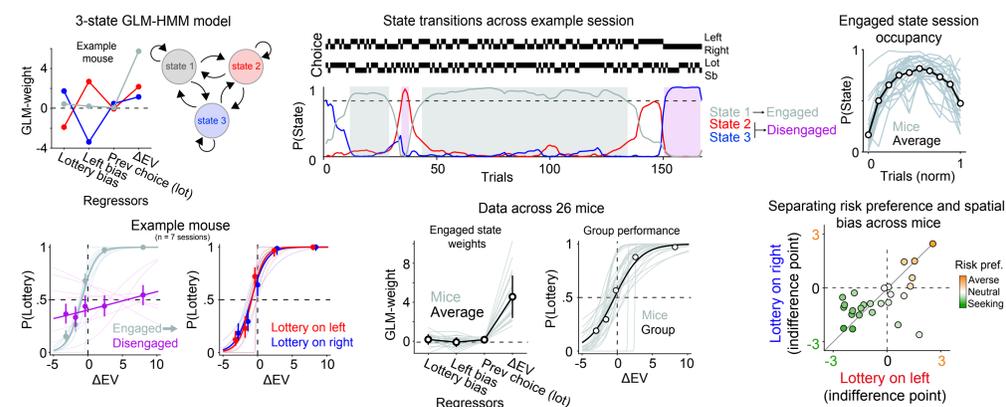
Head-fixed mice choose between a small 'Surebet' reward and a probabilistic 'Lottery'



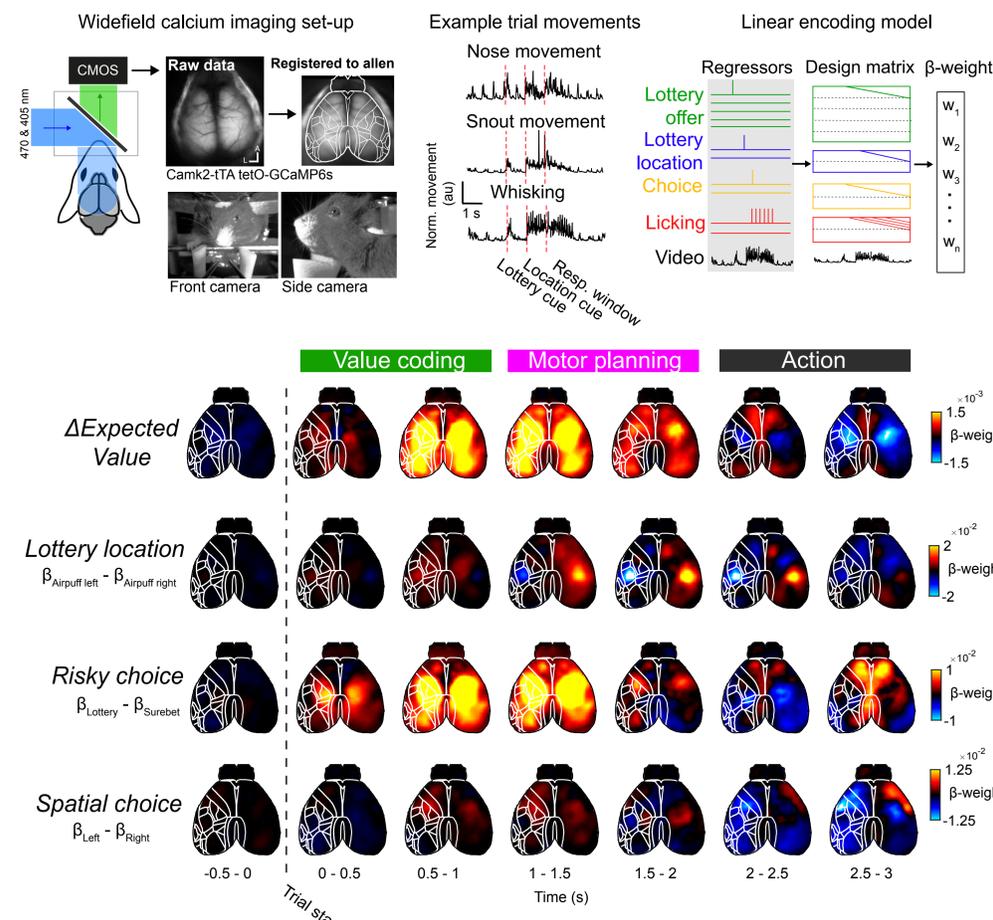
Example mouse performance



3 Behavioural modelling reveals task 'engaged' and 'disengaged' states

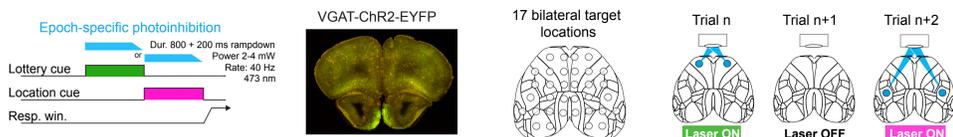


4 Mapping spatiotemporal coding of task information across cortex

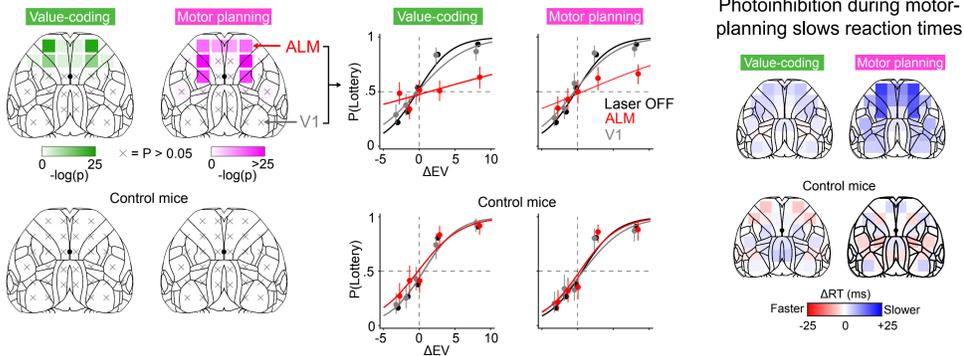


5 Causal optogenetic survey of dorsal cortex during task performance

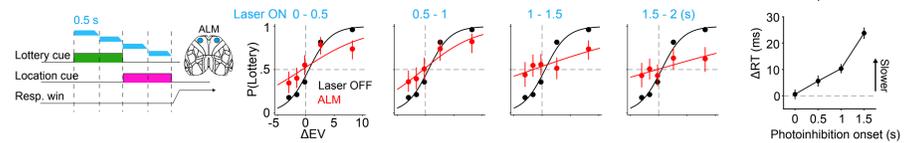
Experimental design: laser-scanning optogenetic photoinhibition



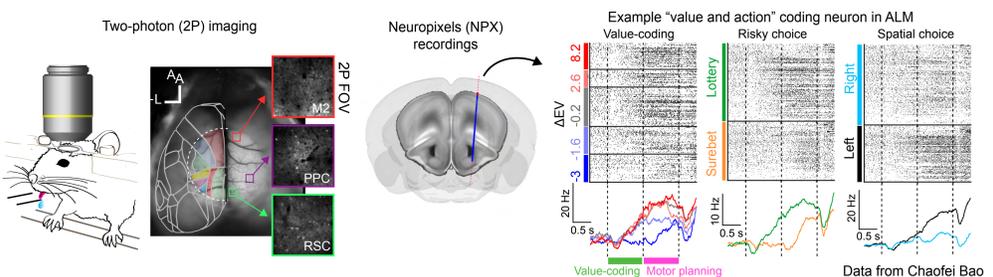
Mapping behavioural effect of region and epoch-specific photoinhibition



Sub-epoch photoinhibition of ALM

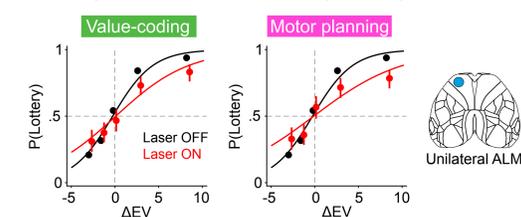


7 Ongoing cellular resolution recording experiments: 2P & NPX

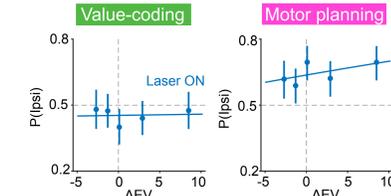


6 Distinct roles for ALM during value and motor planning epochs

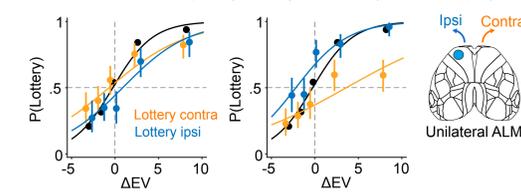
Unilateral photoinhibition of ALM also perturbs performance



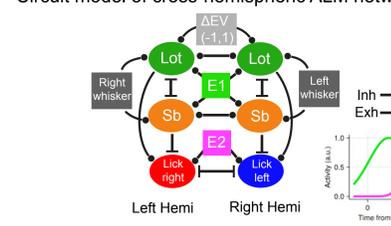
Uni photoinhibition of ALM drives ipsi choice bias selectively during motor-planning epoch



Laser ON trials split by lottery location (contra vs ipsi)



Circuit model of cross-hemispheric ALM network



8 Conclusions

- A novel task to separate value and action during economic choice
- Mesoscale survey of the dorsal cortex indicates widespread coding of value and value-choice signals
- Optogenetic experiments reveal selective and distinct roles of frontal motor cortex (ALM) in abstract value-coding and motor planning
- Ongoing recording and dynamical modelling experiments aim to reveal the cellular and circuit mechanisms for value-to-action transformation

Methods & tool development

