Inferring reward and path learning in depressed patients with logistic regression and active inference

Panny B[1], Price RB[1]

University of Pittsburgh[1]

Background

- The two-step task measures decision-making
  - "Model-free" decision making
  - "Model-based" decision making
- Model-free = Reward Learning
- Model-based = Reward Learning and Path Learning
- Active inference (AI) model differs from Hybrid Reinforcement Learning (RL) model because AI includes an "exploration incentive" in addition to "reward"

Participants and Design

*104 depressed (>=26 MADRS score) participants*

1. Completed two-step task at baseline
2. Received either ketamine or placebo infusion
3. Completed task one day after infusion
4. Received either active or sham cognitive training
5. Completed task at 3 more visits up to 1 month

## Two-Step Task

Stage 1   Stage 2   Reward
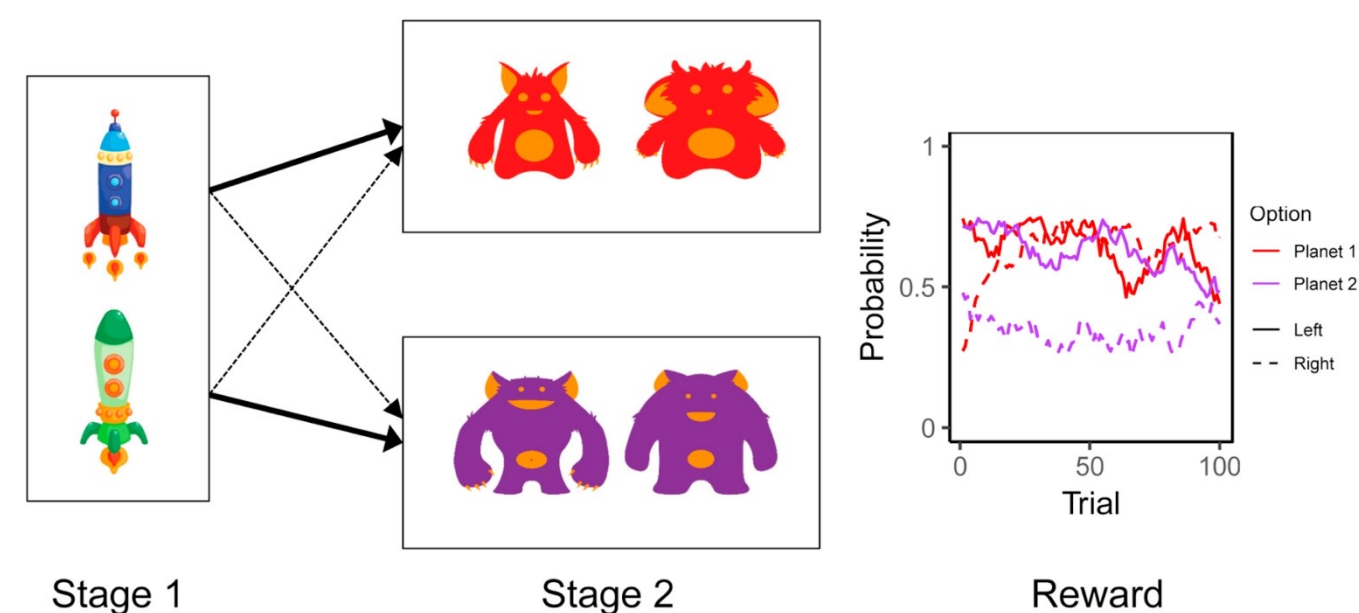
1. Choose rocket at stage 1
2. Choose alien at stage 2 and receive reward with probability p
3. Probabilities of reward drift after each trial
4. Rocket has a "common" (solid line) and "rare" (dashed line) transition

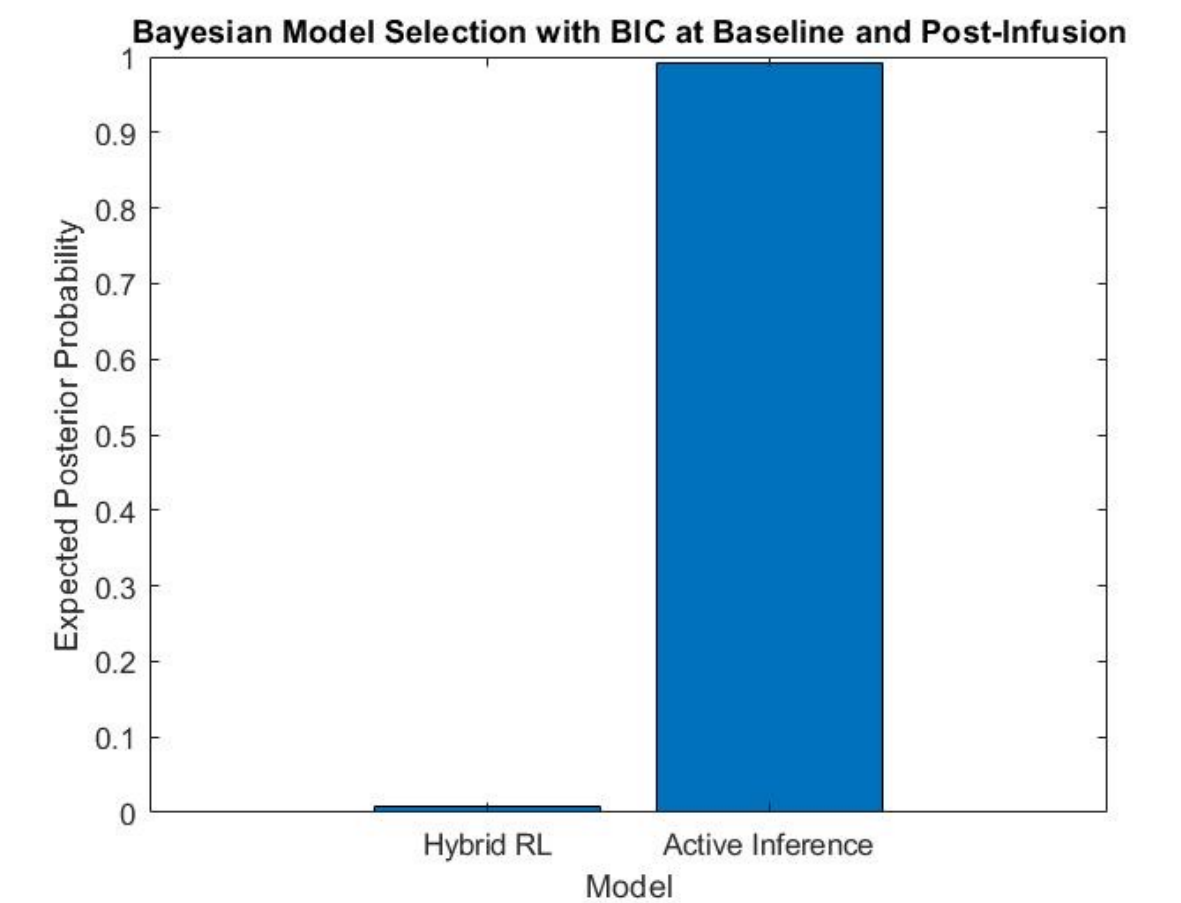### Fixed Effects of Ketamine Infusion on Decision-Making
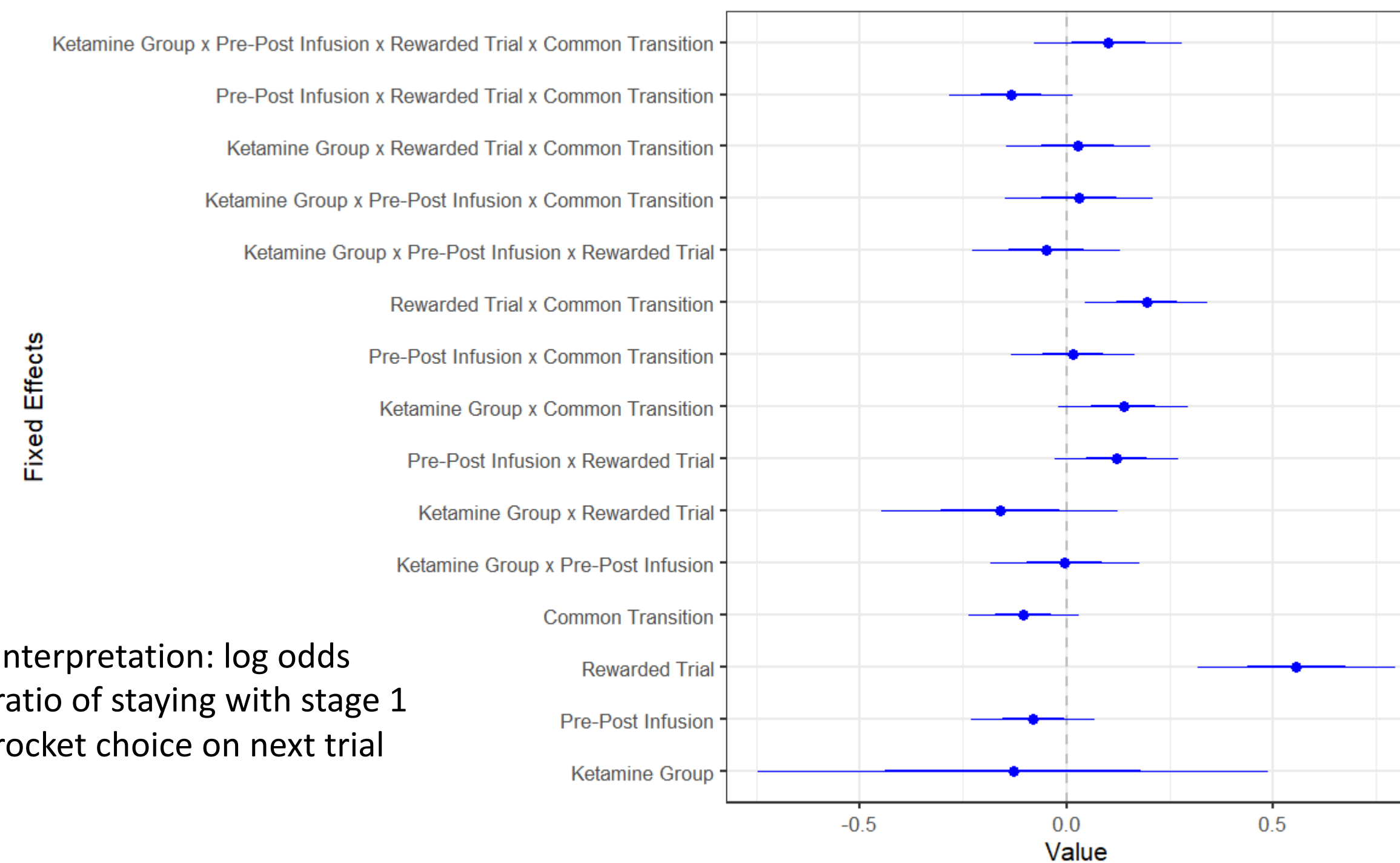
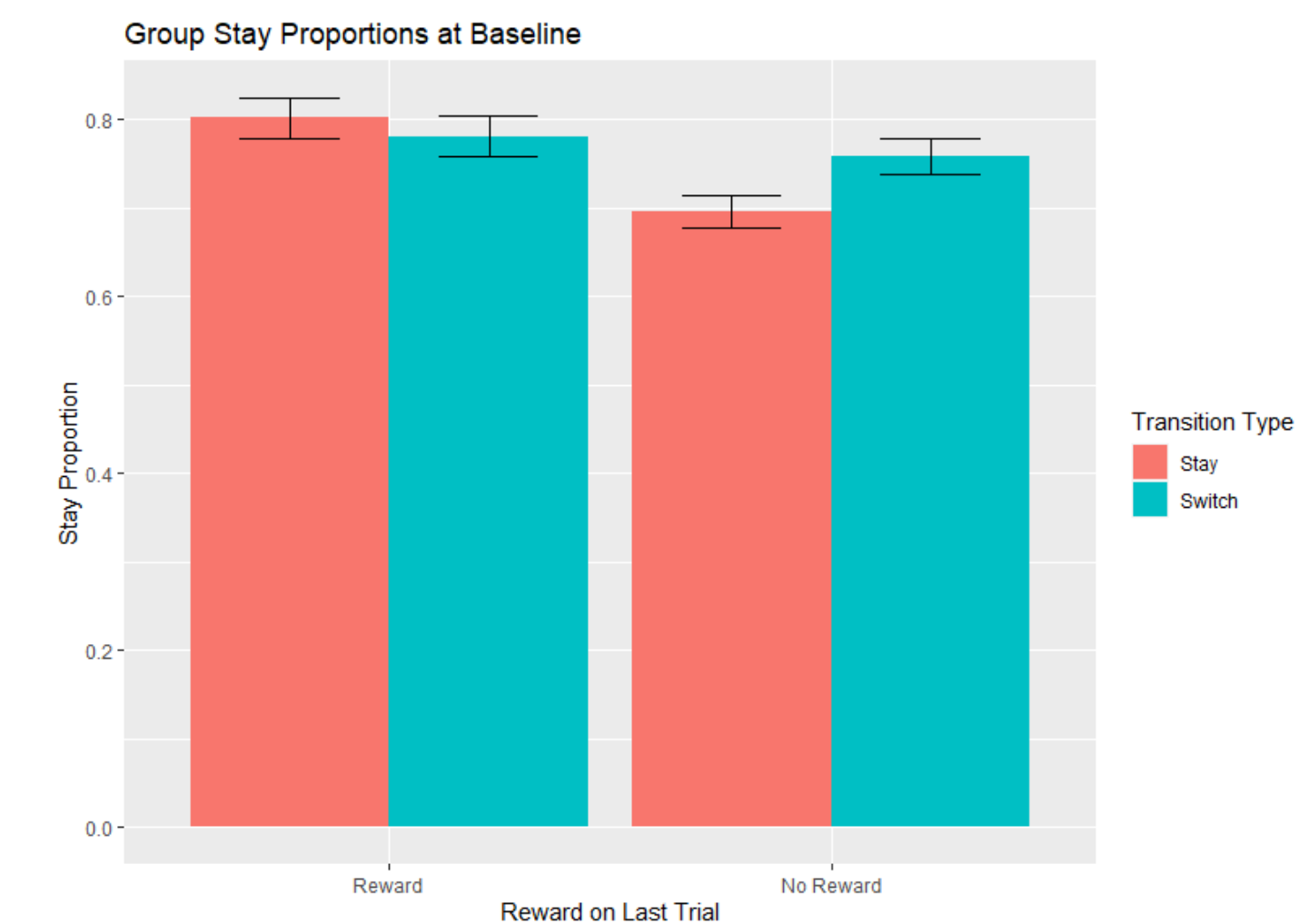Interpretation: log odds ratio of staying with stage 1 rocket choice on next trial

Fixed Effects of Treatment Group Trajectories on Decision-Making
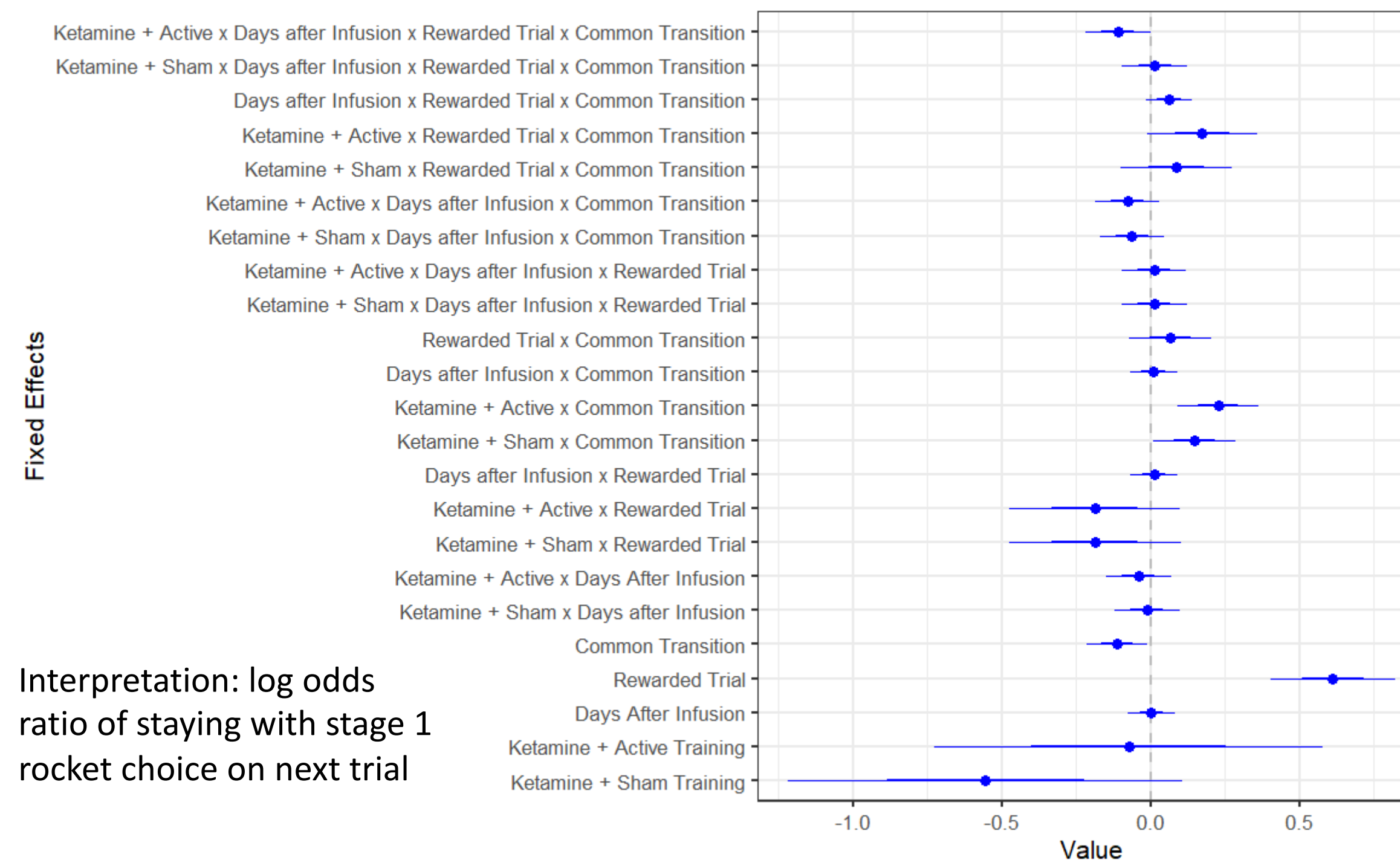
Interpretation: log odds ratio of staying with stage 1 rocket choice on next trial

Active Inference Model has relatively better fit to baseline and post-infusion data than Hybrid Reinforcement Learning Model.

Ketamine did not significantly influence "model-free" or "model-based" patterns before and after an infusion

Over time, those who received ketamine infusion + cognitive training showed less model-based planning

1. Brown VM, Chen J, Gillan CM, Price RB. Improving the Reliability of Computational Analyses: Model-Based Planning and Its Relationship With Compulsivity. Biol Psychiatry Cogn Neurosci Neuroimaging. 2020 Jun;5(6):601-609. doi: 10.1016/j.bpsc.2019.12.019. Epub 2020 Jan 13. PMID: 32249207; PMCID: PMC7286766.
2. Gijsen S, Grundei M, Blankenburg F. Active inference and the two-step task. Sci Rep. 2022 Oct 21;12(1):17682. doi: 10.1038/s41598-022-21766-4. PMID: 36271279; PMCID: PMC9586964.