

Electrophysiological Dynamics of Insula in Effort Based Decision Making

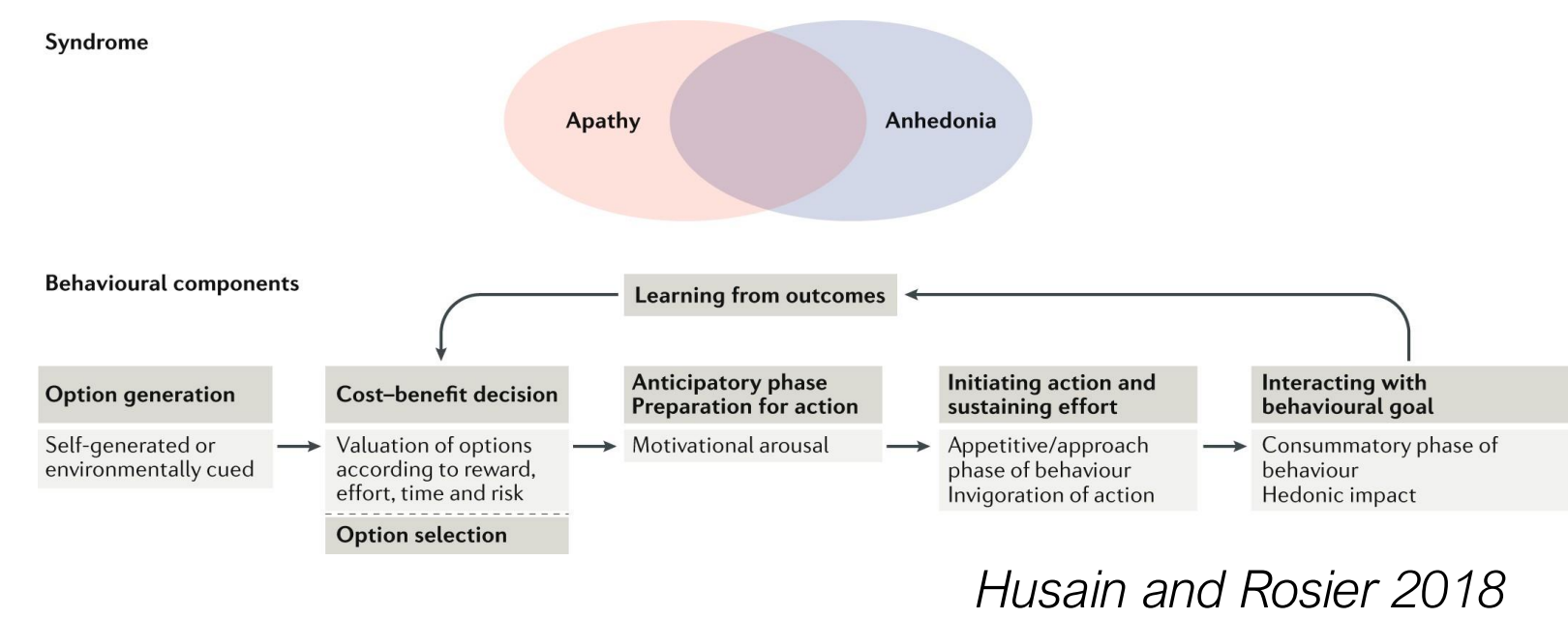
Vivek Anand¹, Camilla May¹, Nealen Laxpati², Ezequiel Gleichgerrcht², Michael Treadway², Christopher Rozell¹, **Sankaraleengam Alagapan¹**

Georgia Institute of Technology¹, Emory University²



BACKGROUND

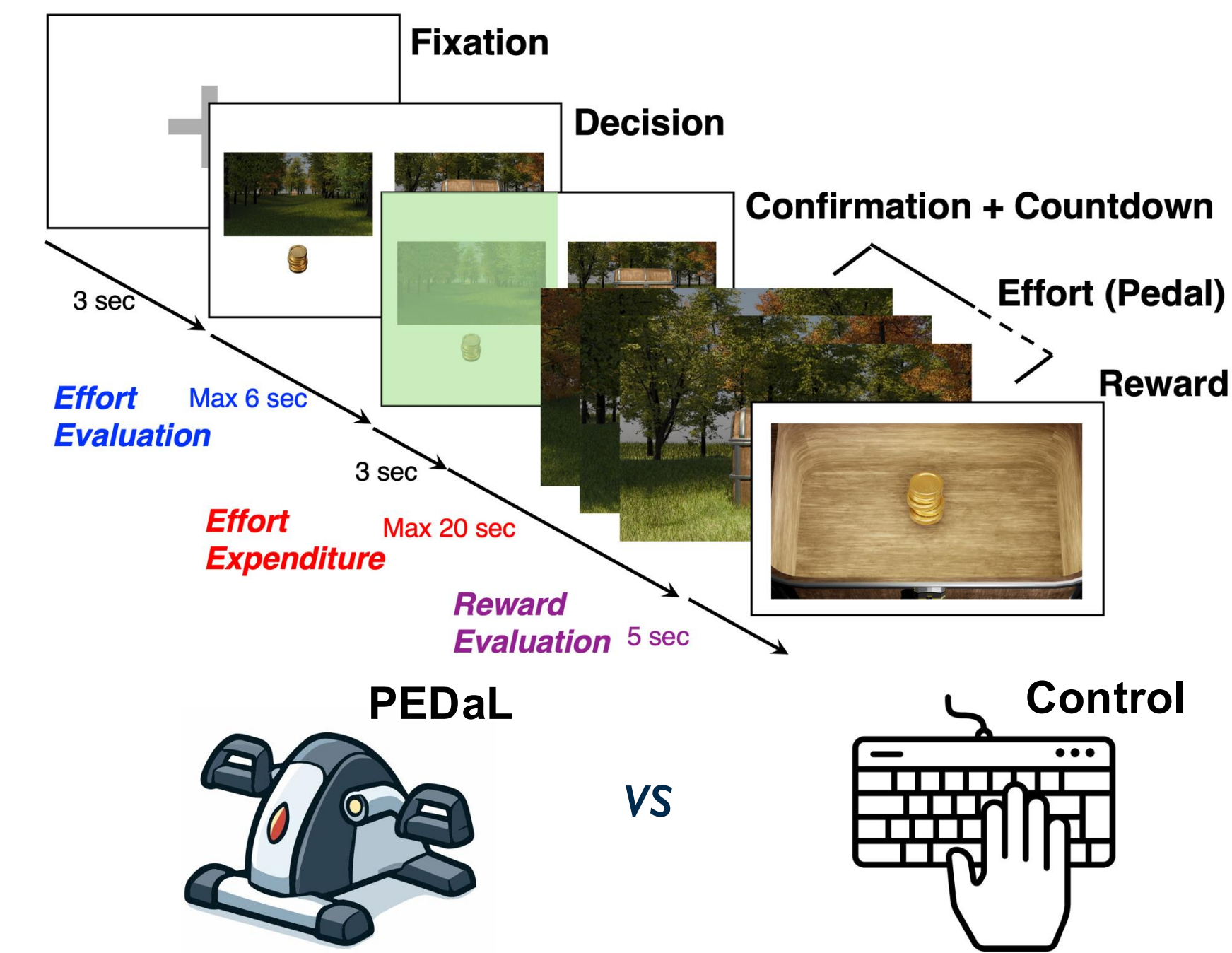
- Effort-Based Decision Making:
- Experimental paradigm to capture motivational deficits



- Physical effort not ecologically valid: common daily activities require substantial metabolic demand
 - Need paradigms integrating effort that places metabolic demand similar to daily activities
- Circuit dynamics of regions involved in EBDM (Anterior cingulate cortex; ACC, Insula, Orbitofrontal Cortex; OFC, dorsal and ventral striatum) not fully understood

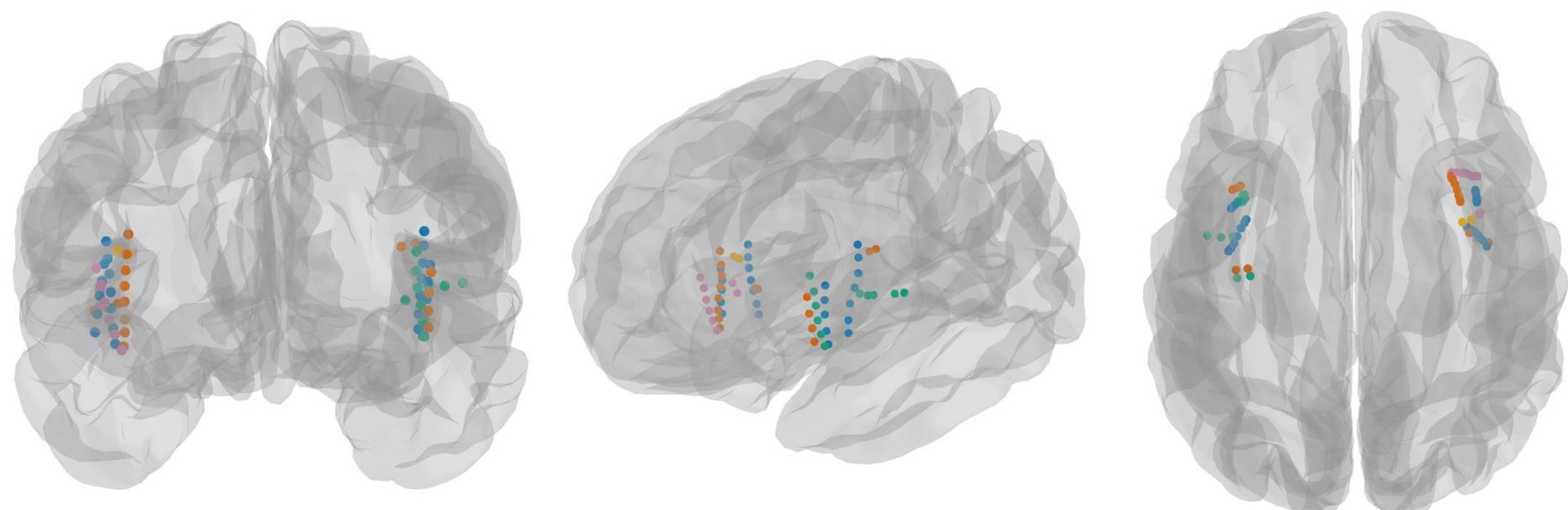
METHODS

Physiologically-demanding **Effort Decision and Learning (PEDaL)** Task



- Based on EEfRT task (Treadway et al. 2009)
- 24 trials with one reference effort/reward
- 4 blocks of 6 trials fully randomized

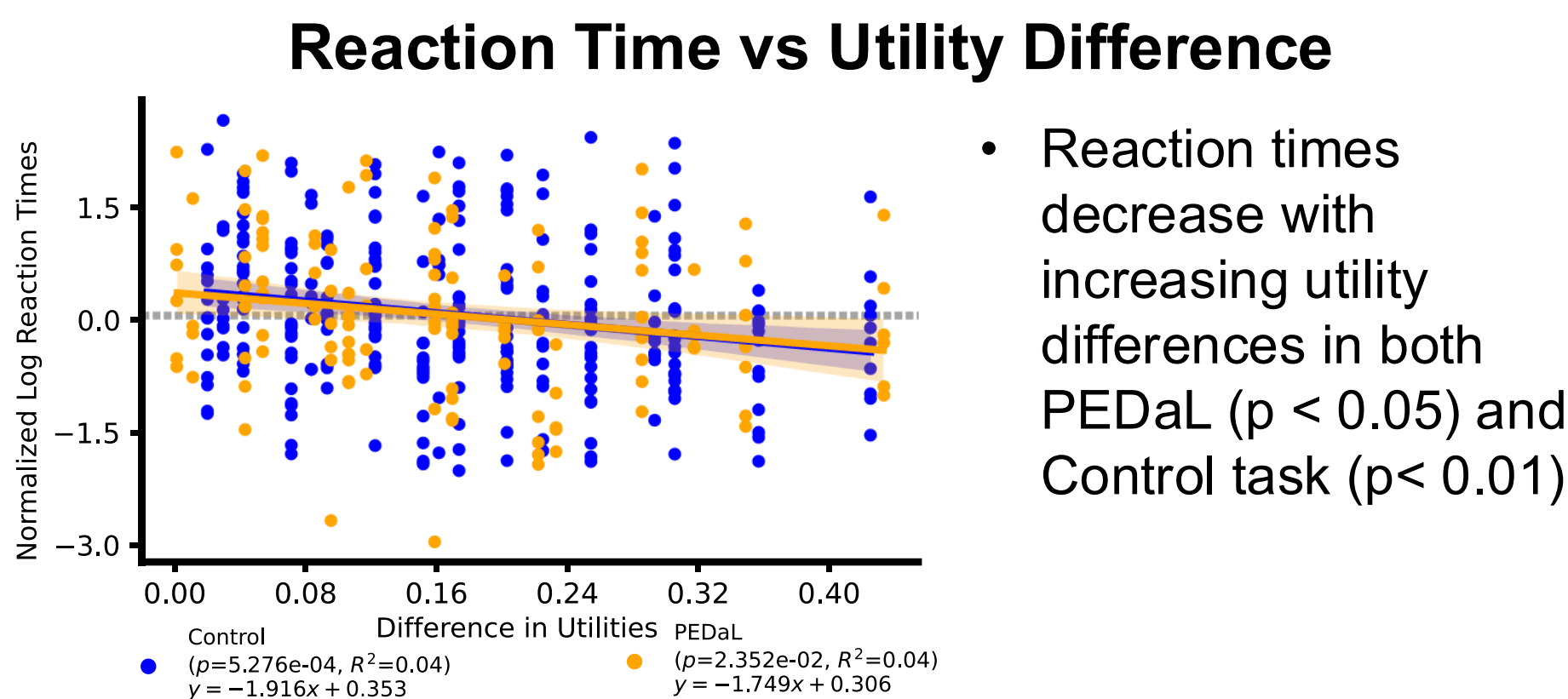
Localization of sEEG contacts in Insula (n = 5*)



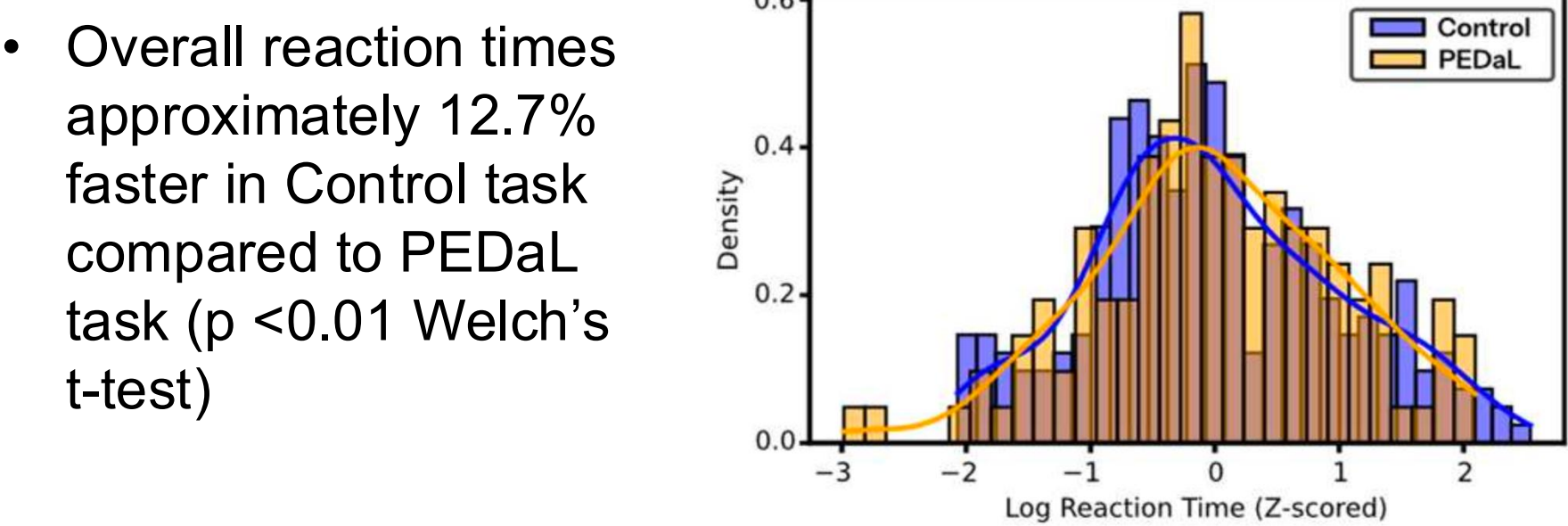
* - completed both PEDaL and Control tasks

RESULTS

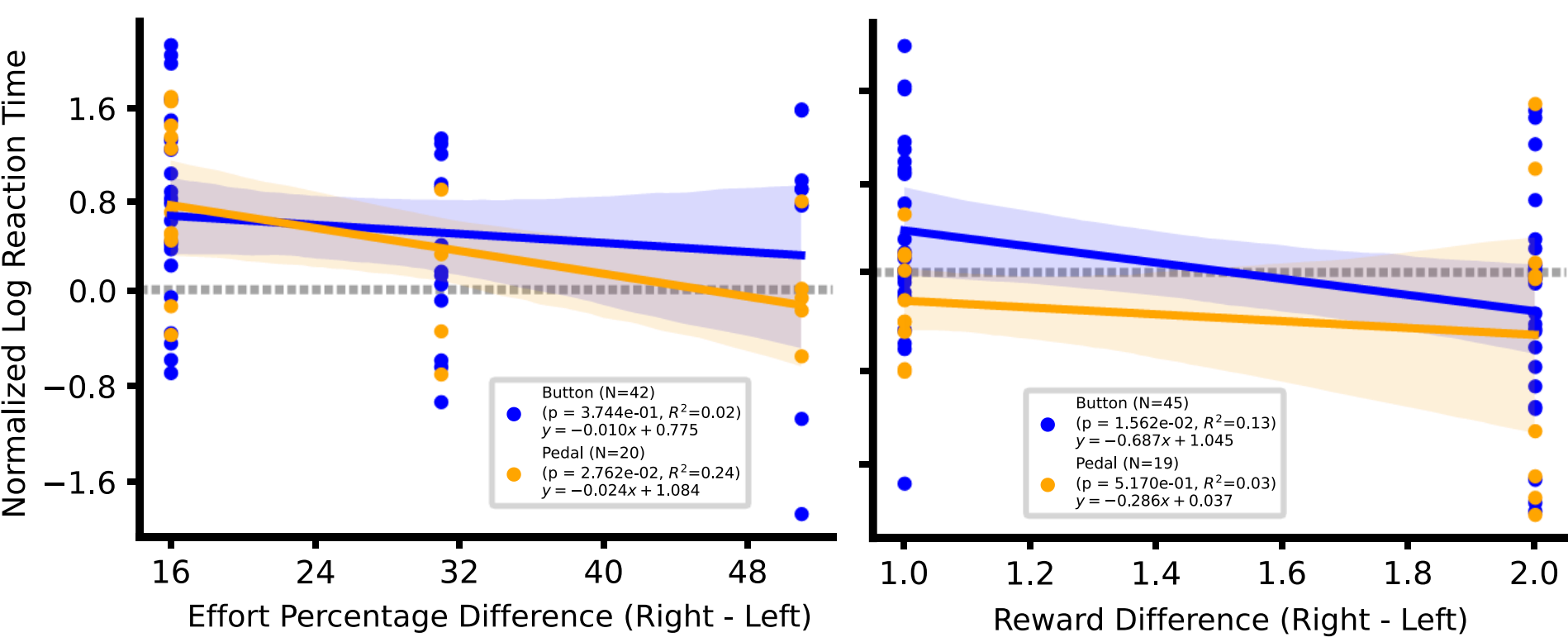
Effort is weighed more in PEDaL compared to Control



Reaction Time Difference between PEDaL and Control task

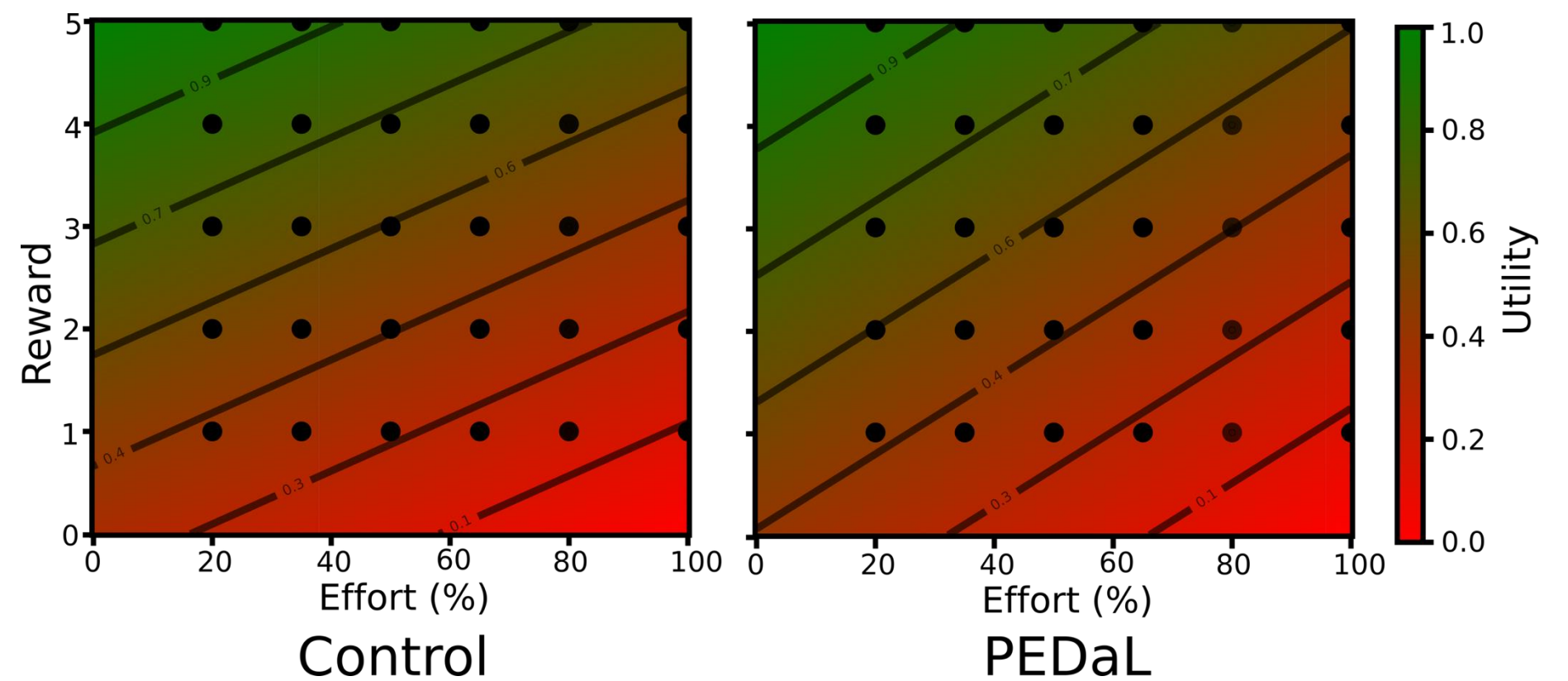


Reaction Time vs Effort or Reward Differences



- When rewards are equal, reaction times decrease with increasing effort difference in PEDaL task (p < 0.05)
- When effort is equal, reaction times decrease with increasing reward difference in Control (p < 0.05)

Utility Landscapes Based on Choices

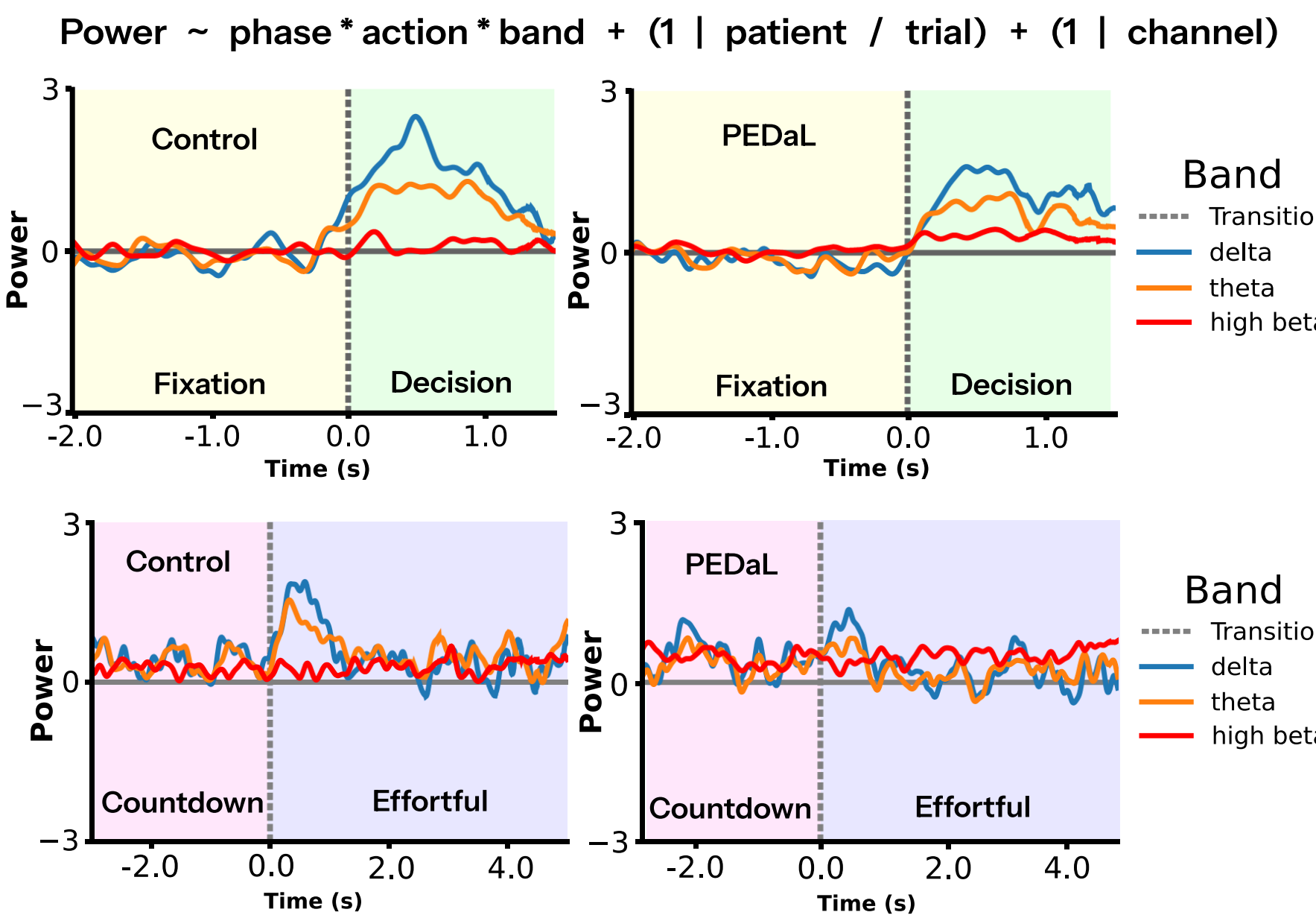
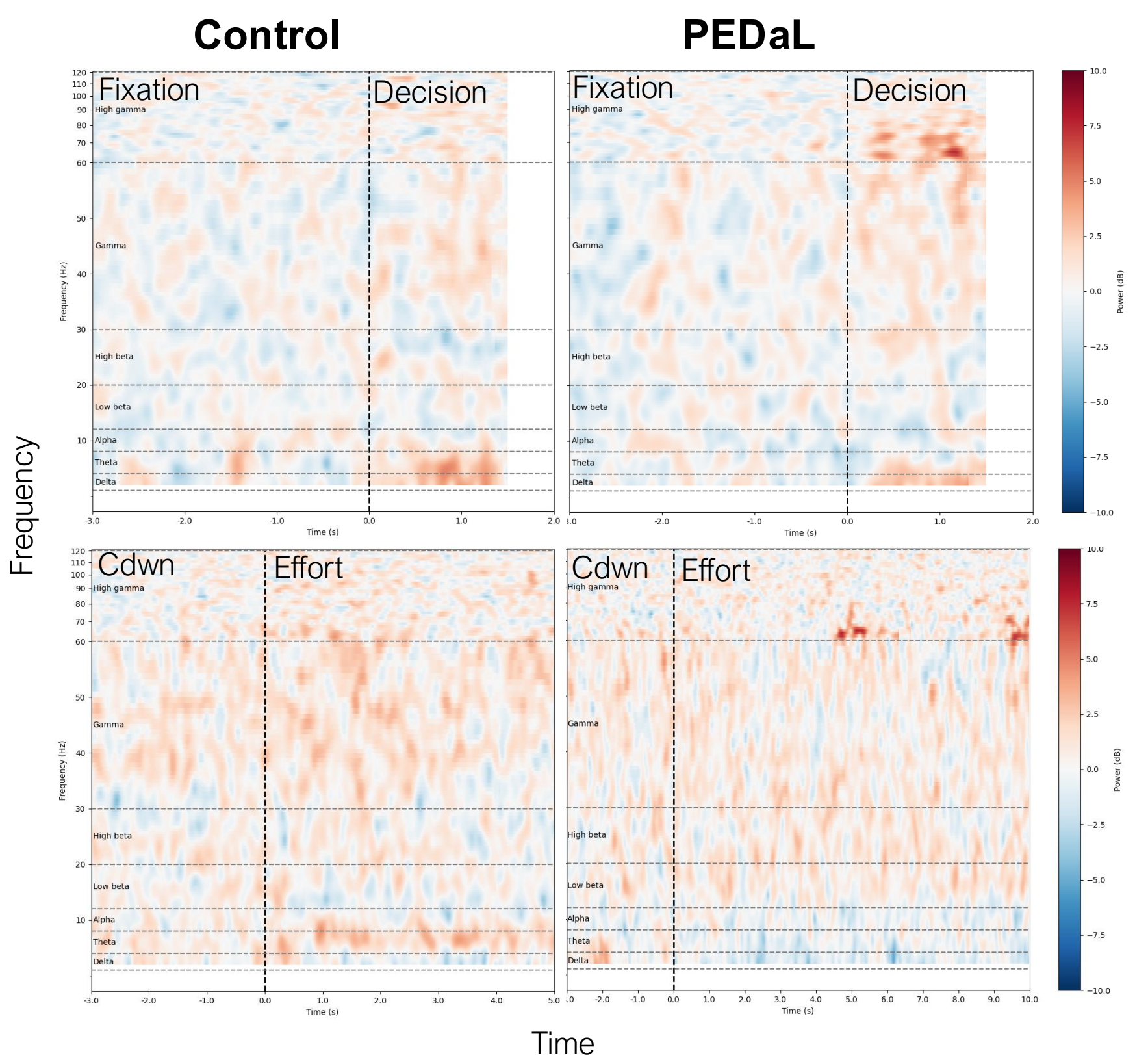


- Estimated logistic model slightly different between PEDaL and Control with effort weighed more for PEDaL. (n.s.)

RESULTS

Insula exhibits differential modulation of delta, theta and beta bands

Modulation of different oscillatory activity during task



- Delta, theta increased during effort evaluation phase in both tasks, but high beta increased only in PEDaL task
- Increased high beta persisted through effort expenditure only in PEDaL task
- All interaction terms significant to p < 0.01

NEXT STEPS

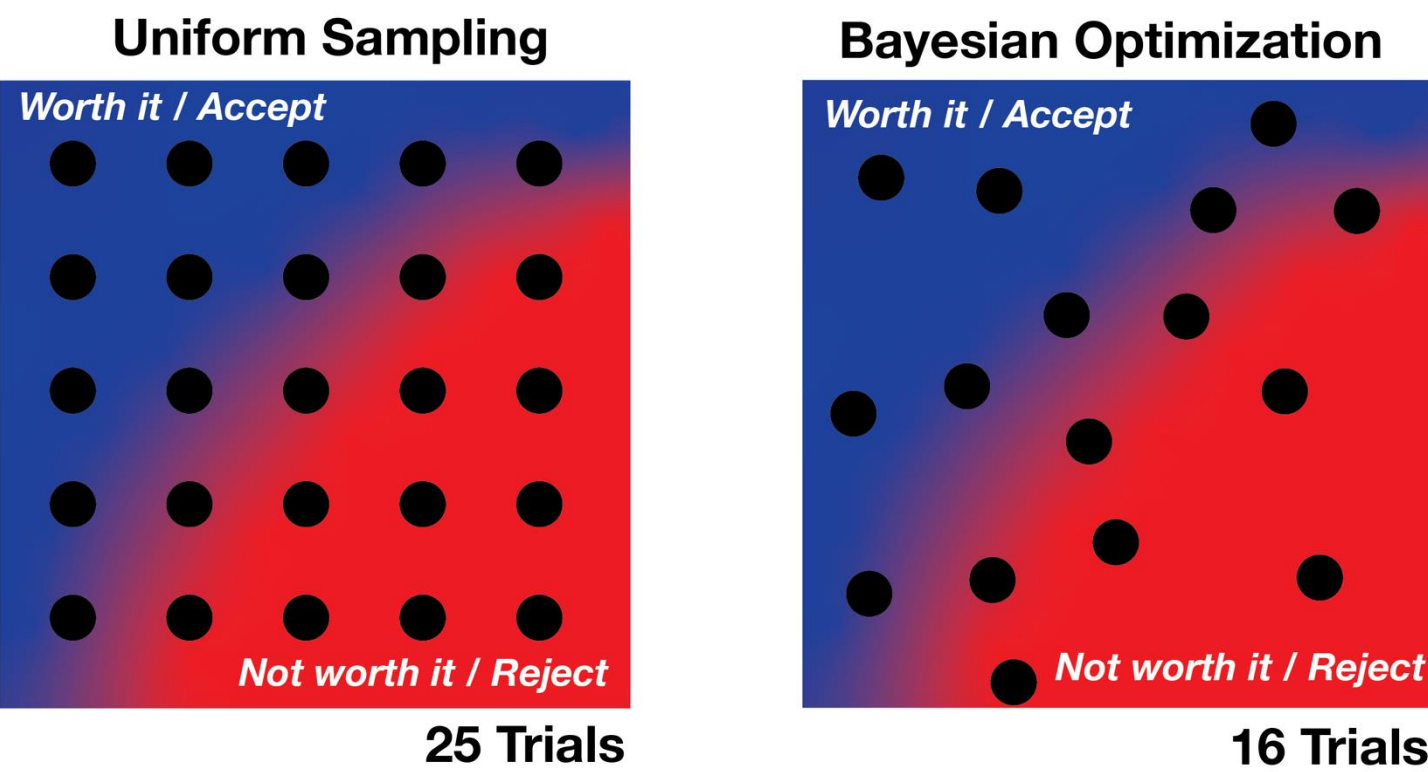
- Collect more data (targeted n = 15)
- Explore association between neural activity and behavior
 - Utility differences and delta/theta/beta activity
- Causal perturbation of neural activity with electrical stimulation
- Network dynamics (ACC – Insula – OFC) vs local dynamics

RELATED ONGOING WORK

Efficient individualized assessment of indifference curve

- Motivation
 - Individual differences in indifference curves
 - Comparing PEDaL and Control Task Neural Data
 - Effect of interventions on indifference curves

- Approach
 - Bayesian Optimization to estimate indifference curves using accept/reject and 2 alternative choices

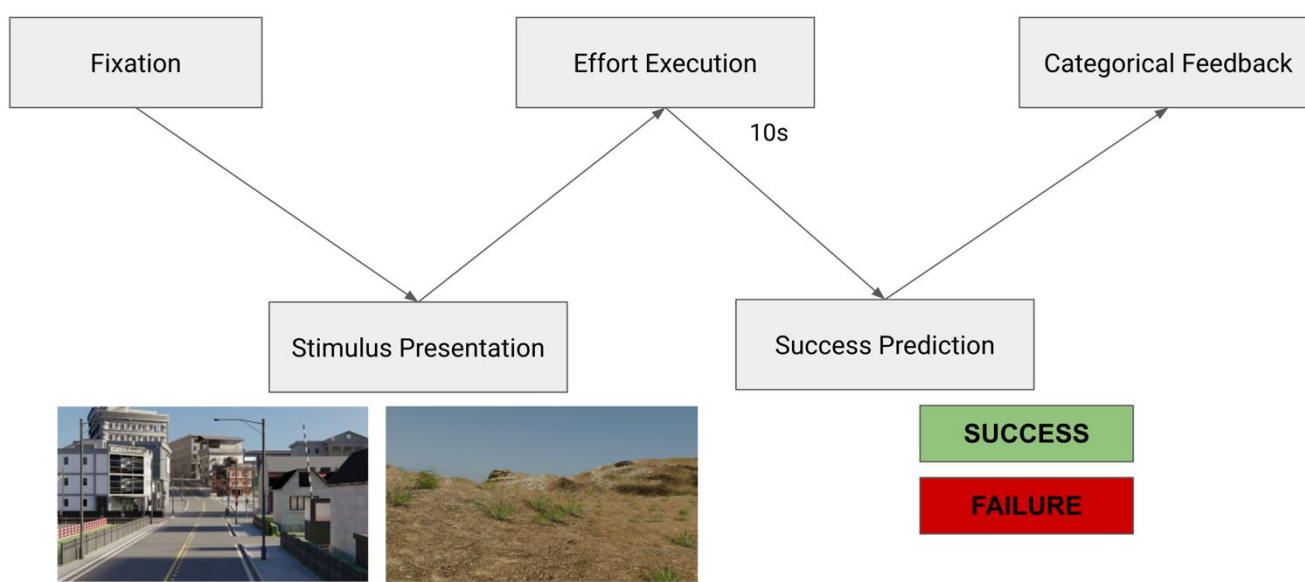


Neural Substrates of Effort Learning

Leela Raj-Sankar, Tyler Albarran

- Motivation
 - How do individuals learn how effortful an activity is and what is the role of effort circuit?

- Approach
 - Based on Effort Learning task (Hauser et al. 2017)
 - Healthy volunteers → sEEG patients



REFERENCES

- Husain, M. & Roiser, J. P. Neuroscience of apathy and anhedonia: a transdiagnostic approach. *Nature Reviews Neuroscience* 1, (2018).
- Treadway, W. E., M. T. ., Buckholz, J. W. ., Schwartzman, A. N. ., Lambert & Zald, D. H. Worth the 'EEfRT'? The effort expenditure for rewards task as an objective measure of motivation and anhedonia. *PLoS ONE* 4, e6598 (2009).
- Hauser, T. U., Eldar, E. & Dolan, R. J. Separate mesocortical and mesolimbic pathways encode effort and reward learning signals. *Proceedings of the National Academy of Sciences* 114, E7395–E7404 (2017).

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email: sankar.alagapan@gatech.edu