Lesions to value-responsive brain regions lead to impairments in voluntary persistence

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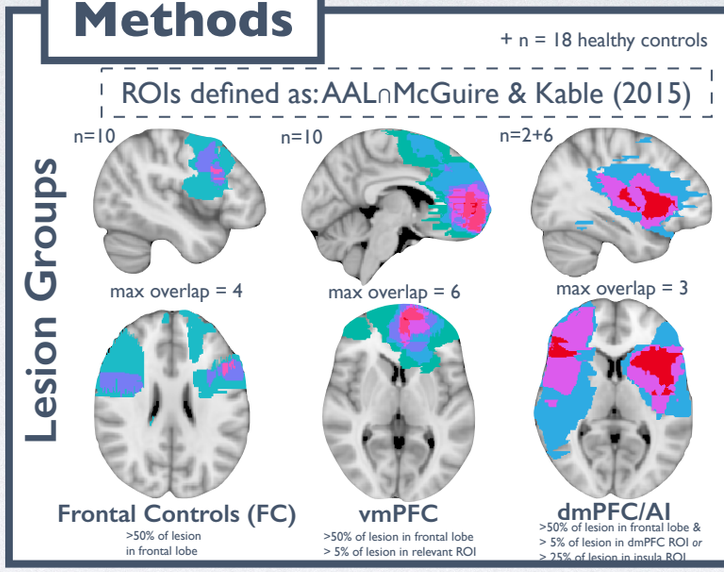
Background

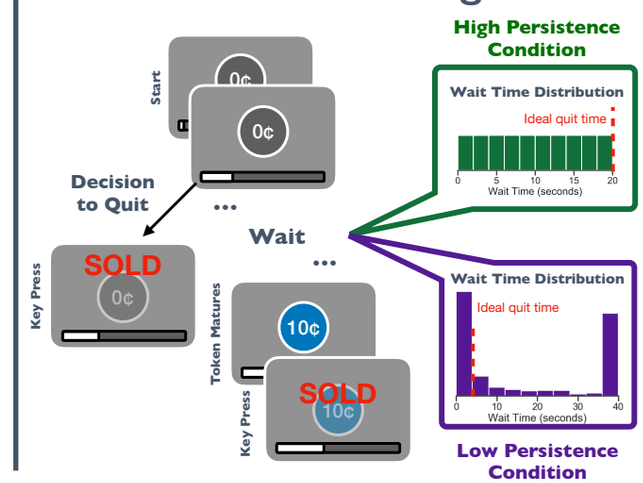
- The ability to keep waiting for future rewards has long been framed as a problem of self-control (Metcalfe & Mischel, 1999).
- But in some temporal environments, it is actually optimal to stop waiting if the reward has not yet arrived. Humans can learn this and make value-maximizing wait vs quit decisions (McGuire & Kable, 2012).
- Activity in cortical brain regions underlies this voluntary persistence: the vmPFC tracks the subjective value of waiting, while activity in the dmPFC + anterior insula (AI) increases before "quit" decisions (McGuire & Kable, 2015).

Question | How do **lesions** to different areas of the frontal cortex affect voluntary persistence?

Methods

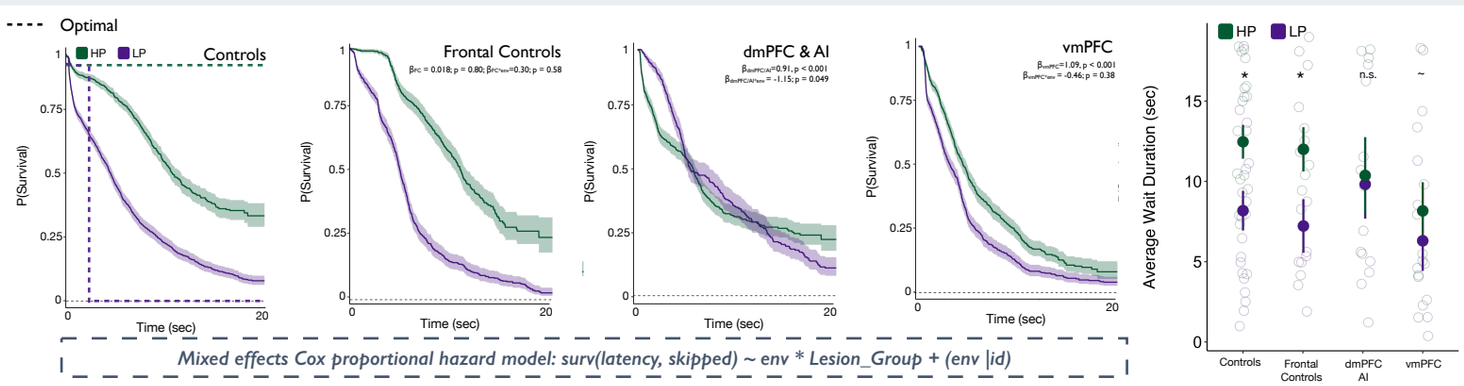


Task Design



Behavior

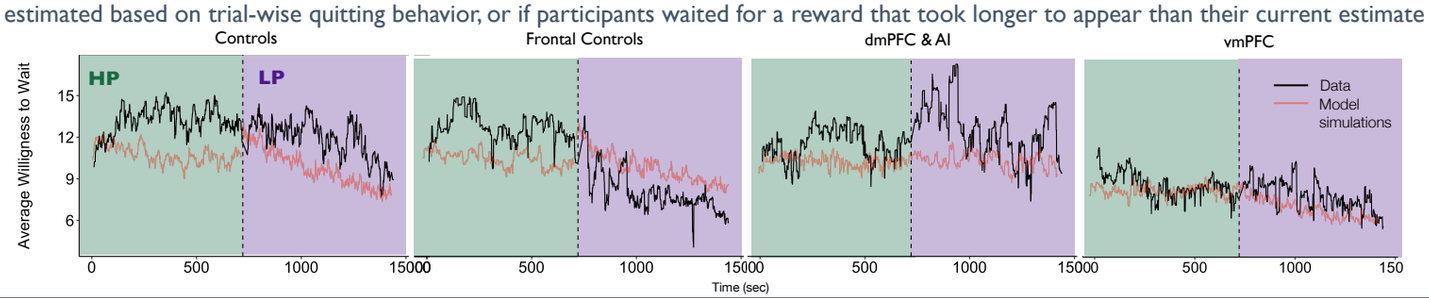
Trial-wise waiting behavior



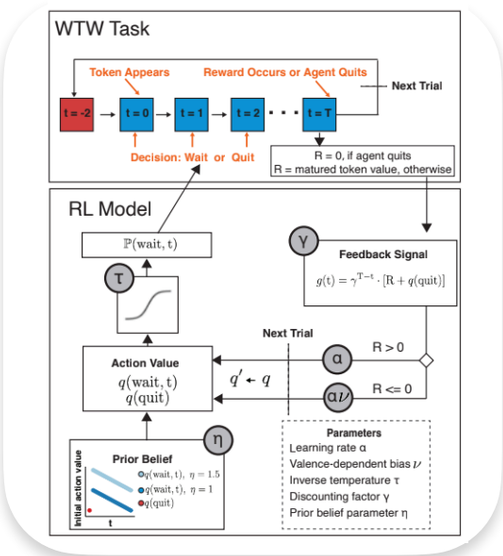
*Mixed effects Cox proportional hazard model: surv(latency, skipped) ~ env * Lesion_Group + (env |id)*

Willingness to wait (WTW) across the experiment

Local WTW: Serves as a proxy for learning
estimated based on trial-wise quitting behavior, or if participants waited for a reward that took longer to appear than their current estimate



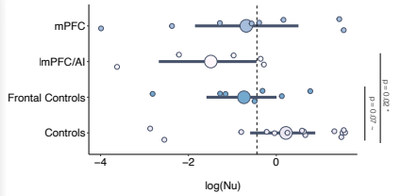
Computational Model



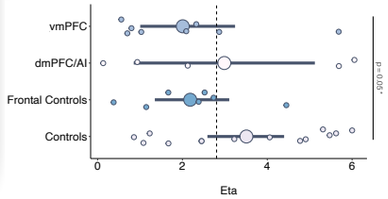
courtesy of Chen & McGuire, *RLDM poster abstract* (2022)
Poster 1.99

Parameter Estimates*

Valence-dependent bias (ν)



Prior belief parameter (η)



*Here, we only visualize the subset of parameter estimates that show meaningful differences. Only additional difference: $\tau_{\text{Frontal Controls}} > \tau_{\text{Controls}}$ (p = 0.06).

Take Home | Lesions to the **vmPFC** decrease persistence overall while lesions to the **dmPFC or AI** impair learning to persist adaptively.

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