

Intracranial Electrophysiology of Mentalizing

Under the hood of an fMRI TR



- Mentalizing is the ability to consider internal worlds of others & oneself
- Hundreds of fMRI studies reveal that many types of mentalizing recruit consistent default network regions
- Discerning the relative functions of mentalizing regions has been difficult due to the low temporal resolution of fMRI – a TR is usually 2 seconds
- Electrophysiological studies show critical millisecond timing differences across default network regions – mentalizing likely also evokes such differences



Time within TR

- The same BOLD result can arise from many different combinations of the magnitude & timing of underlying neuronal activity
- Both toy examples produce the same BOLD result (Other > Self) despite drastic differences in underlying neuronal dynamics
- High spatial & temporal resolution is needed for a truly incisive understanding of mentalizing's neural underpinnings (or that of any other cognitive construct)



Fox et al., 2018

- We conducted the first iEEG study of mentalizing to probe the social brain with millimeter spatial resolution & millisecond temporal resolution
- iEEG is an invasive technique that involves surgically implanting electrodes onto cortical surface or deep into cortical & subcortical tissue
- In humans, iEEG is typically only used in treatment protocols for drug-resistant epilepsy – some patients kindly volunteer to do studies like ours
- Here we focus on the high-frequency broadband (HFB) spectrum (70 Hz+) reflects aggregate spiking rate of neuronal populations immediately adjacent to an electrode

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2000ms

р_{ЕПР} < .05



 Onset latencies show clear sequence of activation across ROIs, suggesting a **hierarchy of processing** during mentalizing (Visual \rightarrow TPJ/PCC \rightarrow dmPFC \rightarrow vmPFC)

This sequence is consistent with vmPFC's proposed roles in situational, schematic & affective processing – vmPFC may integrate outputs from lower levels of processing

• Other takes longer than Self at higher levels of processing; differences in peak & offset latencies more pronounced at successive levels (PCC \rightarrow dmPFC \rightarrow vmPFC)

• The social selectivity of dmPFC in fMRI literature may arise from the duration, rather than magnitude, of underlying neuronal activity evoked by Other vs. Self

Self & Other mentalizing appear to rely on common neural mechanisms – BOLD differences may arise from computational load (knowing oneself better than others)

Possible future directions: causal modeling across ROIs; analysis of oscillatory spectra (e.g. theta); interrelations between mentalizing, semantic & episodic memory; interrelations between mentalizing & rest (pre-stimulus, post-stimulus & resting-state)

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