PREDICTIVE CODING MIGHT EXPLAIN THE TIME MANAGEMENT BY OUR BRAIN DURING ACTION UNDERSTANDING

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Background: Traditional hierarchical models states that external information is processed in a bottom-up direction from primary brain regions (e.g. V1) to higher regions (e.g. V5). If we imagine two people singing in synchrony, the follower should always lag >100ms behind the leader due to sensorimotor delays. Predictive coding theory suggests how our brain can overcome such delays: predictions about upcoming events are generated in higher brain regions and sent instead of sensory input to lower brain regions. Only when something happens that defies predictions, feed-forward flow of information dominates.
If the action observation networks (incl. superior temporal sulcus (STS), parietal area PF and ventral premotor cortex) implements predictive coding, we expect a feedback flow of information from premotor to PF when observing predictable actions. On the other hand, if the observed action is unpredictable, a feed-forward flow of information from STS to PF is expected.

Aims: To test the validity of the predictive coding theory for action observation.

Method: The average thickness of the cortex in humans is 2.4 mm. We developed a sequence at 7Tesla to acquire voxels sized 0.8mm^3 and look at the functional activation separately in outer, middle and inner layers of the cortex. 14 volunteers watched videos of everyday actions in predictable and unpredictable (temporally scrambled) sequences. We scanned the parietal node to look at the activity in the PF where we expect activity in the outer and/or inner cortical layers while the subjects viewed the predictable movies, and activity in middle layers while the observation of the unpredictable movies.

Preliminary results: We will present a new pipeline using sulcal patterns to align the partial functional volume acquired in the parietal lobe to anatomical scans. We will further present ways to smooth data in layer specific ways and compute inter-subject correlational analysis in ways suitable for layer-specific analysis. We will further present preliminary results about the change of layering in inter-subject correlation across predictable and unpredictable sequences.

Conclusions: We will show how information flows when we observed predictable and unpredicable actions, i.e whether we predict or react to the action of others.

Keywords: Laminar fMRI, Predictive coding, Action prediction, Information flow, Feedback and feed-forward.

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