

What Event-related neural responses can tell us about language comprehension: A dynamic generative framework

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The goal of comprehension is to extract the underlying message that the communicator intends to convey. This is challenging because language unfolds very fast, our linguistic inputs are noisy and ambiguous, and our communicative environments keep changing. In this talk, I will describe a dynamic generative framework of language comprehension that provides one way of understanding how the brain meets these challenges (Kuperberg & Jaeger, 2015). Within this framework, comprehenders use multiple contextual cues, in conjunction with the stored linguistic and non-linguistic knowledge that they believe is relevant to a given communicative situation (together, their ‘generative model’), to probabilistically predict upcoming information. Moreover, they are able to adapt this generative model (or switch to new models) in response to changes in their broader communicative environments.

I will argue that this framework can naturally accommodate results from a large body of studies probing event-related brain responses using ERPs, MEG and fMRI that provide a valuable window into the dynamic consequences of anticipatory neural processes during real time comprehension (Kuperberg, 2013; Kuperberg, 2016). I will discuss evidence that the N400 ERP component, visible at the scalp surface between 300-500ms, reflects the process of retrieving (or accessing) new semantic information that has not already been predicted, that it adapts to changes in the statistical contingencies of the broader environment (Delaney-Busch, Morgan, Lau & Kuperberg, 2017), and that it primarily reflects activity within left lateral and medial temporal cortices that mediate the retrieval of widely distributed semantic features that are widely distributed across the cortex (e.g. Lau et al., 2016; Wang et al., 2018).

I will also argue that, under some conditions, comprehenders can use specific cues within a context to generate high certainty predictions of a specific event or a broader event structure, prior to new bottom-up evidence becoming available. If this new bottom-up evidence violates such high-certainty predictions, comprehenders take longer to infer the event or event structure that was intended by the communicator (i.e. they take longer to fully ‘integrate’ the bottom-up input into the context) because of the need to suppress such high-certainty predictions. I will argue that this prolonged inference manifests as a set of late positivities that are visible on the scalp surface from 500-1000ms. I will present multimodal imaging evidence suggesting that these late positivities reflect partially distinct underlying mechanisms, depending on whether comprehenders infer an entirely new event structure (late posterior positivity/P600; activity within inferior frontal, orbitofrontal and fusiform cortices), or a specific new event (late frontal positivity; activity within inferior frontal, orbitofrontal and lateral temporal cortices). Finally, rather than conceptualizing these prolonged neural responses as ‘costs’ of prediction, I will suggest that they may play a crucial role in triggering us to modify our current generative model (or switch to a new generative model) so that we can quickly adapt to the statistical structure of new communicative environments and predict more efficiently in the future.

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