Dynamic duo: Insights from a dual-unit predictive coding model of lexico-semantic processing

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Hierarchical predictive coding is a biologically plausible algorithm for approximating Bayesian inference in the cortex. A key feature is the use of two functionally distinct units each level of the cortical hierarchy: “State units” that infer representations, and “error units” that encode information that is not predicted by state units at the level above (prediction error). Until now, this algorithm has not been implemented in the language domain. Here, we describe a predictive coding model that infers word meaning from orthographic form. Our simulations leverage the state-error distinction in predictive coding to explain why we are faster to respond to primed/predicted words versus unprimed/unpredicted words, despite producing a smaller evoked response (300-500ms: the N400): State units encoding primed/predicted words accumulate activity more quickly, driving the faster behavioral response, while activity within error units is more effectively suppressed, leading to the smaller evoked response. Finally, our model predicts a dissociation between behavioral and neural measures for targets preceded by form-related primes. Our empirical findings confirmed this striking dissociation. In an event-related potential experiment (N=22), the N400 amplitude was smaller to form-primed targets (wire-WIFE < gear-WIFE), while in a behavioral experiment (N=64), participants took longer to make semantic categorization judgments to the same targets. These findings situate language comprehension within the broader context of predictive coding research and demonstrate how the unique properties of predictive coding can explain key brain-behavior relationships during language processing.