

LangCog Talk

Speaker: Thomas Clark, MIT Brain and Cognitive Sciences

September 16, 2025

5:30-7:00pm, in William James Hall, Room 1550

Title: A Model of Incremental and Approximate Noisy-Channel Language Processing

Abstract: How are comprehenders able to extract meaning from utterances in the presence of production errors? The Noisy-Channel theory provides an account grounded in Bayesian inference: comprehenders may interpret utterances non-literally when there is an alternative with higher prior probability and a plausible error likelihood. Yet the question of how such alternatives are generated and evaluated, given the intractability of the exact probabilistic inference problem, is open to debate. Here, we model noisy-channel processing as approximate probabilistic inference over intended sentences and production errors. We define a generative model of noisy language using a large language model prior and a symbolic error model. We then approximate the distribution over intended messages, conditional on some noisy utterance, using Sequential Monte Carlo inference with rejuvenation — an algorithm that is incremental but allows reanalysis of previous material. We demonstrate that the model reproduces known patterns in human behavior for implausible or erroneous sentences, without fitting to human data, in three case studies: a) inferential interpretations of implausible sentences with near neighbors in syntactic alternations, with an insertion-deletion asymmetry (Gibson et al., 2013), b) item-level edit preferences in sentences with ambiguous agreement errors (Qian & Levy, 2023), and c) a dissociation in surprisal between recoverable and non-recoverable errors (Ryskin et al., 2021). The model also motivated a novel prediction about regressive eye movements in the reading of temporarily plausible sentences, which was borne out experimentally in a pilot study using mouse-tracking for reading. Our results offer a step towards a flexible, algorithmic account of inference during real-world language comprehension. We make our code publicly available at: https://github.com/thomashikaru/noisy_channel_model