

A Simple Computational Model of Interactive Language Processing

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Psycholinguistic studies (e.g. by Tanenhaus and colleagues) suggest a model of human language processing in which parsing and word recognition interactively depend on the interpretations of hypothesized words in some discourse or environment context. At the same time, it is attractive to assume that many kinds of intra-sentential processing (including parsing and semantic composition) are performed within a severely-constrained short-term memory store, possibly containing as few as three or four disconnected elements. This talk will describe an implemented computational model of language processing that attempts to satisfy both these desiderata, tempering the rich conditioning of the interactive model with austerity of human-like memory bounds. The result is a simple, implementable, and empirically-successful model that provides a unified explanation of some previously unrelated linguistic phenomena.

The model parses sentences in a transformed representation that minimizes memory requirements by turning right-branching structures into left-branching structures of incomplete constituents, which can be composed immediately upon being encountered. The talk will first present results of a corpus study suggesting that this transformed constituent structure is sufficient to allow a vast majority of naturally occurring sentences to be parsed using a memory store containing only three or four incomplete constituents. I will then present evidence that this constituent structure also provides a natural explanation of speech repair (in which speakers `back up and restart' incomplete constituents following speech errors) as an ordinary syntactic phenomenon, providing accuracy comparable to that of the best unbounded-memory parsers. Finally, I will describe a simple factorization of this model to allow interactive interpretation, by augmenting each incomplete constituent in the memory store with an `incomplete referent': a vector of word co-occurrences, latent concepts, or sets of individuals, composed through matrix multiplication. Results using a real-time speech interface implementing this interactive model show this model can deliver more accurate recognition than a non-interactive baseline.