Neural networks as a framework for modeling human syntactic processing

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Five decades of research in psycholinguistics have produced an increasingly detailed picture of human syntactic processing. Most existing computational models only account for a specific part of this picture, and, because they do not attempt to capture the full complexity of natural language, these models cannot provide quantitative predictions for any arbitrary sentence. Artificial neural networks, which can learn a considerable amount about syntax simply by predicting the next word in the sentence, have the potential to address these limitations: they are a broad-coverage modeling framework, which, when combined with a very general linking function such as surprisal, can yield quantitative predictions for any sentence, regardless of its structure; and, unlike hand-crafted models, they provide an explicit account of how their representations are learned.

In this talk, I will present experiments evaluating particular neural networks as models of the difficulty that humans experience in the disambiguating region of syntactically ambiguous sentences (garden path effects), and as models of the interference between similar elements in the processing of subject-verb agreement dependencies (agreement attraction). I will show that a standard network used in the language technologies world shows some, but not all, of the syntactic signatures of human agreement attraction. The same model correctly predicts increased reading times in the disambiguating region of garden path sentences compared to controls, but, at least when coupled with the surprisal linking function, substantially underestimates the magnitude of the processing difficulty experienced by humans. While neural networks provide a promising framework for developing models of human sentence processing, then, the networks used in the language technologies community are not, in and of themselves, complete cognitive models; I will discuss future directions for closing this gap.