Syntactic Comprehension: Practice Makes Perfect and Frequency Makes Fleet

Mark F. St. John
Department of Cognitive Science
University of California, San Diego
La Jolla, CA 92093

Morton Ann Gernsbacher
Department of Psychology
University of Wisconsin, Madison
Madison, WI 53706

Abstract

Passive and cleft-object constructions are harder to comprehend and breakdown more easily under stress or brain damage than active and cleft-subject constructions. Are they harder because they require special comprehension processes that are localized in brain areas damaged in aphasia, because they require greater central processing capacity that is reduced in aphasia, or because they are simply less frequent and therefore less well practiced and more easily disrupted by brain damage? A PDP model of the word-by-word comprehension process demonstrates that less frequently trained constructions are learned more slowly (though eventually mastered) and break down more easily. The model employed a simple recurrent network architecture similar to St. John and McClelland (1990). The model was trained on 15,912 instances of four sentence constructions (simple active, simple passive, cleft-subject, and cleft-object). The model's task was to determine the agent and patient of a presented sentence. One construction was arbitrarily chosen to be trained 8 times more frequently than the others. The high frequency construction was mastered first, though all were mastered eventually. Generalization to new sentences was high, demonstrating mastery of the syntax rather than memorization of the training instances. Following training, processing breakdown was simulated by adding uniformly distributed noise to the units in the hidden layer of the network. The low frequency constructions were more prone to error than the high frequency construction. Sentence length also increased learning time and the potential for breakdown. Frequency and length are simple but powerful factors throughout cognition; the model demonstrates that they can also be powerful factors in normal and aphasic language comprehension.

Reference

St. John, M. F. & McClelland, J. L. (1990). Learning and applying contextual constraints in sentence comprehension. *Artificial Intelligence, 46,* 217-257.