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Agrammatism as a Failure in the Lexical Activation Process

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Introduction

Agrammatism is special kind of Broca's aphasia that severely impairs sentence comprehension. A signature of this disorder is an inability in assigning thematic roles in psychological verbs. These verbs are divided in two classes, depending on whether the thematic role of Experiencer shows up as the subject (Experiencer-Subject verbs, *ES*) or the object (Experiencer-Object verbs, *EO*) of the sentence. In the active form, verbs of the first group have a default Experiencer/Theme thematic construction, whereas the others require a Theme/Experiencer grid.

As reported by Piñango (2000), the crucial factor in determining the patients' performance with those verbs seems to be the canonical order of thematic roles. Using EO psychological verbs, she showed that impaired performance was obtained when the order of thematic roles in syntactic representation had been reversed with respect to that canonical. This was confirmed to happen in EO active sentences, and was already known for ES passive ones. Such a result has been explained by the Slow Syntax Hypothesis (Piñango, 2000), according to which lexical activation in agrammatic patients is slower than normal, and, therefore, they are unable to build the syntactic structure of the sentence quickly enough to prevent semantic linking from emerging and dominating the meaning derivation process.

A computational model

We postulated that the slowing of lexical processes is a consequence of an inability to concentrate attentional resources on the current lexical information. To test this hypothesis, we developed a computational model within the ACT-R architecture (Anderson & Lebière, 1998) and performed a virtual lesion to simulate agrammatic patients.

Consistently with Ullman's (2001) framework, lexical information is stored in declarative memory. While reading a sentence, the model updates an internal semantic representation on the basis of the currently attended lexical information. The retrieval of a thematic grid is cued by particular target words and triggers the assignment of roles to the previously encountered nouns. Correct cued retrieval is possible when the activation spreading from the currently attended material overcomes the base level activation of interfering material—i.e., other active lexical information. Since the default argument order in English psychological verbs is Experiencer/Theme, the chunk encoding this thematic grid is more active, and attentional resources are necessary to overcome it and retrieve the opposite structure. This is crucial in passive forms of ES and active forms of EO verbs. With an abnormally lower value of attentional resources, the contribution of contextual activation should be insufficient to enhance the Theme/Experiencer grid, letting the default one interfere in the retrieval.

Results and discussion

We test our model in a simulated sentence comprehension experiment. The model was presented with a study set of 12 sentences, made of six ES verbs and six EO verbs. In each category, half of the sentences were in active, and the other half in passive form. In the undamaged version, the model fully understood all the sentences. In the aphasic version we reduced its attentional resources by lowering the ACT-R's W parameter. Our simulations showed that, in this case, there was a 50% probability of misrepresenting thematic roles whenever the sentence was either a passive ES or an active EO sentence. Results are summarized in Figure 1.

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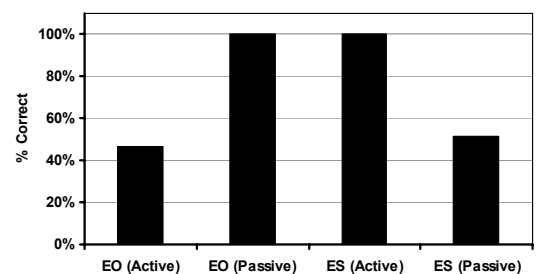
Figure 1: Model's sentence comprehension in its aphasic version (i.e., reduced attentional resources)