Memory load of partial representations during sentence comprehension in Japanese

Models of sentence comprehension are often based on simple dependency structures between words in the sentence. Memory load in particular is usually assumed to be contingent on the number of constituents needed to complete the sentence (e.g., Gibson, 1998; Lewis, Vasishth & van Dyke, 2006). For example, when a NP is read in Japanese, readers predict a verb that can complete the sentence (e.g., a transitive verb for a direct object; Nakatani & Gibson, 2010) and a memory cost is incurred to keep the prediction active until it is satisfied. We report two self-paced reading experiments as evidence that the verb is predicted for object but not subject NPs. We suggest that models must use partial syntactic structures in order to account for such differences during sentence comprehension.

Verbs tend to be more closely related to their object than to their subject (Marantz 1984; Tomlin, 1986). Therefore, a verb is more likely to be predicted when an object NP is read (roughly, the left-corner of the VP in left-corner parsing). If so, a VP-internal phrase (e.g., a locative) should increase memory load when it intervenes between the object and predicted verb. Such a cost should be absent for subject NPs if subjects do not predict the verb.

In Experiment 1, a sentence-initial NP was followed by a long locative phrase and a verb. The NP was either a nominative subject (1a) or a dative object (1b).

1. a. Taro-NOM [ long locative phrase ] V.
2. b. Taro-DAT [ long locative phrase ] V.

The sentence-initial noun (e.g., Taro) was always a proper name to decrease plausibility cues. The five regions of the locative were read more slowly following the dative object than following the nominative subject (mixed models: t= 2.05, p<.05; see Figure 1). However, note that: (i) the first region of the locative is more likely to violate expectations in the dative condition (there are fewer possible continuations after a dative NP, Miyamoto & Nakamura, 2005); (ii) the last region of the locative (the location and the postposition; e.g., “in the café”) may include processes to determine the relation between the N-dat and the locative (e.g., whether the word order is canonical). Therefore, a more conservative analysis was conducted excluding the first and last regions, and similar trends were observed (t= 2.30, p<.05).

In Experiment 2, a different intervening phrase (an accusative NP) replaced the locative in (1) to guarantee that the word order is canonical in both conditions. As in Experiment 1, the dative condition took longer than the nominative condition (all four regions of the NP-acc: t= 1.96, p<.05; excluding the first and last regions: t= 2.14, p<.05; see Figure 2).

An alternative explanation is that the dropped subject preceding Taro–DAT increases memory load in (1b). But this is unlikely. Subject and object predict one verb (Nakatani & Gibson, 2010), hence the number of predictions does not increase with the dropped subject.

In sum, for the dative and nominative NPs compared, one constituent (i.e., a verb) is sufficient to complete the sentence, but the timing of the prediction differs leading to greater load in the dative condition. In the presentation we suggest that this is compatible with models that build syntactic representations as in left-corner parsing (e.g., Abney & Johnson, 1991).
Selected References: