

Hartshorne, J. K. & Snedeker, J. Rapid online effects of verb argument structure on pronoun resolution. Poster presented at the 22<sup>nd</sup> Annual Meeting of the CUNY Conference on Human Sentence Processing, Davis.

There is a strong tendency for non-reflexive pronouns to be interpreted as referring to the first-mentioned entity in the previous sentence (typically the subject). This *first-mention bias* (Corbett & Chang, 1983; Gernsbacher & Hargreaves, 1988) influences processing 400-800ms after pronoun onset (Arnold et al., 2000; Jarvikivi et al., 2005). Curiously, this bias is not present in all verbs (Garvey & Caramazza, 1974). Compare (1) with (2).

In some cases the preferred referent appears to be a function of the verb's argument structure (Brown & Fish, 1983). This is clearest for psych-verbs, which can vary in argument structure despite having similar meanings. Stimulus-subject (SS) verbs (*frighten, please, anger*) seem to bias pronoun resolution towards their grammatical subject, while stimulus-object (SO) verbs (*fear, like, hate*) seem to bias pronoun resolution towards their grammatical object.

Because only a small proportion of relevant verbs have been tested (Rudolph & Forsterling, 1997), in Experiment 1 we tested all 220 SS and 44 SO-verbs listed by Levin (1993). Native English speakers on the Internet (N=573) resolved the pronouns for 24 verbs in sentences like (1) and (2). The expected pattern was confirmed for all SO-verbs (all  $ps < .05$ ) and 182 of the SS-verbs (121 with  $ps < .05$ ). Thus this pattern is robust across verbs.

The time course of these effects has generated considerable debate (Koornneef & Van Berkum, 2006; Stewart, Pickering & Sanford, 2000), perhaps because the methods used (ERP, self-paced reading, and probe tasks) have not directly measured pronoun reference. Moreover, few studies systematically distinguish between psych-verbs and other verbs that show pronoun-resolution biases (but see McDonald & MacWhinney, 1995).

In Experiment 2, participants (N=28) listened to sentences like (3) accompanied by scenes including the two mentioned characters, while their eye-movements were recorded. Replicating Experiment 1, participants assigned the pronoun to the surface subject of SS-verbs (79%,  $p < .01$ ) and the surface object of SO-verbs (62%,  $p < .05$ ). Eye-tracking data revealed that while the bias emerged rapidly for SS-verbs (500-600ms after pronoun onset), SO-verbs elicited equal fixations to both targets through adjective onset (“nice”).

Was an SO effect on early eye-movements canceled out by the first-mention bias? Experiment 3 replicated Experiment 2, but with all sentences passivized. Participants (N=28) now assigned the pronoun to the surface object of SS-verbs (73%,  $p < .01$ ) and the surface subject of SO-verbs (76%,  $p < .01$ ), suggesting that the effect is thematic. Again the effect influenced eye-movements by 600ms after pronoun onset for SS-verbs ( $p < .05$ ), but no significant effects for SO-verbs appeared before adjective onset.

Thus, the argument structure of a verb in one clause can have a rapid effect on the resolution of a pronoun in the following clause in a manner distinct from the first-

mention effect. The SO-SS asymmetry is consistent with theories of argument realization positing distinct thematic roles or lexical processes for these verb classes. Implications for pronoun resolution, the processing of argument structure, and their interaction (“implicit causality”; Brown & Fish, 1983) are discussed.

(1) Sally *frightens* Mary because she is a dax.

(2) Sally *fears* Mary because she is a dax.

(3) Mickey Mouse likes Donald Duck very much, because he is so very nice. Can you point to him?