What’s next? Sufficiency of subject-object plausibility for anticipatory eye movements

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Introduction

Visual-world studies have shown that listeners can combine verb restrictions and case information with world knowledge to anticipate upcoming arguments (e.g., Altmann & Kasrda, 1999; Kamide, Schepers, & Altmann, 2003). Kamide, Altmann, & Heywood (2003) further demonstrated that anticipation does not depend on main verbs but can also be driven by the combination of nominative and dative-marked NPs. In their study, a dative NPs implicated a subsequent transferable THEME object. Unlike dative NPs, nominative NPs only weakly constrain dependencies amongst remaining objects.

Question

Can listeners make immediate predictions based on semantic cues driven only by the subject NP, e.g., plausibility of subject-object combinations? If so, then anticipatory looks to plausible object referents, given a particular subject, should be observed.

Experiment

- 24 visual scenes (provided by Muckel et al., 2002) showed two THEME objects, a distractor, and one of three potential agents. The three agents differed in whether they were likely to occur with one THEME object, the alternative THEME object, or were neutral with respect to plausible subject-object combinations (Figure 1).
- German sentences accompanying the scenes were of the structure subject NP-Aux-Adv-object NP-verb. Subject NPs, but not auxiliary and adverbs, biased towards particular object NPs (Table 1).
- 24 German participants.
- Anticipatory looks to plausible objects were predicted following biasing subject NPs. No object preference was expected for neutral subject NPs.

Results and Discussion

Table 1

<table>
<thead>
<tr>
<th>Biasing subject NP</th>
<th>Neutral subject NP</th>
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<tr>
<td>a. The Schlosser had driven the Motor ausgetaucht.</td>
<td>The mechanic had later the motor replaced.</td>
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<tr>
<td>b. The Tourist had driven the Dollar umgesteuert.</td>
<td>The tourist had later the dollar changed.</td>
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<tr>
<td>c. Der Rentner hatte den Motor ausgetaucht.</td>
<td>The senior citizen had later the motor replaced.</td>
</tr>
<tr>
<td>d. Der Rentner hatte den Dollar umgesteuert.</td>
<td>The senior citizen had later the dollar changed.</td>
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Figure 2: Time course of the eye-movement data showing the mean proportion of fixations to entities from the onset of the spoken sentence with onset of auxiliary and NP1 indicated.

Figure 3: Mean percentage of fixations to the motor and dollar following the biasing subject NPs during the time window of 1000ms - 1700ms.

Figure 4: Mean percentage of fixations to the motor and dollar following the control subject NP during the time window of 1000ms - 1700ms.

- Fixations driven by the subject region, 200-1000ms, were directed equally often to the two THEME objects, F < .1. During the Auxiliary=Adverb region the fixations to the THEME objects diverge. (Figure 2)
- After hearing “Schlosser”, looks to the motor increased relative to the alternative object motor (Figure 3). This trade off of attentional preferences, which arises before the THEME objects are mentioned, gave rise to a cross-over interaction, F(1, 23) = 14.9, p < .001, F(1, 23) = 10.2, p < .005.
- Simple contrasts reveal more looks to motor following the mechanic, t(23) = 4.00, p < .001; t(23) = 2.5, p < .05, and more looks to the dollar following the tourist, t(23) = 2.08, p < .05; t(23) = 1.6, p = .16.
- After hearing a neutral subject NP (Figure 4), the motor and the dollar were equally likely to be fixated, all Fs < 1.

Co-occurrence search

- The results demonstrate that listeners can generate expectations for likely upcoming arguments in the absence of syntactic verb-specific cues. Plausibility in the context of a visual scene can be sufficient.
- If plausibility drives the expectations, what drives plausibility? Plausibility could be linked to Noun-Noun co-occurrence or to lexical associations. In a corpus analysis, we addressed the first possibility.
- We obtained the frequency of each Noun-Noun pair from the Frankfurter Rundschau corpus (> 12.5 million sentences).

Summary

- Subject-object plausibility can influence participants’ anticipatory eye movements during sentence processing.
- Anticipatory eye movements are not dependent on grammatical information from, for example, the verb or case marking.
- These results suggest that the anticipatory eye movements for these particular sentences and scenes are not driven by alternative interpretations of the verb, contra Mückel et al. (2002).
- A corpus study suggests plausibility derives from Noun-Noun co-occurrence, but further investigation is still needed to evaluate the additional influence of, for example, lexical associations.

References