Pronoun interpretation in the context of dynamic action: A test of the retrieval hypothesis

Tiana V. Simovic, Craig G. Chambers (University of Toronto)

Comprehending a pronoun (*she*, *they*…) involves using linguistic and non-linguistic cues to select an intended candidate from entities in a comprehender's mental model of the discourse or situational context. Pronoun interpretation is often described as a dependency relationship involving anaphoric links to referents that have been mentioned earlier, giving rise to the notion of a "linguistic antecedent". But what kind of information in a mental model is needed for resolving coreference? Given their status as deep anaphors [1], pronouns need not "match" linguistic antecedents with the same surface form (i.e., agreement or constituency: "I need a fork, where do you keep them?", "Jo ran into Sue while shopping. They…"), yet the idea of *retrieval* is evoked in many theoretical accounts [2, 3, 4, 5]. We explored the role of the antecedent term's *semantics* by using novel situations where the content of this expression is no longer viable when pronoun interpretation occurs. Fig. 1 shows a visual environment where objects are located within a grid. Critically, in this context, the outcome of an instruction like "Move the house on the left to area 12" entails that the unmoved/unmentioned house is now the leftmost one. If a subsequent instruction contains a pronoun (e.g., "Now move it…"), the key point is that the antecedent expression in discourse memory no longer accurately describes the intended referent. Thus, if retrieving the antecedent term's semantics is a fundamental part of the process, some measurable processing cost should be observed relative to when the semantics are still valid, despite the intuition that the previously mentioned object is ultimately the intended referent. Our key evidence comes from **Experiment 1** (Visual World, *N*=24), using instruction sequences (see Fig. 1). In control conditions, the second instruction contained a full NP ("Now move the same/other house to area 4"). For fixations to the previously moved object, the control conditions showed the expected unambiguously distinct patterns (Fig. 2). Critically, when the second instruction contained a pronoun ("Now move it to area 4"), mouse click reaction times on the intended referent showed no differences, regardless of whether the antecedent term's semantics were still viable (Fig. 3). Further, fixation patterns were strikingly similar for the two pronoun conditions (Fig. 2). There was neither a delay nor any momentary consideration of the referent that now matched the antecedent term's semantics when the original description was no longer viable. The similarity across the pronoun conditions was corroborated by Bayesian parameter estimation (Fig. 4). **Experiment 2** (production, *N*=56) was conducted to confirm certain background assumptions. After encountering the first instruction and viewing its outcome (Fig. 1), speakers were prompted to describe various objects in the display. When prompted to describe the previously moved object, results showed that, when speakers used a spatial description, the content reflected the updated visual scene (i.e., speakers did not treat the NP in the initial sentence as a "linguistic precedent" [6]). This tendency was stable regardless of whether the past action required a switch (e.g., from "on the left" to "on the right": 96% of descriptions reflecting updated scene) or not (97%). This behavior was expected but the findings validate the idea that the original description is no longer adequate following the action, and thus should cause difficulty if relied upon in a subsequent interpretation process. Results also showed modifiers like "on the left" are readily produced alongside other modifier types (10.25% overall), suggesting expressions of this type are natural (validating how they were used in Exp't 1).

In sum, the data suggest a pronoun is effortlessly linked to an intended referent regardless of whether the semantics of its linguistic antecedent are still relevant. Thus, if neither antecedent form nor semantics are relevant, what is "retrieved" on a retrieval account? The results instead support accounts where real-world referents are linked to mental

variables via attentional bindings [7]. The information linked to an attentional index can change or become irrelevant without a direct impact on coreference processes [8]. Among other things, this approach helps explain cases where there is a shift in precisely what is being referred to in antecedent-pronoun sequences (A: "Speaking of pets, Ty got a capybara", B: "Huh? How do you spell it?", where the antecedent denotes a conceptual kind, yet the pronoun denotes an orthographic pattern).

***Figure 1**: Display before first sentence is heard.*
"Move the house on the left to…
a. …area 9" (original desc. remains viable)
b. …area 12" (original desc. no longer viable)

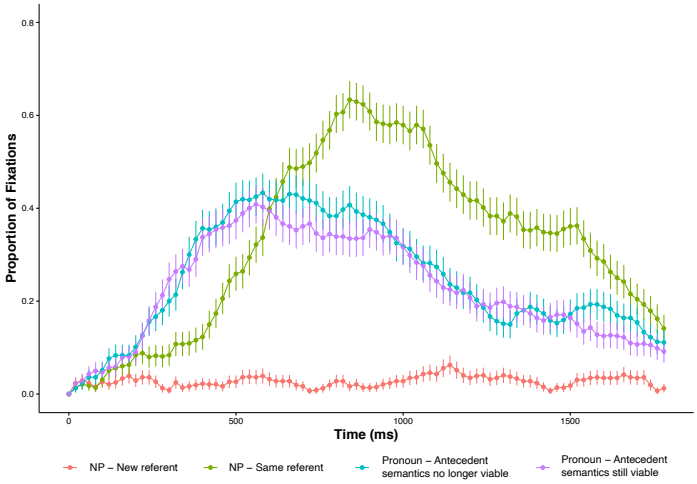

***Figure 2**: Proportion of fixations over time relative to pronoun onset (experiment conditions) or ADJ onset (controls).*

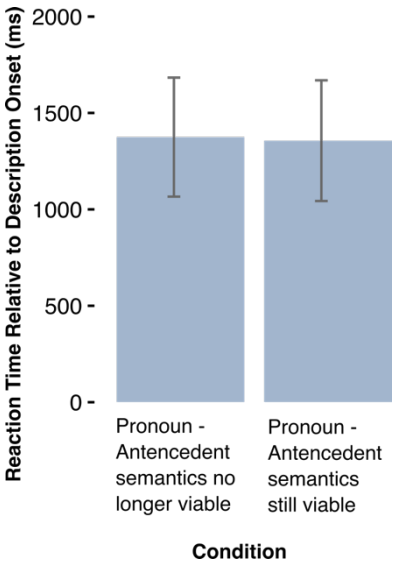

***Figure 3**: Mean reaction times for pronoun conditions in Exp't 2.*

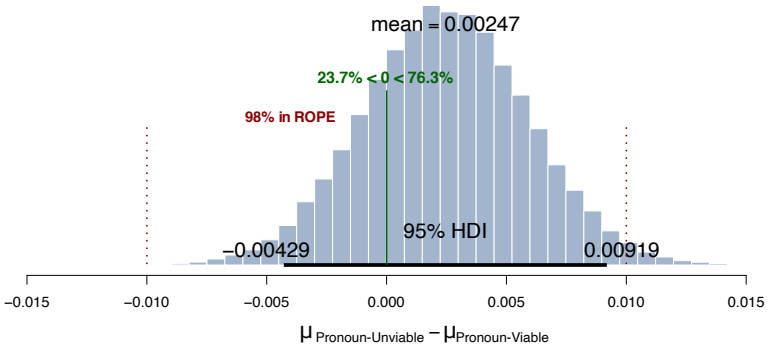

***Figure 4**: Bayesian parameter estimation results showing t-distribution of possible parameter values for the difference between the means of the pronoun conditions. Region of Practical Equivalence (ROPE) is between -0.01 and 0.01. The results allow us to accept the hypothesis that the two conditions are not different.*

References

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