

Resolving ambiguous VP ellipsis in eye tracking: A case for underspecification

Possessive pronouns (*his / her*) in verb phrase ellipsis (VPE) as in (1) are ambiguous (Fiengo & May, 1994). In the *strict* reading, the elided pronoun refers to the non-local subject (*policeman*), whereas the *sloppy* reading binds the pronoun to the local subject (*fireman*).

(1) The policeman likes his car, and the fireman does, too.

Strict: The fireman likes the policeman's car. *Sloppy*: The fireman likes his own car.

Previous studies propose that either (i) both interpretations are activated (Shapiro et al., 2003) or (ii) a sloppy interpretation is computed first (Frazier & Clifton, 2000). However, the availability for sloppy interpretations is potentially confounded with a preference to resolve the pronoun to the most recently accessed topic (e.g., Grosz et al., 1995). We present two eye tracking studies using a gender mismatch paradigm to address this concern. Exp. 1 post-poses the subject after the ellipsis, e.g., *as did the fireman* (2), showing a sloppy advantage even without a preceding local noun. Exp. 2 contextually disambiguates the readings after the ellipsis (3), showing a cost when evidence for the strict interpretation conflicts with stereotypical gender information. We propose that the pronoun is initially underspecified, but that resolution is costly when doing so potentially challenges more general discourse information, such as stereotypical gender biases.

Background. In a cross-modal priming study, Shapiro et al. (2003) found a recognition advantage for words related to both strict and sloppy interpretations of the pronoun after the ellipsis site, despite strongly biasing subjects towards the sloppy interpretation. They proposed that the two readings are computed in parallel, but that lexical and pragmatic information quickly dispenses with the illicit strict interpretation. However, if both interpretations are available early, it is surprising that sentences biased towards a sloppy interpretation are read faster in typical adults (Frazier & Clifton, 2000; Koornneef et al., 2011), and computed more easily by children (e.g., Guo et al., 1996) and by Broca's aphasics (Vasic et al., 2006). Yet, the design of the latter studies may introduce two potential confounds: (i) the subject in the ellipsis clause *precedes* VPE, so that the rapid availability of a sloppy interpretation may reflect a preference to resolve the elided pronoun to the closest noun, and (ii) one reading is not typically forced over another, making it difficult to distinguish between a sloppy reading bias and an ambiguity advantage, where the pronoun reference simply isn't resolved.

Design. Our two eye tracking experiments used inverted coordinate (*and so did NP*) and parenthetical (*as did NP*) structures to place the subordinate subject after the ellipsis. We manipulated whether a post-ellipsis subject (*librarian/bouncer*) matched the stereotypical gender of the non-local subject noun (*stylist*) and matrix predicate (*organized her makeup*), and so whether the post-ellipsis subject plausibly binds the pronoun as necessary for the sloppy reading (2a, 3). Critical nouns were normed for stereotypical gender (N=23) in a ratio ratings task.

Experiment 1 (N=52). We first tested whether a sloppy interpretation was initially preferred. If mismatching gender renders the sloppy interpretation implausible, we predict an advantage for matching gender in structures with elided pronouns (2a) compared to no-pronoun controls (2b).

(2) Sample item (24 items in total) from Exp 1. Analysis regions are indicated by '/':

a. The stylist_F / organized **her** makeup, / and so did / the {**librarian**_F, **bouncer**_M}, Pronoun

b. Brady / organized the stylist's_F makeup, / and so did / the {**librarian**_F, **bouncer**_M}, Control
... / in order to / tidy up the apartment.

Data were modeled as sum-coded (G)LMERs. The subordinate subject revealed (marginal) interactions in go past [$t=1.93$, $p=0.05$] and right-bounded [$t=2.52$, $p<.05$] times. Ambiguous ellipsis structures (2a) elicited a gender mismatch penalty, indicative of an overall sloppy reading preference, in the form of longer second pass (re-reading) times on the matrix VP when the sloppy interpretation was not compatible with the stereotypical gender [$t=2.10$, $p<.05$]; see Fig 1.

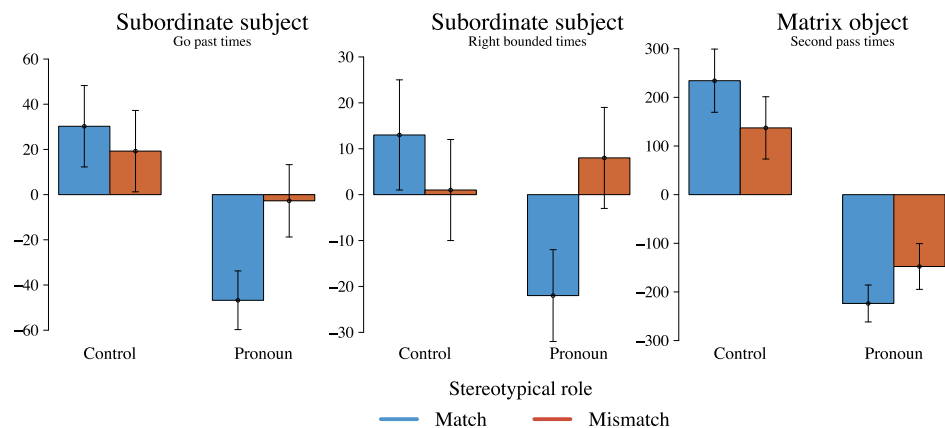
Experiment 2 (N=52). We then addressed the possibility that the interpretation of the elided pronoun remains underspecified when both interpretations are initially plausible. Exp. 2 manipulated the number of the possessed object in post-ellipsis material to grammatically force either a strict (singular *the*, 3b) or sloppy (plural *both*, 3a) reading.

(3) *Sample item (24 items in total) from Exp 2. Analysis regions are indicated by ‘/’.*

- a. The waitress_F / tore her dress, / as did / the {nurse_F, pilot_M}, / and **both dresses** Pl (*Sloppy*)
 b. The waitress_F / tore her dress, / as did / the {nurse_F, pilot_M}, / and **the dress** Sg (*Strict*)
 ... / had been / recently washed.

The gender mismatch penalty in regression path [$t=2.34$, $p<.05$] and right-bounded times [$t=3.22$, $p<.05$] on the subordinate subject (*the pilot/nurse*) was replicated. An interaction in go past times on and regressions out of the post-disambiguation spillover region (*had been*) was also observed: Plural disambiguation to the sloppy interpretation was costly in Mismatch conditions, whereas disambiguation did not affect Match conditions, suggesting that the processor selected a strict reading if gender did not match, but did not disambiguate when both readings were plausible.

Fig 1. Mean-centered reading time results from Experiment 1.



Conclusion. The previously attested preference for sloppy interpretations cannot simply be attributed to an intervening subject noun: processing is facilitated when the sloppy interpretation can be plausibly maintained without revising stereotypical gender information (Exp 1). However, resolution to strict interpretations is not inherently costly (Exp 2). The results suggest that the elided pronoun is initially underspecified for reference, and that resolving towards a sloppy interpretation becomes costly when doing so requires revising discourse information.

Selected references. Fiengo & May (1994). *Indices and identity*. MIT Press □ Frazier & Clifton (2000). On bound variable interpretations: The LF-only hypothesis. *JPR*, 29: 125-140 □ Koornneef et al. (2011). Tracking the preference for bound-variable dependencies in ambiguous ellipses and *only*-structures. *Experiments at the interfaces* (pp. 67-100). Brill □ Shapiro et al. (2003). Charting the time-course of VP-ellipsis sentence comprehension: Evidence for an initial and independent structural analysis. *JML*, 49: 1-19.