



“Who’s he?” Event-related brain potentials and unbound pronouns



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ABSTRACT

Three experiments used event-related potentials to examine the processing consequences of gender-mismatching pronouns (e.g., “The aunt found out that he had won the lottery”), which have been shown to elicit P600 effects when judged as syntactically anomalous (Osterhout & Mobley, 1995). In each experiment, mismatching pronouns elicited a sustained, frontal negative shift (Nref) compared to matching pronouns: when participants were instructed to posit a new referent for mismatching pronouns (Experiment 1), and without this instruction (Experiments 2 and 3). In Experiments 1 and 2, the observed Nref was robust only in individuals with higher reading span scores. In Experiment 1, participants with lower reading span showed P600 effects instead, consistent with an attempt at coreferential interpretation despite gender mismatch. The results from the experiments combined suggest that, in absence of an acceptability judgment task, people are more likely to interpret mismatching pronouns as referring to an unknown, unheralded antecedent than as a grammatically anomalous anaphor for a given antecedent.

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Introduction

Speakers tend to use pronouns (e.g., ‘she’ and ‘it’) to refer to entities that are in the focus of attention, sidestepping the costs associated with explicitly repeating antecedents (e.g., Almor & Nair, 2007; Ariel, 1988; Arnold, 2010; Gordon, Grosz, & Gilliom, 1993; Gordon & Hendrick, 1998; Gundel, Hedberg, & Zacharski, 1993). This preference is mirrored in comprehension: comprehenders have a strong preference for antecedents that are readily available (e.g., Garnham, 2001; Garrod, O’Brien, Morris & Rayner, 1990; Gernsbacher, 1989; Sanford & Garrod, 1989). In the context of a readily available antecedent, unbound pronouns like ‘he’ and ‘she’ are often understood immediately, and without effort (e.g., Clark & Sengul, 1979), despite the

fact that they are always formally ambiguous (Chomsky, 1981). In fact, an antecedent does not even have to be explicitly mentioned in order to be available for reference. Pronouns without explicit antecedents (i.e., unheralded; Gerrig, Horton, & Stent, 2011) are ubiquitous, usually when the intended referents are part of *common ground* (i.e., shared experience or sociocultural knowledge, providing background and antecedents for sentences such as “They dug up the road again”; Gerrig et al., 2011; Greene, Gerrig, McKoon, & Ratcliff, 1994; see also Kitzinger, Shaw, & Toerien, 2012; Sanford, Garrod, Lucas, & Henderson, 1983). This opens up the question, though, of how people understand pronouns for which the context does not provide an explicit, suitable antecedent. For example, in the sentence “The aunt found out that he had won the lottery,” how is *he* interpreted? Who is *he* most likely to be?

Absence of a suitable antecedent could arise when speaker and listener are not talking about the same people

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or objects (see also Barr & Keysar, 2002), or when speakers make gender agreement errors (see Vigliocco & Franck, 1999). Furthermore, pronouns sometimes precede referents ('cataphoric pronouns', e.g., "While he was sleeping, John became very rich"; see Filik & Sanford, 2008; Gernsbacher & Jescheniak, 1995; Kazanina, Lau, Lieberman, Yoshida, & Phillips, 2007; Van Gompel & Liversedge, 2003). Resolution of a pronoun without a suitable antecedent may thus depend on whether one thinks that the speaker is talking about somebody new or that the speaker simply made a grammatical mistake. The current work examines the online processing consequences of such referentially problematic utterances, as reflected in the brain's electrophysiology. Whereas many electrophysiological studies on pronoun resolution have investigated the processing consequences of biological and/or grammatical gender mismatch (e.g., Hammer, Jansma, Lamers, & Münte, 2008; Harris, Wexler, & Holcomb, 2000; Lamers, Jansma, Hammer, & Münte, 2006; Nieuwland & Van Berkum, 2006; Osterhout, Bersick, & McLaughlin, 1997; Osterhout & Mobley, 1995; Qiu, Swaab, Chen, & Wang, 2012; Streb, Rösler, & Hennighausen, 1999; Xu, Jiang, & Zhou, 2013), the fact that pronouns can introduce novel referents has been largely ignored in the study of pronoun resolution (but see Filik, Sanford, & Leuthold, 2008).

Behavioural and ERP studies on pronoun resolution suggest that readers and listeners do not delay attempts to interpret a pronoun until it can be unambiguously resolved, and that resolution is rapidly shaped by pronominal gender (e.g., Arnold, Eisenband, Brown Schmidt, & Trueswell, 2000; Koornneef & Van Berkum, 2006; Kreiner, Sturt, & Garrod, 2008; Nieuwland & Van Berkum, 2006; Osterhout, Bersick, et al., 1997; Sturt, 2003). Crucially, this incrementality has potential implications for what happens when people read "The aunt found out that" followed by 'she' or 'he' (henceforth called *matching* and *mismatching* pronouns), even though both pronouns are a grammatical continuation. I will discuss two possible processing situations before mapping them onto extant theories of reference processing and spelling out predictions for brain responses.

The first possibility is that the pronoun – irrespective of its gender – is interpreted as referring to 'aunt'. This referentially parsimonious interpretation may be driven by the strong preference to have locally available, prominent referents (e.g., Foraker & McElree, 2007; see Cunnings, Patterson, & Felser, 2014, for antecedent recency effects; for a review, see Garnham, 2001; Garrod & Sanford, 1994). This interpretation is not imposed by the syntactic constraints of English grammar (the pronoun is 'free' as opposed to reflexive pronouns that must be bound within a syntactically defined local domain; Chomsky, 1981). Nevertheless, if comprehenders try to establish a coreferential interpretation for 'he' and 'aunt', this might lead them to perceive a violation of the formal requirement that coreferencing elements agree in gender. This possibility was advocated by Osterhout and Mobley (1995), who reported that such pronouns elicit ERPs that are also seen in response to outright syntactic violations (e.g., subject-verb number agreement). Arguably, when comprehenders per-

ceive a syntactic anomaly, they can adhere to the initial coreferential interpretation by assuming that the wrong gender was used.

The second possibility is that people interpret 'she' as referring to 'aunt' but assume a novel, unknown referent for 'he'.¹ This may come about when pronoun gender is used as a non-defeasible filter on anaphoric interpretation (see Badecker & Straub, 2002; Sturt, 2013). The invocation of a novel referent could be construed as an elaborative inference if readers go beyond what is literally stated and try to infer who the referent might plausibly be (e.g., Graesser, Singer, & Trabasso, 1994; Levine, Guzmán, & Klin, 2000). Such a novel-referent inference has been shown to incur a processing cost (e.g., Benatar & Clifton, 2014; Burkhardt, 2006, 2007; Burkhardt & Roehm, 2007; Murphy, 1984; Schumacher & Hung, 2012; Yekovich & Walker, 1978). New referents may increase working memory load and/or representational complexity (e.g., Gibson, 1998; Gordon, Hendrick, & Johnson, 2001; Martin & McElree, 2008, 2011; Warren & Gibson, 2002). However, without any further contextual information regarding the identity of the new referent, the pronoun is referentially ambiguous.

Extant discourse-based theories of pronoun resolution appear to allow for a novel-referent interpretation to occur, but do not explicitly allow the parser to overwrite pronoun gender if an agreement error is perceived.² For example, the memory-based framework of anaphor resolution posits that all antecedents with sufficient features in common with an anaphor are automatically activated (Gerrig, 2005; McKoon & Ratcliff, 1998; Myers & O'Brien, 1998). When the anaphor and antecedent do not have sufficient feature overlap, when the antecedent is outside of the focus of attention, or when there are competitors, the situation could occur that no antecedent resonates to sufficient degree. This situation triggers additional episodic retrieval processes to recover additional information that might help to infer the most plausible referent. For example, an attempt may be made to retrieve an antecedent from outside the focus of attention. A related account, the Bonding and Resolution framework (Garrod & Terras, 2000; Sanford & Garrod, 1989), distinguishes between the initial localization of an antecedent and the ultimate full commitment to one particular interpretation. In "the aunt found out that he" the pronoun matches the antecedent in number but not in gender, which might be sufficient for bonding to occur or for the antecedent to become activated, but not enough for resolution to proceed smoothly. Similarly, in a framework for pro-

¹ Another possibility is that the pronoun is interpreted as referring to someone else irrespective of its gender, in which case no processing differences for matching and mismatching pronouns are predicted. This option seems unlikely given that a prominent referent is readily available for a matching pronoun.

² Comprehenders need not consistently favour one interpretation. Sentence context may bias readers away from or towards one specific referent (e.g., Koornneef & Sanders, 2012; Koornneef & Van Berkum, 2006; Nieuwland & Van Berkum, 2006). Readers are also known to differ in pronoun comprehension strategy (Almor, Kempler, MacDonald, Andersen, & Tyler, 1999; Arnold, in press; Nieuwland & Van Berkum, 2006). Additionally, readers can switch from one interpretation to another when the unfolding sentence makes a particular referential interpretation more plausible than another.

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