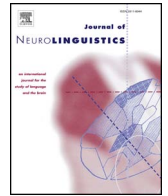


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Proform-Antecedent linking in individuals with agrammatic aphasia: A test of the Intervener Hypothesis[☆]

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ABSTRACT

Purpose: To evaluate processing and comprehension of pronouns and reflexives in individuals with agrammatic (Broca's) aphasia and age-matched control participants. Specifically, we evaluate processing and comprehension patterns in terms of a specific hypothesis – the Intervener Hypothesis – that posits that the difficulty of individuals with agrammatic (Broca's) aphasia results from similarity-based interference caused by the presence of an intervening NP between two elements of a dependency chain.

Methods: We used an eye tracking-while-listening paradigm to investigate real-time processing (Experiment 1) and a sentence-picture matching task to investigate final interpretive comprehension (Experiment 2) of sentences containing proforms in complement phrase and subject relative constructions.

Results: Individuals with agrammatic aphasia demonstrated a greater proportion of gazes to the correct referent of reflexives relative to pronouns and significantly greater comprehension accuracy of reflexives relative to pronouns.

Conclusions: These results provide support for the Intervener Hypothesis, previous support for which comes from studies of *Wh*- questions and unaccusative verbs, and we argue that this account provides an explanation for the deficits of individuals with agrammatic aphasia across a growing set of sentence constructions. The current study extends this hypothesis beyond filler-gap dependencies to referential dependencies and allows us to refine the hypothesis in terms of the structural constraints that meet the description of the Intervener Hypothesis.

Individuals with agrammatic aphasia (sometimes referred to as Broca's aphasia) typically have difficulty comprehending sentences containing syntactic dependencies. Previous investigations have explored these deficits in constructions that contain filler-gap dependencies (e.g. object relatives, *Wh*- questions) and referential dependencies between proforms (e.g. him/himself) and antecedents. The current study investigates real-time processing (Experiment 1) and final comprehension (Experiment 2) of sentences containing proforms in two participant groups: individuals with agrammatic aphasia (IWA-Ag) resulting from left-hemisphere brain damage and neurologically unimpaired age-matched control (AMC) participants.

Our purpose is to investigate how proform type (e.g., pronouns and reflexives) and distance from antecedent influence moment-to-moment processing and comprehension patterns. The focus of the current paper is on a particular theoretical account, the

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Intervener Hypothesis (Sheppard, Walenski, Love, & Shapiro, 2015; Sullivan, Walenski, Love, & Shapiro, 2016), which posits that sentence processing is negatively impacted when a sentence element of similar structure intervenes between two elements of a dependency chain. We begin here with a discussion of classical binding constraints and review of previous studies. We then describe the theoretical framework underlying the current study, the Intervener Hypothesis, and its relevance to our study.

1. Binding constraints

Proforms like *him* and *himself* are examples of referential dependencies: in order to be understood, they must be linked to another sentence element (or *antecedent*). Pronouns and reflexives differ in terms of the binding principles that constrain how referential dependencies are formed. Consider:

- (1) The grandma_a said that the baker_b cleaned herself_{a*/b}.
 (2) The grandma_a said that the baker_b cleaned her_{a/b*}.

Within the Government and Binding framework (Chomsky, 1981) the interpretation of the reflexive *herself* in (1) is constrained by binding principle A, which states that a reflexive must have a local antecedent; in (1), the noun phrase (NP) *the baker* serves as the local antecedent, where ‘local’ refers to the same clause in which the reflexive and its antecedent are positioned. The interpretation of the pronoun *her* in (2) is constrained by binding principle B, which states that a pronoun cannot take an antecedent within its local clause.

Sentences containing pronouns and reflexives also differ in other important ways. First, the dependency relation between a reflexive and antecedent can be determined using only syntactic information within the sentence. For sentences with pronouns (e.g., *The baker cleaned her*), syntactic information alone is insufficient to unambiguously determine the dependency relation between a pronoun and antecedent. Unlike reflexives, pronouns require access to discourse information in addition to syntactic information. For this reason, pronouns are sometimes said to be discourse-linked (D-linked; e.g., Avrutin, 2000, 2006) and thus add an additional level of complexity to be successfully processed. Second, and more to the purpose of the current investigation, the pronoun *her* in (2) is far from its antecedent NP *the grandma* and a sentence element of the same structure (*the baker*; DET N) intervenes between the antecedent and the pronoun. For sentences such as (1), where the reflexive *herself* is close to its antecedent *the baker*, there are no sentence elements that intervene between the two elements of the dependency chain. The possibility we consider here is that the presence of an intervening element between a proform and antecedent creates a greater challenge for establishing the dependency chain in sentences containing pronouns relative to reflexives. In line with the Intervener Hypothesis detailed below, we posit that this difficulty arises as a result of similarity-based interference between the intervening NP and the antecedent NP in the dependency chain (see Gordon, Hendrick, & Johnson, 2004; Gordon, Hendrick, Johnson, & Lee, 2006 for unimpaired subjects; see Sheppard et al., 2015; Sullivan et al., 2016 for individuals with Broca’s aphasia). A critical point here is what “between” means within a similarity-based interference framework. Select accounts of similarity-based interference characterize “between” in structural terms (Rizzi, 1990). Note that in previous studies of the IH using filler-gap dependencies, a structural characterization was the only relevant one (Sheppard et al., 2015; Sullivan et al., 2016). Additional accounts of similarity-based interference center on processes of working memory and the serial nature of linguistic input (Grodner & Gibson, 2005; Lewis & Vasishth, 2005; Lewis, Vasishth & Van Dyke, 2006; for related work in aphasia see: Beretta, 2001; Varkanitsa et al., 2016; Miyake, Carpenter & Just, 1994). The current study is the first investigation of the IH to tease apart the construct of interference by using sentence types that yield distinct predictions for linear versus structural interference, detailed below under *Current study*.

2. Binding constructions in aphasia

Several studies of IWA-Ag have found poor comprehension of binding constructions (Avrutin, Lubarsky, & Greene, 1999; Choy & Thompson, 2010; Edwards & Varlokosta, 2007; Grodzinsky, Wexler, Chien, Marakovitz, & Solomon, 1993; Love, Nicol, Swinney, Hickok, & Zurif, 1998) Using a sentence-picture matching task,¹ Grodzinsky et al. (1993) reported chance performance in sentences containing pronouns but good comprehension when they contain reflexives. However numerous other studies have found a different pattern, that is, chance or low performance for sentences containing either pronouns or reflexives (Choy & Thompson, 2010; Edwards & Varlokosta, 2007; Love et al., 1998).

Fewer studies have examined the online processing of sentences containing pronouns and reflexives in IWA-Ag. Using a cross-modal lexical priming method, Love et al. (1998) presented sentences like (3) below to investigate the time course of re-activation of the second noun phrase, *the skier* (the correct antecedent for the reflexive condition) at the offset of the overt anaphor ‘him’ and ‘himself’:

- (3) The boxer said that **the skier** in the hospital would blame him/himself for the injury.

They found that while IWA-Ag incorrectly re-activated (primed) *the skier* after hearing the pronoun (*him*), no such facilitation was

¹ In a sentence-picture matching task, participants listen to a sentence and then choose the picture (out of two or three) that best matches the sentence. This method is typically untimed and allows for the use of metalinguistic, conscious reflection in generating a response.

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