



# Reflexive attraction in comprehension is selective

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## ARTICLE INFO

### Article history:

Received 29 June 2016

revision received 4 January 2017

Available online 26 January 2017

### Keywords:

Reflexives

Agreement

Attraction

Sentence processing

Memory retrieval

ACT-R

## ABSTRACT

Many studies have shown that attraction effects are consistently found for linguistic dependencies like subject-verb agreement, e.g., *\*The key to the cabinets are on the table*. However, not all dependencies are equally susceptible to attraction. A parade case involves reflexive-antecedent dependencies, which rarely show attraction effects. The contrast between agreement and reflexives with respect to attraction has motivated various proposals regarding the memory architecture for the parser, including the use of qualitatively different access mechanisms or the selective use of morphological features as retrieval cues for different dependencies. In this paper, we show how to systematically induce attraction effects for reflexives in three eye-tracking experiments. Furthermore, we show based on computational simulations that it is possible to derive both the presence and absence of reflexive attraction from the same retrieval mechanism, based on the ACT-R architecture. We then propose an account of why agreement and reflexives are differentially susceptible to attraction, based on the predictability of the dependency.

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## Introduction

The task of building a sentence structure requires mechanisms for encoding a structured representation in memory and accessing specific elements of that representation to guide further elaboration. The effects of grammatically irrelevant items on real-time linguistic dependency formation have proven to be a useful tool for understanding these mechanisms. For instance, to determine whether the reflexive anaphor *themselves* in (1) is appropriately licensed, memory access mechanisms must recover the encoding of the subject noun *executive*, while avoiding interference from grammatically irrelevant items that match the agreement features of the reflexive, such as the embedded plural noun *managers* (example (1) is from [Dillon, Mishler, Sloggett, & Phillips, 2013](#)).

- (1) *\*The executive who oversaw the managers doubted themselves on most decisions.*

Previous research has shown that grammatically irrelevant items rarely interfere during reflexive licensing (e.g., [Clifton, Frazier, & Deevy, 1999](#); [Cunnings & Sturt, 2014](#); [Dillon et al., 2013](#); [Nicol & Swinney, 1989](#); [Sturt, 2003](#); [Xiang, Dillon, & Phillips, 2009](#); but cf. [Cunnings & Felser, 2013](#); [Patil, Vasishth, & Lewis, 2016](#)). However, retrieval processes do not always avoid grammatically irrelevant items during dependency formation. For instance, Dillon and colleagues found that retrieval for subject-verb agreement licensing in closely matched sentences like (2) is susceptible to interference ('attraction') from the grammatically irrelevant plural noun *managers*, giving rise to an 'illusion of acceptability' ([Dillon et al., 2013](#); see also [Clifton et al., 1999](#); [Patson & Husband, 2015](#); [Pearlmutter, Garnsey, & Bock, 1999](#); [Phillips, Wagers, & Lau, 2011](#);

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Tanner, Nicol, & Brehm, 2014; Tucker, Idrissi, & Almeida, 2015; Wagers, Lau, & Phillips, 2009).

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- (2) \*The executive who oversaw the managers were dishonest.
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The contrast between agreement and reflexive licensing with respect to attraction is striking, since subject-verb agreement and reflective-antecedent dependencies have superficially identical agreement constraints and retrieval in both cases targets the same structural position, i.e., the subject of the current clause. The reasons for this contrast remain unresolved, and we attempt to address this puzzle in the current study.

#### *Interference effects in comprehension*

Research on memory access in sentence comprehension has identified two distinct types of interference. The first type is referred to as ‘inhibitory interference’, and manifests as increased processing difficulty during dependency formation. For example, Van Dyke and Lewis (2007) tested sentences like those in (3) and observed processing difficulty reflected in longer reading times at the verb *complaining* in (3b) relative to (3a). Van Dyke and Lewis interpreted this effect as a case of inhibitory interference, where the overlap in animacy between the two subject noun phrases (NPs) *the resident* and *the neighbor* made it relatively difficult for comprehenders to retrieve the target subject *the resident* during subject-verb binding in (3b). Similar effects have been observed across a number of other studies (e.g., Fedorenko, Babyonyshev, & Gibson, 2004; Gordon, Hendrick, & Johnson, 2001, 2004; Gordon, Hendrick, Johnson, & Lee, 2006; Van Dyke, 2007).

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- (3) a. The worker was surprised that the resident who was living near the dangerous warehouse was complaining about the investigation.  
b. The worker was surprised that the resident who was living near the dangerous neighbor was complaining about the investigation.
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The second type of interference, known as ‘attraction’ (also called ‘intrusion’ or ‘facilitatory interference’), manifests as eased processing and increased acceptability during dependency formation, relative to sentences that should be equally acceptable or unacceptable. Comprehenders frequently experience attraction during subject-verb agreement licensing. For instance, Wagers and colleagues used self-paced reading and speeded-acceptability judgments to examine the processing of grammatical and ungrammatical subject-verb agreement dependencies like those in (4).

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- (4) a. The key to the cabinet(s) unsurprisingly **was** rusty...  
b. \*The key to the cabinet(s) unsurprisingly **were** rusty...
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Wagers and colleagues found that in grammatical sentences like (4a), the number marking on the plural distractor *cabinets* did not impact acceptability judgments or reading times after the verb. However, in ungrammatical sentences like (4b), the presence of the plural distractor *cabinets*, which matched the number of the verb *were*, increased rates of acceptance and facilitated reading times after the verb, relative to an ungrammatical condition with the singular *cabinet*.

Wagers and colleagues argued that the facilitation observed in sentences like (4b) was due to incorrect retrieval of the plural distractor, e.g., *cabinets*, which matches the plural retrieval cue at the verb. Wagers and colleagues offered two suggestions for how a retrieval-based account could capture the grammatical asymmetry observed in (4). One possibility is that retrieval functions as an error-driven repair mechanism that is triggered by the detection of an agreement violation. In (4), the subject NP predicts the number of the verb. When the verb form violates this prediction, as in (4b), the parser engages a cue-based retrieval at the verb to recover a number matching noun to license agreement. The distractor *cabinets* should sometimes be incorrectly retrieved because it matches the verb in number, leading to the false impression that agreement is licensed. In the grammatical condition (4a), the verb fulfills the number prediction made by the subject NP, and therefore retrieval is not engaged, reducing the possibility of attraction. Another possibility is that retrieval is always engaged, regardless of grammaticality. On this view, no attraction is expected in the grammatical condition, since the presence of a fully matching target NP should strongly outcompete partial matches. These accounts contrast with earlier proposals that attraction results from the ‘percolation’ of plural features from the distractor to the subject noun (Eberhard, Cutting, & Bock, 2005; Franck, Vigliocco, & Nicol, 2002; Pearlmutter et al., 1999), which incorrectly predict grammatically symmetrical attraction effects.

Attraction effects are not limited to subject-verb agreement and have also been reported for negative polarity item (NPI) licensing and null subject licensing (e.g., Drenhaus, Saddy, & Frisch, 2005; Parker, Lago, & Phillips, 2015; Parker & Phillips, 2016; Vasishth, Brüssow, Lewis, & Drenhaus, 2008; Xiang et al., 2009). Across most of these studies, the facilitation effects were interpreted as the behavioral signature of faulty memory retrieval mechanisms.<sup>1</sup>

Inhibitory interference and attraction have different behavioral signatures and license different conclusions about memory access in sentence comprehension. Inhibitory interference occurs in multiple match contexts, where the target and distractor both match some of the retrieval cues. Inhibitory interference could reflect a number of different underlying mechanisms, such as feature-overwriting during encoding (Nairne, 1988, 1990) or the use of degraded cues in retrieval (Anderson, 1974). By contrast, attraction arises when the target and distractor are

<sup>1</sup> Xiang et al. (2009) argued that the facilitation effect observed for NPI licensing does not reflect misretrieval, but rather over-application of the pragmatic licensing mechanisms that are responsible for normal NPI licensing.

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