

Agreement attraction in reflexive pronouns depends on subject-verb agreement

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Background: Research has revealed effects of agreement attraction in subject-verbs [1-3] and in anaphora [4-6] dependencies. Interestingly, both verbs and reflexive pronouns, need to agree with the same subject noun. Are these processes independent? The cue-based retrieval model of attraction [7] predicts that erroneous retrieval at the verb will increase the chances of later misretrieval (as it increases the activation level of the distractor). This should result in cascading attraction effects. On the other hand, consulting verbal agreement can help the parser avoid attraction errors at the reflexive, either through intermediate updating the representation of the subject, and giving high weight to the verb's features, or through bypassing direct retrieval of the subject and establishing agreement only with the local verb.

In the current study, we investigate gender attraction in Hebrew reflexives. We compare reflexive pronouns' sensitivity to agreement attraction when the preceding verb bears grammatical, ungrammatical, or no gender cues. If attraction at the verb enhances the chances of attraction at the reflexive, we should observe more prominent attraction following ungrammatical verbs (where verbal attraction usually occurs [3]). If the representation of the agreement of the subject is deduced from, or updated at, the verb, we should observe agreement attraction only when no verbal agreement is available.

Experiment 1 (self-paced reading, $N=72$, 30 sets+60 grammatical fillers, see Table 1): Ungrammatical reflexives (mismatching the subject in gender) followed three possible predicate types: grammatical verbs (matching the subject), ungrammatical verbs (matching the reflexive), or predicates with no agreement marking. In addition, for the attraction manipulation, a distractor either matched or mismatched the ungrammatical reflexive. Results revealed agreement attraction at the reflexive when the predicate had no agreement ($p = .01$), but not when the verb manifested ungrammatical agreement ($p > .99$; interaction $p = .05$), or when the verb manifested grammatical agreement ($p = .42$; non-significant interaction $p = .30$). These results are partly consistent with the hypothesis that reflexive agreement utilizes features derived from the verb rather than retrieves the subject or distractor repeatedly.

Experiment 2 (self-paced reading, $N=60$, 28 sets+84 grammatical fillers, see Table 1): In this experiment we wanted to verify that readers do not neglect agreement if ungrammaticality is identified early in the sentence. We presented grammatical and ungrammatical reflexives following grammatical and ungrammatical verbs (keeping the distractor gender fixed). The results revealed that after an ungrammatical verb, a reflexive that matched the subject incurred higher reading times ($p = .03$), while the reverse was observed in the grammatical verb conditions ($p < .001$; interaction $p < .001$). The finding that ungrammatical reflexives are easier to process following ungrammatical verbs suggests that early ungrammaticality does not lead participants to neglect dependencies, but to modify agreement preferences. Moreover, the results suggest that verbal agreement has high weight (relative to the subject's features) in the processing of the reflexive (in line with [8]).

Experiment 3 (forced-choice completion, $N=60$, 28 sets, see Table 1) aimed to fully cross agreement on the verb, the reflexive and the distractor, and to replicate the findings using another type of experimental task. We asked participants to choose the gender of the reflexive pronoun after reading a preamble in RSVP. We found that the proportion of ungrammatical form completions is affected by verbal agreement, distractor match and their interaction, such that there is lower rate of attraction when the verb shows agreement cues, both when it is grammatical (interaction $p = .02$) and ungrammatical (interaction $p = .002$).

Conclusions: Taken together the experiments suggest that verbal agreement (grammatical or ungrammatical) can reduce attraction at a subsequent reflexive, in contrast to predictions of the cue-based retrieval model. This could arise if verbal agreement alters the representation of the subject; or if the subject is not retrieved at the reflexive when there are enough agreement cues on the verb (verifying verb-reflexive agreement as a "shortcut").

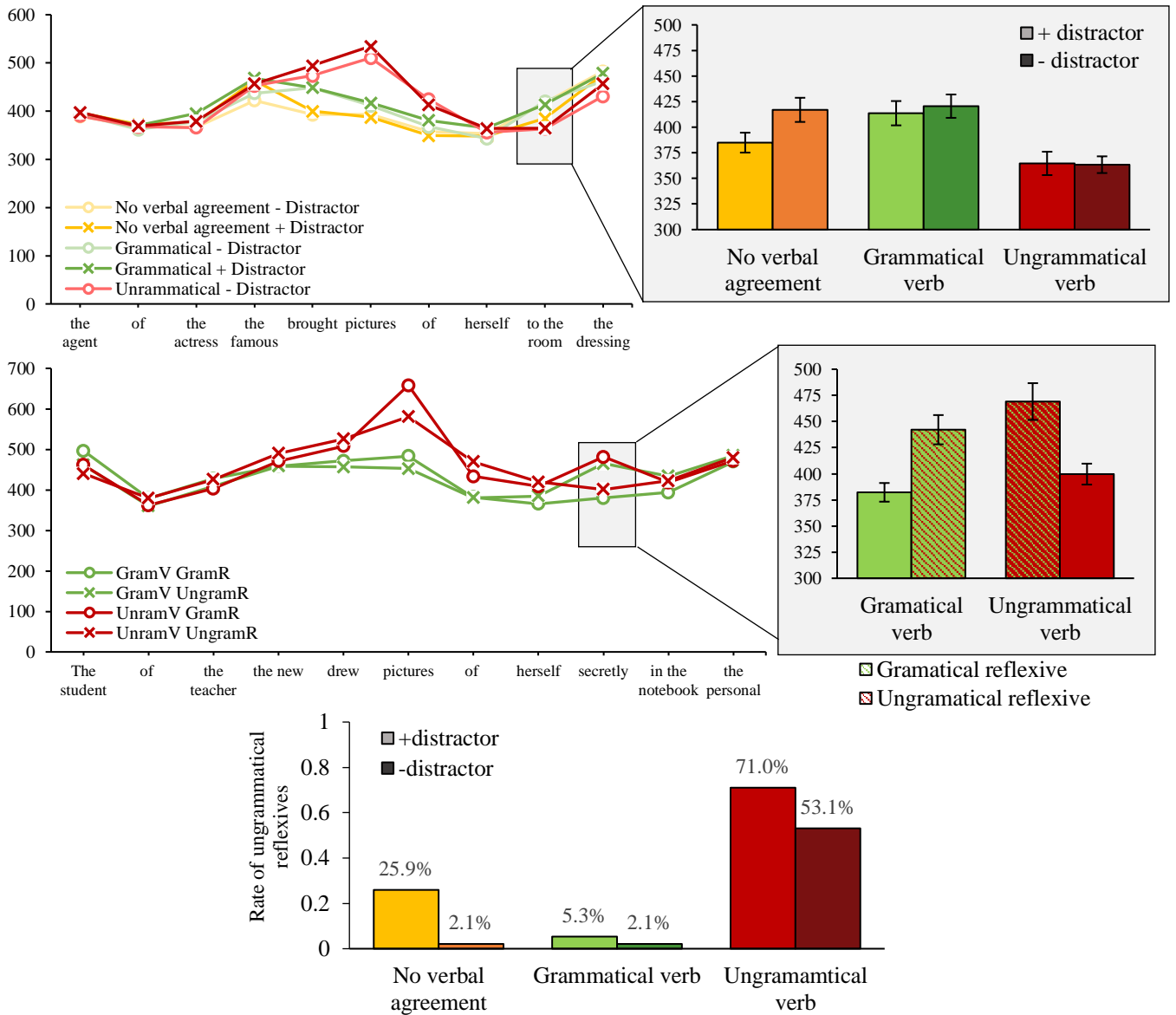


Figure 1. A: By condition mean RTs in Exp. 1. **B:** By condition mean RTs in Exp. 2. **C:** The rate of choosing a reflexive form mismatching the gender of the subject head noun in Exp. 3. * $p < .05$; ** $p < .01$; *** $p < .001$; Error bars mark ± 1 SE.

Condition	Example sentence
Experiment 1:	+distractor -distractor
Grammatical verb	<i>ha-soxen šel {ha-saxkanit ha-saxkan} hixnis tmunot šel acma le-</i> the-agent.M of {the-actress the-actor } <u>put.M</u> pictures of herself to- <i>xadar ha-halbaša</i> room the-dressing 'The actress'/actor's agent.M put.M pictures of herself in the dressing room.'
Ungrammatical verb	<i>ha-soxen šel {ha-saxkanit ha-saxkan} hixnisa tmunot šel acma le-</i> the-agent.M of {the-actress the-actor } <u>put.F</u> pictures of herself to- <i>xadar ha-halbaša</i> room the-dressing 'The actress'/actor's agent.M put.F pictures of herself in the dressing room.'

No verbal agreement	<p><i>la-soxen šel {ha-saxkanit ha-saxkan} yeš tmunot šel acma be-xadar ha-halbaša</i> to.the-agent.M of {the-actress the-actor } <u>BE</u> pictures of herself in room the-dressing</p> <p>'The agent.M of the actress/actor has pictures of herself in the dressing room.'</p>
Experiment 2: Grammatical verb	<p style="text-align: right;">Grammatical reflexive Ungrammatical</p> <p><i>ha-soxen šel ha-saxkanit hixnis tmunot šel {acmo acma } le-xadar ha-halbaša</i> the-agent.M of the-actress <u>put.M</u> pictures of {himself herself} to room the-dressing</p>
Ungrammatical verb	<p><i>ha-soxen šel ha-saxkanit hixnisa tmunot šel {acmo acma } le-xadar ha-halbaša</i> the-agent.M of the-actress <u>put.F</u> pictures of {himself herself} to room the-dressing</p>
Experiment 3: Grammatical verb	<p style="text-align: right;">+distractor -distractor</p> <p><i>bikašnu še-ha-soxen šel {ha-saxkanit ha-saxkan} yacig</i> we.asked that-the-agent.M of {the-actress the-actor } <u>will.present.M</u> <i>be'ofen rišmi et _____ [acmo / acma]</i> in-manner official ACC _____ [himself/herself]</p> <p>'We asked that the agent.M of the actress/actor will formally introduce.M [himself/herself]'</p>
Ungrammatical verb	<p><i>bikašnu še-ha-soxen šel {ha-saxkanit ha-saxkan} tacig</i> we.asked that-the-agent.M of {the-actress the-actor } <u>will.present.F</u> <i>be'ofen rišmi et _____ [acmo / acma]</i> in-manner official ACC _____ [himself/herself]</p> <p>'We asked that the agent.M of the actress/actor will formally introduce.F [himself/herself]'</p>
No verbal agreement	<p><i>bikašnu me-ha-soxen šel {ha-saxkanit ha-saxkan} lehacig</i> we.asked from-the-agent.M of {the-actress the-actor } to.present in- <i>be'ofen rišmi et _____ [acmo / acma]</i> manner official ACC _____ [himself/herself]</p> <p>'We asked the agent.M of the actress/actor to formally introduce [himself/herself]'</p>

Table 1. Example stimuli from the three experiments.

References: [1] Bock & Miller (1991). Broken agreement. *Cognitive Psychology*. [2] Pearlmutt, Garnsey, & Bock (1999). Agreement processes in sentence comprehension. *JML*. [3] Wagers, Lau, & Phillips (2009). Agreement attraction in comprehension: Representations and processes. *JML*. [4] Bock, Nicol, & Cutting (1999). The ties that bind: Creating number agreement in speech. *JML*. [5] Parker & Phillips (2017). Reflexive attraction in comprehension is selective. *JML*. [6] Jäger, Mertzen, Van Dyke, & Vasishth (2020). Interference patterns in subject-verb agreement and reflexives revisited: A large-sample study. *JML*. [7] Lewis, Vasishth, & Van Dyke (2006). Computational principles of working memory in sentence comprehension. *TiCS*. [8] Molinaro, Kim, Vespignani, & Job (2008). Anaphoric agreement violation: An ERP analysis of its interpretation. *Cognition*.