

Number attraction in pronoun production: evidence for antecedent feature retrieval

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Pronoun production involves two processes: deciding to refer to a referent with a pronoun rather than a full NP and determining pronoun form. A speaker presumably decides to produce a pronoun after accessing the conceptual referent, and it is possible that this access provides the features required to determine pronoun form, e.g. by highlighting relevant features salient in the message or facilitating lemma activation [1]. However, agreement studies of pronoun number [2-4] and gender [5] show attraction from non-antecedent referents (1), suggesting that pronoun form is not derived directly from the message but rather through a feature retrieval process. Yet, these studies may bias speakers to such a process by requiring access of multiple referents to determine the message of the sentence to utter [5] or applying a preamble elicitation paradigm [2-5], which has been shown to influence anaphor planning [6]. Furthermore, the decision to refer to a referent with a pronoun is removed in these studies, as participants are explicitly instructed to begin or complete sentences with a pronoun or to produce sentence tags, in which a pronoun is required by the nature of the construction. In 3 scene-description experiments, we find reliable pronoun number attraction effects, in some instances leading to apparent Principle B violations [7], showing that pronoun encoding involves retrieval referencing items active in the linguistic representation, even when the relevant features could be accessed directly from the message. Timing data shows that this process occurs even in trials where errors are avoided.

Experiments: Participants were introduced to 3 types of alien and the action mimicking: when an alien mimes another, the other alien's antenna lights up (Fig 1). Participants viewed scenes of aliens mimicking and described who mimicked whom, disambiguating the action by referencing the other aliens on the screen. We manipulated the number of aliens in the scenes so that the NPs in the responses either matched or mismatched in number (Table 1). In Exp 1, participants described scenes using either an object or reflexive pronoun (e.g. "The bluey above the greeny mimmed it/itself"); we report the object pronoun trial results here. Exp 2 elicited only the object pronoun trials from Exp 1. Exp 3 elicited sentences in the form "The bluey mimmed the greeny above it". In all experiments, speakers were significantly more likely to produce pronoun number errors in the mismatch conditions (Fig 2). The effect size was similar in Exp 1 and 2. In Exp 3 (where the effect was larger), speakers were more likely to pause before pronoun articulation in the mismatch conditions in error-free sentences, paralleling timing effects observed for verb number attraction with intervening attractors [e.g. 6, 8-10].

Discussion: The presence of attraction in our study suggests that pronoun form is determined through an agreement process referencing the features of the linguistic antecedent. We show that the effect occurs in a setting similar to natural speech when speakers make a choice about how to refer to the referent. We observed interference effects in timing even when no error was made, suggesting that this retrieval process is not limited to cases when agreement goes awry. In situations of intra-sentential pronominalization, decisions about pronoun use may depend on other items in the sentence (rather than the conceptual referent) because speakers must attend to these items to abide by constraints on anaphora use and NP repetition. We explain our results using a retrieval model of attraction [e.g. 11-13] within the context of a pronoun selection model in which an *in focus* feature of the conceptual referent cues the speaker to produce a pronoun instead of the full NP [e.g. 1]. The antecedents in our experiments had unambiguous number, so the observed effects cannot be attributable to a faulty or ambiguous number evaluation, as proposed by representational models of attraction [e.g. 4, 14-16]. We propose that after accessing the conceptual referent and noting its *in focus* feature, cueing need for a pronoun, the speaker uses a retrieval process to look for a corresponding *in focus* antecedent. In our sentences, there may be two linguistic representations in focus (salient in the discourse and active in working memory): the antecedent plus an NP lure (in Exp1-2, the sentence subject, recently activated for verb agreement; in Exp 3, the NP individuated by the PP modifier containing the pronoun). The presence of two *in focus* items may lead the agreement process to pick the number feature of the incorrect NP for agreement, resulting in a form error.

- (1) Agreement attraction occurs when nearby material interferes with normal agreement processes. This effect is typically studied within the context of subject-verb agreement.

Agreement type	Example attraction error
Verb number	*The key to the cabinets <i>are</i> on the table [17]
Pronoun number (reflexive)	*The actor in the soap operas watched <i>themselves</i> [2]
Pronoun number (tag)	*The actor in the soap operas rehearsed, didn't <i>they?</i> [2]
Pronoun gender	Kijk, daar ligt een aardappelc bij een badpak _N . # <i>Het</i> _N is gaar. [5] (Look, there is a potato [_{common gender}] next to a backpack [_{neuter gender}]. It [_{neuter}] is cooked.)

Figure 1: Stills from experiment scenes

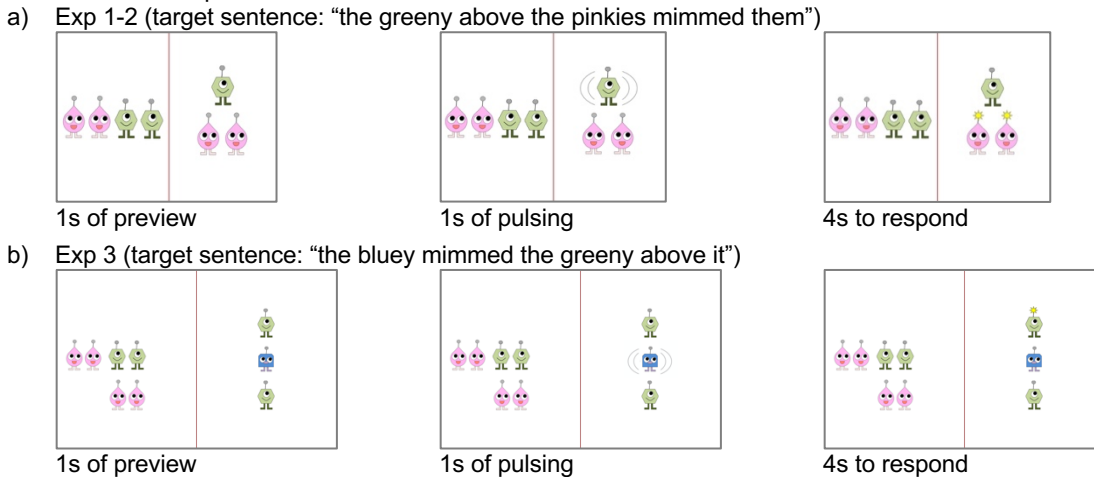
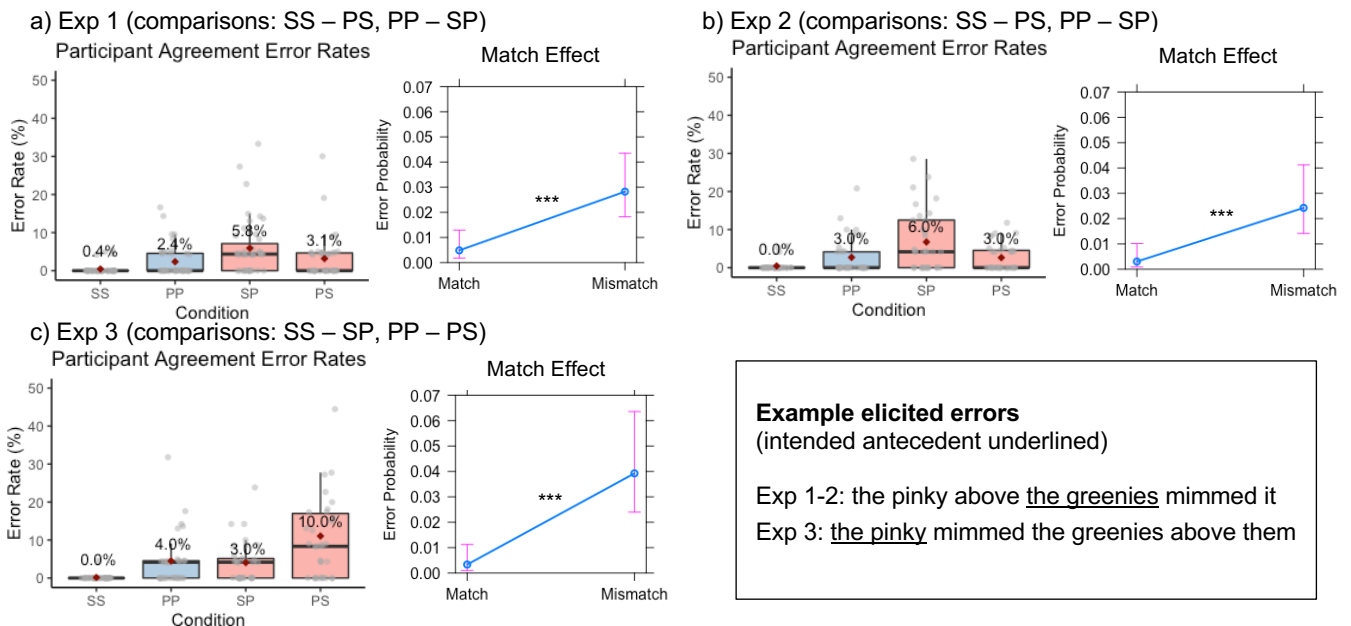


Table 1: Experiment conditions with example sentences

Condition	Sub-Condition	Exp 1-2 sentence	Exp 3 sentence
Match	SS	the pinky above the greeny mimmed it	the pinky mimmed the greeny above it
Match	PP	the pinkies above the greenies mimmed them	the pinkies mimmed the greenies above them
Mismatch	SP	the pinky above the greenies mimmed them	the pinky mimmed the greenies above it
Mismatch	PS	the pinkies above the greeny mimmed it	the pinkies mimmed the greeny above them

Figure 2: Participant error rates and match effect plots



References: [1] Schmitt et al., 1999; [2] Bock et al., 1999; [3] Bock, Cutler, et al., 2004; [4] Bock, Eberhard, & Cutting, 2004; [5] Meyer & Bock, 1999; [6] Kandel et al., 2019; [7] Chomsky, 1981; [8] Staub, 2009; [9] Staub, 2010; [10] Veenstra et al., 2014; [11] Badecker & Kuminiak, 2007; [12] Wagers et al., 2009; [13] Dillon et al., 2013; [14] Bock & Eberhard, 1993; [15] Solomon & Pearlmuter, 2004; [16] Eberhard et al., 2005; [17] Bock & Miller, 1991