

¹ (In)sensitivity to surface-level heuristics: A case from Turkish verbal
² attractors

³ Utku Turk^{a,*}

^a University of Maryland, College Park, Linguistics, Marie Mount Hall, College Park, 20742

⁴ **Abstract**

Linguistic illusion literature has stimulated ongoing debate on what type of information can be used to access memory representations. Prior work tests whether structural, semantic, or discourse cues guide subject-verb dependencies; it remains unclear whether native speakers rely on phonological information as a retrieval cues for memory access during dependency resolution, such as person agreement. Traditionally, accidental phonological resemblance to having a plural ending as in /s/ sound in *course* was found to not induce erroneous plural agreement, meanwhile, phonological resemblance that correlates with controllerhood amplifies attraction given an already present plural morpheme. In apparent contradiction to this generalization, Slioussar (2018) proposed that memory search for a subject in Russian sentences can be mediated through an accidental phonological resemblance. Given the theoretical importance of this proposal and the lack of comparable effects in other languages, we test whether phonological overlap can elicit erroneous agreement in Turkish, where the plural morpheme -lAr surfaces on both nouns and verbs. Turkish provides a critical test: both verbal elements and nominal elements can surface as subjects, but only nominal plural -lAr controls verbal agreement. Two speeded acceptability studies show no attraction from plural-marked verbs (Exp. 1 N = 80; Exp. 2 N = 95) but robust attraction from genitive plural nouns. We report a first-of-its-kind dissociation under minimal manipulation: verbal attractors that can be subjects yet cannot control agreement do not induce attraction, whereas genitive plural nouns that can be subjects and control in other environments do. To our knowledge this pattern has not been shown in any other language, and it constrains cue-based retrieval by tying attraction to abstract controller features rather than surface phonology.

⁵ *Keywords:* form-sensitivity, memory, agreement attraction, linguistic illusions, sentence processing

⁶ **1. Introduction**

⁷ Human sentence processing draws on abstract grammatical features and on heuristics that exploit surface
⁸ regularities, such as plausibility (Speer and Clifton, 1998), frequency (Lau et al., 2007), and task-specific fac-
⁹ tors (Laurinavichyute and von der Malsburg, 2024; Arehalli and Wittenberg, 2021; Hammerly et al., 2019;
¹⁰ Logačev and Vasishth, 2016). We focus on one such heuristic, surface-form overlap, where phonological
¹¹ similarity between the sentence constituents modulates performance (Acheson and MacDonald, 2011; Kush
¹² et al., 2015; Copeland and Radvansky, 2001; Rastle and Davis, 2008). Prior work shows reliable slowdowns
¹³ and comprehension accuracy costs under surface-form overlap, but it is unresolved whether this heuristic
¹⁴ penetrates dependency resolution itself, including subject-verb agreement, pronoun resolution, or the licens-
¹⁵ ing of negative polarity items, beyond general effects on reading ease and memory. The few studies that
¹⁶ bear directly on subject-verb agreement exhibit contradictory findings (Bock and Eberhard, 1993; Slioussar,
¹⁷ 2018).

*Corresponding author

Email address: utkuturk@umd.edu (Utku Turk)

18 A central question for understanding human cognition is what information is encoded and later available
19 to memory during comprehension, and how faithful these encodings are to the input. A general cue-based
20 retrieval approaches hold that constituents are stored with detailed abstract features and later accessed by
21 matching retrieval cues; it remains open whether phonological codes persist to serve as such cues during
22 dependency building (Lewis and Vasishth, 2005). On the other hand, Good-Enough and noisy accounts
23 allow that detailed analyses are not always maintained when heuristics suffice, raising the possibility that
24 surface regularities affect judgments (Ferreira et al., 2002). Clarifying whether surface-form overlap modu-
25 lates dependency resolution therefore identifies what human cognition counts as diagnostic information for
26 retrieving dependency controllers and how faithful the stored representations are.

27 Agreement provides a precise diagnostic because its computations are known to be sensitive to feature
28 overlap. Classic findings in the computation of agreement show that people make systematic errors in
29 establishing a number agreement relation between a verb and its agreement controller, when another NP
30 with a different number (the attractor) interferes. As a result, speakers may produce sentences like (1) or
31 misclassify them as acceptable (Bock and Miller, 1991; Pearlmuter et al., 1999).

32 (1) * The player on the courts are tired from a long-game.

33 Despite much research on what quantitatively modulates agreement errors, the role of phonology remains
34 unclear. Pseudoplurals attractors such as *course* do not increase agreement errors in production, arguing
35 against a purely phonological route (Bock and Eberhard, 1993). Overlaps that align with abstract features
36 or subject-likeness do increase errors, as in case syncretism in German production (Hartsuiker et al., 2003),
37 genitive subject-likeness in Turkish comprehension (Lago et al., 2019), and structural resemblance in Ro-
38 manian comprehension (Bleotu and Dillon, 2024). These effects arise when the attractor bears the relevant
39 plural marking and shares morphological features with a possible subject, not when they are singular but
40 phonologically similar to a plural subject, supporting accounts that downplay surface-form similarity. By
41 contrast, Russian results have been interpreted as evidence that phonological overlap between a singular geni-
42 tive attractor and a plural nominative form affects agreement judgments, reading, and production (Slioussar,
43 2018).

44 An alternative interpretation notes that genitive-marked nouns in Russian can participate in other agree-
45 ment relations, making them plausible agreement controllers in some configurations. This raises the possibil-
46 ity that the observed effects reflect a version of subject-likeness rather than phonology per se. Together, these
47 considerations motivate a targeted test that dissociates the possibility of controllerhood from surface-form
48 overlap.

49 To this end, we utilize the surface-form overlap between the verbal and nominal morphological reflexes of
50 agreement in Turkish, a language that shows attraction when attractors carry controller-relevant features
51 (Türk and Logačev, 2024; Ulusoy, 2023; Türk, 2022; Lago et al., 2019). Unlike previously tested languages,
52 Turkish uses the same surface suffix, -lAr, for plural marking on nouns and for plural agreement on finite
53 verbs. Typologically, Turkish is agglutinative with a near one-to-one mapping between grammatical mean-
54 ings and affixes, in contrast to English, a more analytic language where pure phonological overlap has not
55 yielded attraction, and to Russian, a fusional language where overlap effects have been reported. Crucially,
56 strings bearing verbal -lAr can occur in subject position, yet they never control finite clause agreement; only
57 nominal plurals do. These properties allow a direct test of whether form overlap alone modulates agreement
58 errors, or whether modulation requires an element that can in principle serve as an agreement controller.

59 We report two high-powered speeded acceptability experiments in Turkish. Experiment 1 manipulates
60 the number on an embedded verb that appears near the matrix clause, comparing embedded plural -lAr to
61 embedded singular. Experiment 2 retains this manipulation and adds items with nominal plural attractors
62 drawn from prior Turkish work, creating a within-session benchmark for canonical attraction. Across both
63 experiments, embedded verbal -lAr did not increase acceptance of plural matrix agreement. Nominal plural
64 attractors produced the expected attraction. These results indicate that surface-form overlap alone does

65 not function as a retrieval cue for agreement in Turkish. Dependency resolution appears to rely on abstract
66 features and structural relations, with phonology influencing processing primarily outside of retrieval.

67 *1.1. Background*

68 One domain in which researchers investigated how memory representations interacts with real time sentence
69 processing is the agreement phenomenon. It is reported that native speakers from 296 of out 378 languages
70 surveyed exhibit systematic agreement between the verb and another constituent(s), such as subject, object,
71 or both (Siewierska, 2013). However, this agreement process is not always error-free. In their seminal work,
72 Bock and Miller (1991) demonstrated that participants systematically produce erroneous verb forms (*are*)
73 when there is a nearby noun, an attractor, that has a mismatching number as in (2b) compared to their
74 counterpart with singular attractor as in (2a). The effect of the number mismatching attractor, agreement
75 attraction, was also found to be robust in comprehension (Nicol et al., 1997; Pearlmuter et al., 1999) of such
76 sentences in various languages, including Arabic (Tucker et al., 2015), Armenian (Avetisyan et al., 2020),
77 Hindi (Bhatia and Dillon, 2022), Spanish (Lago et al., 2015), Russian (Slioussar, 2018), and Turkish (Lago
78 et al., 2019; Türk and Logačev, 2024; Ulusoy, 2023).

- 79 (2) a. Singular Attractor
80 The player on the court ...
81 b. Plural Attractor
82 The player on the courts ...

83 Studies mainly investigated the interaction between the agremenet process and various syntactic and
84 semantic factors. These factors include hierarchical distance (Hartsuiker et al., 2001; Nicol et al., 1997; Kaan,
85 2002), linear distance (Pearlmuter, 2000; Bock and Cutting, 1992), semantic interactions of nouns involved
86 (Eberhard, 1999; Vigliocco et al., 1995; Humphreys and Bock, 2005), and syntactic category of the phrase
87 containing the attractor (Bock and Miller, 1991; Bock and Cutting, 1992). A widely accepted accounts of
88 such effects was able to capture these effects by blaming different part of the comprehension and production
89 process. For example, cue-based accounts such as Lewis and Vasishth (2005) or Wagers et al. (2009) argued
90 that participants have a faithful representation of the constituents they process, however, illusion arises
91 occasionally when they are misled by the memory mechanisms they use to identify the controller. Other
92 accounts such as Marking and Morphing (Eberhard et al., 2005), Good-Enough processing (Ferreira et al.,
93 2002), or Rational Inference account (Ryskin et al., 2021) argued that the errors mainly arise due to speakers'
94 representation after encountering linguistic constituents are ill-formed.

95 One interesting prediction of retrieval accounts is that as the identification of the controller gets harder,
96 the retrievel process should be more prone to erroneous representations. This prediction was tested in var-
97 ious languages by manipulating the overt case marking of controllers or attractors, reasoning that surface
98 ambiguity could enhance competition during retrieval or interfere in production [PAPERS]. For example,
99 Hartsuiker et al. (2003) used the overlap between accusative and nominative forms of feminine determin-
100 ers in German and compared these ambiguous forms to distinctively marked dative forms. Participants
101 produced more agreement errors when the preambles contained two noun phrases whose determiners were
102 not distinctively marked, as in (3a), compared to cases where the attractor could be distinguished by form
103 alone, as in (3b). Crucially, this additive effect was limited to feminine nouns, the only gender showing
104 nominative–accusative syncretism in plural forms while other nouns showed the base effect of plural.

- 105 (3) a. Die Stellungnahme gegen die Demonstration-en
106 the.F.NOM.SG position against the.F.ACC.PL demonstration-PL
107 ‘The position against the demonstrations’
108 b. Die Stellungnahme zu den Demonstration-en
109 the.F.NOM.SG position on the.F.DAT.PL demonstration-PL
110 ‘The position on the demonstrations’

109 However, results from other studies with overt case marking in other languages presents an unclear picture.
110 For instance, Franck et al. (2010) used French and compared the unambiguously accusative marked attractors
111 to NPs with no overt case marking. They showed that when unambiguous marking increased the attraction
112 effects substantially, contrary to the predictions of cue based retrieval. Similarly, Avetisyan et al. (2020)
113 also demonstrated that unambiguous case marking in Armenian did not affect neither reading times nor
114 attraction errors.

115 In addition to studies that uses case-manipulation, other studies tested pure phonological similarity that
116 also does not provide clear evidence for the prediction of the retrieval accounts. Bock and Eberhard (1993)
117 tested whether attractors that only sound plural, pseudoplurals such as *course* 4, increase agreement errors
118 compared to true plural nouns (2b). They reasoned that if participants rely on phonological cues rather
119 than abstract features, words ending with plural-like sounds (/s/ or /z/) should behave like true plurals.
120 Participants completed sentence preambles such as (??), where the head noun (*player*) was singular but the
121 attractor varied in form. They found that pseudplural attractors did not induce agreement errors.

122 (4) Pseudoplural Attractor
123 The player on the course ...

124 On the other hand, in a series of three studies Slioussar (2018) argued that surface-form overlap affects
125 the reading pattern and accuracy of participants in Russian agreement. A group of genitive singular nouns
126 in Russian surfaces in the same form with their nominative plural counterparts (5a). Crucially, in her
127 experiments the genitive plural nouns were not ambiguous with their nominative counterparts. Slioussar
128 (2018) showed that participants not only exhibited faster reading times at the plural verb after reading
129 a singular genitive noun (5a) compared to a plural genitive noun (5b), but also judged sentences with a
130 singular attractor as grammatical more often. These effects of plural attractor were only present in cases
131 with ambiguous case marking. In this aspect, the findings of Slioussar (2018) differs from previous findings
132 and shows that the pure phonological similarity, without any contribution from an abstract plural feature,
133 can drive the agreement attraction effects alone.

- 134 (5) a. material dlja kryši byli brakovannymi.
135 material[NOM.SG] for roof[GEN.SG(=NOM.PL)] were defective
136 b. material dlja kryš byli brakovannymi.
137 material[NOM.SG] for roof[GEN.PL(≠NOM.PL)] were defective
138 ‘The material for the roof(s) were defective.’

137 Slioussar (2018) took these results to be an evidence for a cue-based retrieval model in which attraction
138 effects originates from erroneous retrievals of an agreement controller. Under this approach, phrases are
139 encoded in a content-addressable memory as bundles of features called *chunks* which include information
140 like, number, gender, morphophonological case, and syntactic information (Smith and Vasishth, 2020; Lewis
141 and Vasishth, 2005). Participants predict the number of the verb based on the noun phrases they process
142 while reading the previous noun phrases. In grammatical sentences with singular verb agreement, the number
143 prediction and the verb number match, which causes no processing difficulty. In contrast, when participants
144 fail to find the predicted number morphology on the verb, a memory-retrieval process is initiated. This
145 process activates the search for a chunk matching relevant cues for agreement controller. Slioussar (2018)
146 argued that the search for a controller can be mediated through possible forms of nouns with relevant
147 features like, NOM case, PL number, as well as structural cues.

148 In ungrammatical sentences like (??), while neither of the available noun phrases fully matches this spec-
149 ification in ungrammatical agreement attraction sentences, each of the NPs headed by *link* and *websites*
150 matches a subset of cues. Importantly, in (5a) as well, a partial match is also possible. Even though the
151 NP headed by *roof* is not plural, due to phonological overlap, Slioussar (2018) argues, a subset of features

152 relevant for agreement, i.e. +NOM and +PL, is erroneously activated. While this partial match scenario
153 mostly results in participants finding the sentence ungrammatical, they may occasionally retrieve the
154 attractors, *websites* or *roof*, as controllers on some trials.

155 An alternative account that does not depend on activation of relevant features by phonology would depend
156 on encoding of distributional facts as statistical heuristics. In such an account, instead of relying on activation
157 of features through a phonological route, participants would probabilistically associate certain strings, such
158 as genitive marked NP or overt D head, with being an agreement controller. Indeed, similar explanations
159 for syncretism or subject-likeness phenomenon has been reported. For example, Lago et al. (2019) argued
160 that participants can retrieve a noun as the controller if the noun is marked with a case marking that may
161 sometimes control agreement in a language even if that is not the case for the specific sentence. They
162 used Turkish genitive case, which can control the agreement in embedded sentences but not in matrix
163 sentences. They took the presence of attraction effects in Turkish as an indication that Turkish speakers
164 utilize overt genitive-case's association with subjecthood. In a sense, phonological, not functional, syncretism
165 between the marking on the nominal modifier and the embedded subject resulted in attraction. A similar
166 account from Dillon and colleagues was pushed for sensitivity for looking like a controller in languages like
167 Romanian and Hindi (Bhatia and Dillon, 2022; Bleotu and Dillon, 2024). For instance, Bleotu and Dillon
168 (2024) manipulated whether the attractor surfaces with a determiner or in its bare form. Importantly, they
169 note that only nouns with determiners can control agreement in Romanian. They found that Romanian
170 attractors only induced attraction effects when both attractor and the head surfaced with a determiner.
171 They took these results to suggest that participants associated presence of a determiner or related feature
172 with the agreement controller, and attraction only surfaces when subject heads and the attractor look alike.
173 Similarly, Schlueter et al. (2018) argue that and can cause agreement attraction effects in English even when
174 it does not create a plurality because it is associated with the plural feature statistically. Such explanations
175 are based on the assumption that the match between a cue and a chunk does not have to be categorical, but
176 it can be influenced by surface level statistical association (Engelmann et al., 2019).

177 A similar account can also be proposed for Russian findings. Genitive marked nouns can be subjects in
178 negative inversion constructions in Russians. However, when they are subjects, they cannot control the
179 agreement. In other cases, they can be the controller of number or gender marking on adjectival relative
180 clauses. Given this possibility of an alternative account, the contention of initial findings of Bock and
181 Eberhard (1993), and the theoretical importance of the empirical generalization, we test whether pure
182 phonological overlap can derive agreement attraction effects in two high-powered speeded acceptability
183 judgment experiments. To this end we use Turkish, a language where verbal and nominal plural marking
184 share the same surface form, the suffix -lAr. We use reduced relative clause (RRC) structures, in which the
185 verb with the plural marking alone can appear as the attractor (6). Importantly, Turkish -lAr syncretism
186 here is not feature-ambiguous (as in cases of syncretism); it is a form-only overlap that does not share
187 possible argument status with the subject. Even when the RRC can surface without its head as the subject,
188 they cannot control the agreement (7).

- 189 (6) Gör-dük-ler-i çocuk koş-tu-(*)lar.
go-NMLZ-PL-POSS kid[NOM] run-PST-(*)PL

190 ‘The kid that (they) saw ran.’

- 191 (7) Gör-dük-ler-i koş-tu-(*)lar.
go-NMLZ-PL-POSS run-PST-(*)PL

192 ‘(The kid) that (they) saw ran.’

193 In Experiment 1, we tested the form hypothesis directly by comparing ungrammatical sentences with
194 verbal-plural vs. verbal-singular attractors. Experiment 2 replicated this design but included additional
195 nominal-attractor items from a previous Turkish attraction study (Türk and Logačev, 2024), allowing us
196 to test whether the distribution of item types and the presence of genuine attraction-inducing elements
197 modulates the outcome. Across both experiments, we found no evidence that verbal -lAr induces attraction,

198 even when canonical nominal attractors are present in the same session. This pattern aligns with prior
199 findings in general attraction literature and Turkish agreement attraction, namely surface-form overlap
200 alone does not derive agreement illusions. Rather, attraction appears to depend on abstract feature overlap
201 between potential controllers and agreement probes, and possibly statistical associations between the strings
202 and their controllers. In this lights, findings of [Slioussar \(2018\)](#) are best analyzed as a possible increased
203 association between genitive marking and possible subjecthood and being an agreement controller. By doing
204 so, we hope to clarify how cue-mechanisms are employed and the role of phonological overlap in sentence
205 processing.

206 2. Experiment 1: Testing Form-Driven Processing

207 2.1. Participants

208 We recruited 80 undergraduate students to participate in the experiment in exchange for course credit. All
209 participants were native Turkish speakers, with an average age of 21 (range: 18 – 31). The experiment was
210 carried out following the principles of the Declaration of Helsinki and the regulations concerning research
211 ethics at Bogazici University. All participants provided informed consent before their participation and their
212 identities were completely anonymised.

213 2.2. Materials

214 We used 40 sets of sentences like (8), in which we manipulated (i) the number of the attractor and (ii)
215 the number agreement on the verb. Both plural markings were marked with the suffix -ler/-lar, while the
216 singular number and singular agreement were marked by its absence.

- 217 (8) a. Tut-tuğ-u aşçı mutfak-ta sürekli zipla-di.
hire-NMLZ-POSS cook[NOM] kitchen-LOC non.stop jump-PST
218 ‘The cook they hired_{sg} jumped_{sg} in the kitchen non-stop.’
- 219 b. *Tut-tuğ-u aşçı mutfak-ta sürekli zipla-di-lar.
hire-NMLZ-POSS cook[NOM] kitchen-LOC non.stop jump-PST-PL
220 ‘The cook they hired_{sg} jumped_{pl} in the kitchen non-stop.’
- 221 c. Tut-tuk-lar-ı aşçı mutfak-ta sürekli zipla-di.
hire-NMLZ-PL-POSS cook[NOM] kitchen-LOC non.stop jump-PST
222 ‘The cook they hired_{pl} jumped_{sg} in the kitchen non-stop.’
- 223 d. *Tut-tuk-lar-ı aşçı mutfak-ta sürekli zipla-di-lar.
hire-NMLZ-PL-POSS cook[NOM] kitchen-LOC non.stop jump-PST-PL
224 ‘The cook they hired_{pl} jumped_{pl} in the kitchen non-stop.’

225 All sentences were adapted by previous studies in Turkish agreement attraction ([Lago et al., 2019; Türk](#)
226 and [Logačev, 2024](#)). Sentences started with a complex subject NP like ‘tuttukları aşçı’ ‘the cook they
227 hired,’ in which the nominalized relative clause functioned as the attractor, and the head noun were bare.
228 Because the plural marking on nominals is not optional and the head noun was singular, absent of -lar, in all
229 conditions, sentences with plural verb agreement were ungrammatical. To inhibit participants from forming
230 a task-related strategy in which they deemed the sentence ungrammatical upon seeing a plural verb, half of
231 our fillers included plural grammatical verbs, while the other half included singular ungrammatical verbs.

232 2.3. Procedures

233 The experiment was run online, using the web-based platform Ibex Farm ([Drummond, 2013](#)). Each experi-
234 mental session took approximately 25 minutes to complete. Participants provided demographic information
235 and gave informed consent to participate in the experiment. They then proceeded to read the instructions
236 and were given nine practice trials before the experiment began.

237 Each trial began with a blank screen for 600 ms, followed by a word-by-word RSVP presentation of the
238 sentence in the center of the screen, followed by a prompt to indicate their acceptability judgment. Sentences
239 were presented word-by-word in the center of the screen in 30 pt font size, at a rate of 400 ms per word.
240 Participants saw a blank screen for 100 ms between each word, and to see the next item, they needed to
241 press the space key. Participants were asked to press the key P to indicate that a sentence is acceptable
242 and Q to indicate that the sentence is unacceptable. They were instructed to provide judgments as quickly
243 as possible. During the practice, but not during the experiment, a warning message in red font appeared if
244 they did not respond within 5,000 ms.

245 Participants saw 40 experimental and 40 filler sentences. Experimental sentences were distributed among
246 four different lists according to a Latin-square design. Every participant saw one version of the experiment
247 with a specific list and one item per condition.

248 *2.4. Analysis and Results*

249 Participants showed high accuracy in both grammatical ($M = 0.94$, CI = [0.92,0.95]) and ungrammatical
250 filler sentences ($M = 0.92$, CI = [0.9,0.93]), indicating that they understood the task and performed it
251 reliably.

252 Figure 1 presents the overall means and credible intervals for ‘yes’ responses across experimental conditions.
253 As shown, ungrammatical sentences with plural attractors were rated as acceptable as their counterparts
254 with singular attractors ($M = 0.06$ and 0.05 , CI = [0.04, 0.07] and [0.03, 0.07] for singular and plural
255 attractors, respectively).

256 On the other hand, accuracy in grammatical conditions was modulated by the number of the attractor in
257 an unexpected way. Participants rated grammatical sentences with singular attractors as grammatical less
258 often ($M = 0.92$, CI = [0.9,0.94]) compared to their counterparts with plural attractors ($M = 0.95$, CI =
259 [0.93,0.96]).

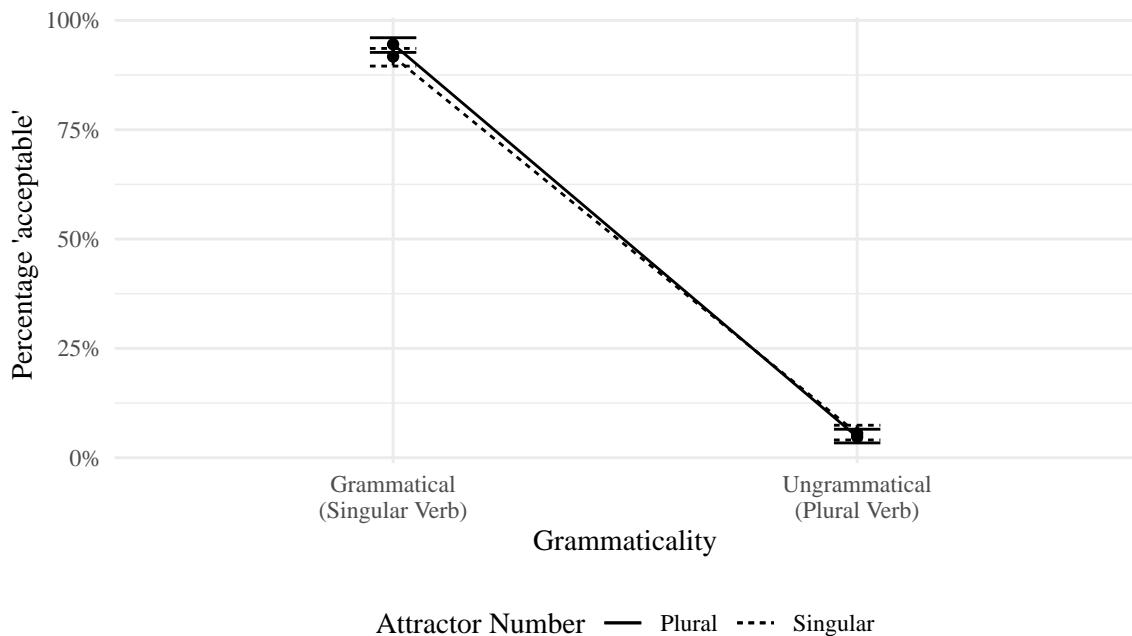


Figure 1: Mean proportion of ‘acceptable’ responses by grammaticality and attractor number. Error bars show 95% Clopper–Pearson confidence intervals.

260 These descriptive trends were confirmed by our Bayesian mixed-effects models implemented in brms, as-
261 suming a Bernoulli logit link. The model was fitted to the binary *yes/no* responses and included fixed effects

262 for Grammaticality and Attractor Number and their interaction, and random intercepts and slopes for both
263 subjects and items.

264 Posterior estimates are summarized in Figure 2. The model revealed a positive effect of grammaticality
265 ($\beta = 5.92 [5.41, 6.46]$, $P(\beta > 1.00)$), but no reliable main effect of attractor number ($\beta = 0.15 [-0.19, 0.51]$,
266 $P(\beta > 0.81)$). On the other hand, there was a small but positive interaction ($\beta = 0.66 [-0.02, 1.38]$, $P(\beta$
267 $> 0.97)$). To clarify the effects' presence in grammatical only, we fitted two more models that is fitted to
268 the subset of the data. While the model fitted to grammatical conditions only showed an effect of attractor
269 number ($\beta = 0.51 [0.06, 1.00]$, $P(\beta > 0.99)$), the model fitted to ungrammatical conditions did not provide
270 evidence for the effect of number manipulation ($\beta = -0.05 [-0.45, 0.37]$, $P(\beta > 0.99)$). These results suggest
271 that the presence of a plural attractor did not increase the acceptability of ungrammatical sentences, nor
272 was this relationship modulated by grammaticality.

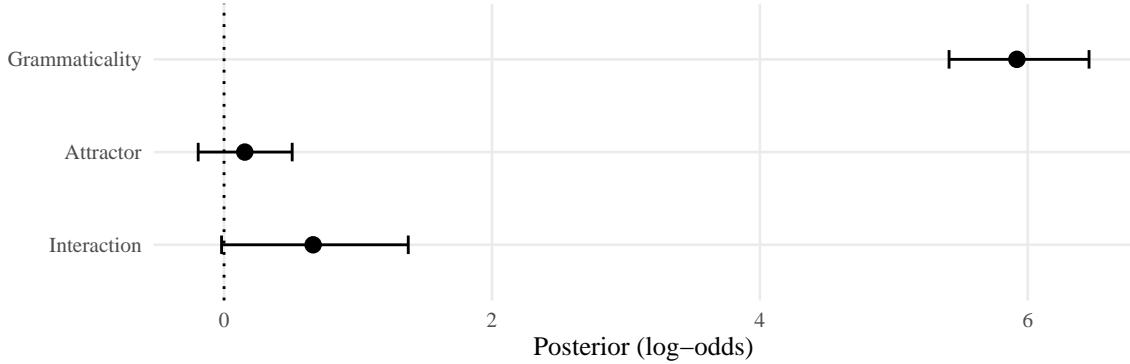


Figure 2: Posterior means and 95% credible intervals for fixed effects in the two Bayesian models. The x-axis shows the posterior mean (log-odds scale). The blue intervals correspond to the model in which a positive interaction was assumed, and the orange intervals to the model in which it was not.

273 2.5. Discussion

274 Experiment 1 tested whether phonological overlap between nominal and verbal plural morphemes in Turkish
275 induces agreement attraction. The results provided no evidence for attraction driven by surface-form
276 similarity. Ungrammatical sentences with plural-marked verbs were not judged more acceptable when the
277 relative clause verb contained a plural morpheme. Instead, participants reliably rejected such sentences
278 regardless of attractor number. This indicates that the verbal plural marker -lAr does not create the same
279 type of interference observed with nominal plural attractors in previous studies.

280 Unexpectedly, grammatical sentences with singular attractors were judged less acceptable than those with
281 plural attractors. This effect is unlikely to reflect agreement attraction, since it arises in the opposite direction.
282 One possibility is that it results from an interaction between plausibility and referential availability.
283 The plural morpheme can license a more general interpretation by allowing an arbitrary or unspecific reference,
284 whereas the singular reduced relative clause more strongly invites a specific referent, which may be
285 less accessible in the context of the task. In other words, plural morphology may facilitate an *arbitrary*
286 *PRO* interpretation of the embedded clause, in which the understood subject of the relative clause is not
287 controlled by any overt antecedent and has a generic or impersonal reference. A similar effect can be seen in
288 English sentences like ‘Just to sit there should be forbidden.’ Here, the subject of the infinitival clause has
289 arbitrary reference. We do not pursue this explanation further, as it falls outside the scope of the present
290 paper.

291 One possible reason for the absence of attraction may lie in the within-experiment statistics. Previous work
292 has shown that participants' global expectations about the frequency of grammatical and ungrammatical
293 sentences can alter attraction patterns. Hammerly et al. (2019) and Türk (2022) demonstrated that reducing
294 the proportion of grammatical trials led to attraction effects even in otherwise grammatical sentences.

295 Similarly, Arehalli and Wittenberg (2021) reported that filler distribution affects error correction rates. It is
296 possible that the current experiment's distribution discouraged attraction: if participants rarely encountered
297 conditions that supported attraction, they may have maintained a strong bias against plural-marked verbs,
298 reinforcing this bias throughout the session.

299 To test this possibility, Experiment 2 introduced additional conditions that have previously been shown to
300 elicit attraction in Turkish (Türk and Logačev, 2024; Lago et al., 2019). This allowed us to assess whether
301 the inclusion of genuine nominal attractors modulates the likelihood of errors and whether participants
302 adapt to the statistical environment of the task.

303 **3. Experiment 2: Testing Within-Experiment Statistical Sensitivity**

304 *3.1. Participants*

305 We recruited 95 undergraduate students to participate in the experiment in exchange for course credit. All
306 participants were native Turkish speakers, with an average age of 21 (range: 18 – 30). The experiment was
307 carried out following the principles of the Declaration of Helsinki and the regulations concerning research
308 ethics at Bogazici University. All participants provided informed consent before their participation and their
309 identities were completely anonymised.

310 *3.2. Materials*

311 The same materials were used with Exp1. We added items from Türk and Logačev (2024) as an additional
312 condition for nominal cases.

313 *3.3. Procedures*

314 The same procedure with Experiment 1 was used.

315 *3.4. Analysis and Results*

316 Participants showed high accuracy in both grammatical ($M = 0.95$, CI = [0.94,0.96]) and ungrammatical
317 filler sentences ($M = 0.94$, CI = [0.93,0.95]), indicating that they understood the task and performed it
318 reliably.

319 Figure 3 presents the overall means and credible intervals for 'yes' responses across experimental conditions,
320 as well as the previous data from Türk and Logačev (2024), which is quite similar to the magnitude of Lago
321 et al. (2019). As shown, in our study, participant gave more 'yes' responses to ungrammatical sentences
322 with plural genitive-marked nominal attractors ($M = 0.12$, CI = [0.09,0.15]) compared to their singular
323 counterparts ($M = 0.12$, CI = [0.09,0.15]).

324 However, similar increase in acceptability was not found with relative clause attractors ($M = 0.05$ and
325 0.05, CI = [0.03, 0.07] and [0.03, 0.07] for singular and plural attractors, respectively). Participants rated
326 grammatical sentences similarly independent of the attractor number or attractor type.

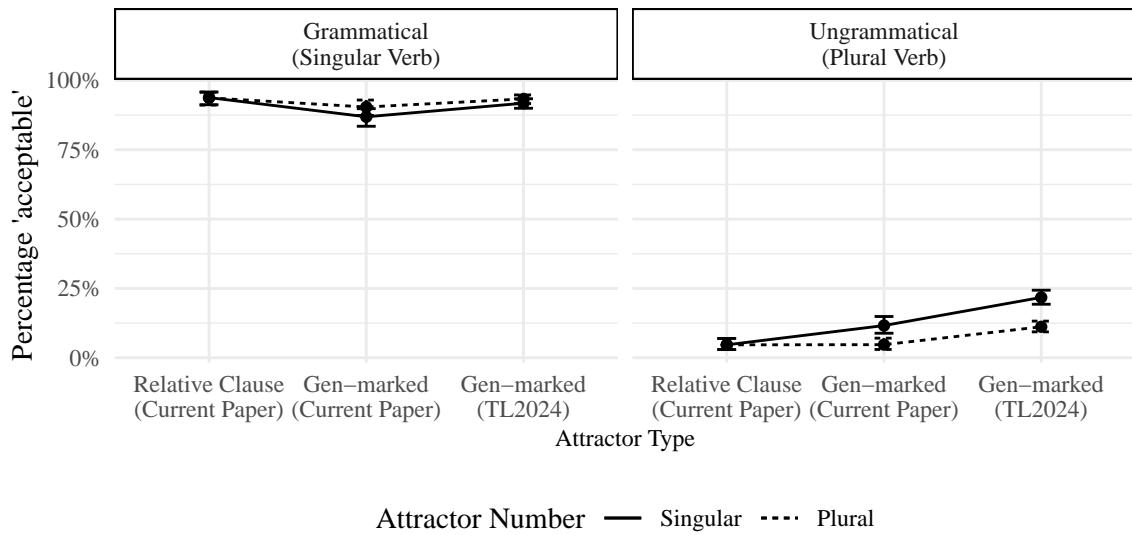


Figure 3: Mean proportion of ‘acceptable’ responses by grammaticality, attractor number and attractor type. Error bars show 95% Clopper–Pearson confidence intervals.

327 Our models also showed similar results, assuming a Bernoulli logit link. Our main research question was
 328 whether verbal attractors induced attraction effects. We also wanted to check whether within-experiment
 329 statistics affected the attraction magnitudes, i.e. the effect of presence of verbal attractors on nominal
 330 attractors. To that end, we included genitive marked nominals from data from our experiment and [Türk](#)
 331 and [Logačev \(2024\)](#). The model was fitted to the binary *yes/no* responses and included fixed effects for
 332 Grammaticality, Attractor Number, and Attractor Type and their interaction, along with random intercepts
 333 and slopes for both subjects and items.

334 We present posterior summaries of estimated regression effects from our model in Figure 4. We found a
 335 robust attraction in both nominal attractor cases, with strongly negative effects for our nominal items ($M = -1.45$,
 336 $CI = [-2.12, -0.78]$, $P(<0) = >0.99$) and items from [Türk and Logačev \(2024\)](#) ($M = -1.16$, $CI = [-1.63,$
 337 $-0.68]$, $P(<0) = >0.99$). More importantly, our model found no evidence for an attraction in verbal attractor
 338 conditions ($M = 0.08$, $CI = [-0.7, 0.86]$, $P(<0) = 0.44$), verifying our observations in the descriptive statistics.
 339 The evidence for a difference in magnitude of attraction between the two genitive types was not found ($M = -0.29$,
 340 $CI = [-1.08, 0.51]$, $P(<0) = 0.72$), suggesting the within-experimental distribution did not affect
 341 attraction magnitudes. Finally, we found strong evidence for a decreased overall acceptability for nominal
 342 items in our experiment ($M = -1.1$, $CI = [-1.79, -0.44]$, $P(<0) = >0.99$), suggesting the within-experimental
 343 distribution did affect overall acceptability, but not attraction.

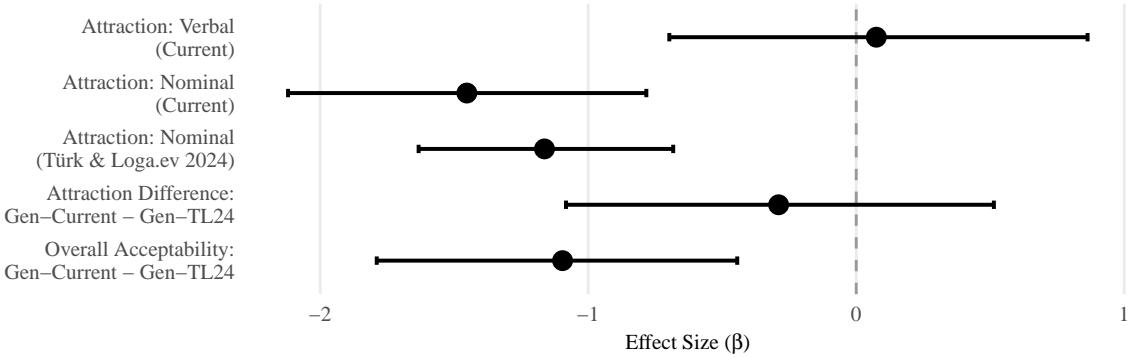


Figure 4: Posterior summaries of attraction-related effects. Points indicate posterior means, and horizontal bars show 95% credible intervals on the log-odds () scale. Attraction was estimated as the interaction between grammaticality and attractor number within each attractor type. Negative values indicate stronger attraction (a reduced ungrammaticality penalty in plural-attractor conditions). Dashed line denotes zero (no effect).

344 3.5. Discussion

345 Experiment 2 tested whether the reason we did not find attraction effects in Experiment 1 was due to
 346 the lack of attraction-inducing conditions. Our results showed that attraction effects in verbal attractor
 347 condition, purely phonological overlap, did not surface even when there are robust attraction-inducing trials.
 348 Participants reliably rejected ungrammatical sentences with verbal attractors regardless of attractor number.

349 Our results and between experiment comparison showed that within-experiment statistics, i.e. exposure to
 350 verbal attraction conditions attraction items, did not substantially reduced the magnitude of the attraction
 351 effects. However, the overall acceptability in our nominal attractor elements were reduced compared to
 352 the trials from [Türk and Logačev \(2024\)](#). This is inline with previous findings that shows participants'
 353 judgments within the experiment are modulated by the distribution of trials. Interestingly, previous studies
 354 achieved this with instructions or filler elements ([Hammerly et al., 2019](#); [Arehalli and Wittenberg, 2021](#)).
 355 We show that the experimental conditions and the presence of an effect within a subset of conditions also
 356 plays a role in modulating overall acceptability.

357 4. General Discussion

358 In two high-powered speeded acceptability judgment experiments, we tested whether pure phonological
 359 overlap between agreement morphemes can elicit agreement attraction. Our goal was to evaluate previous
 360 accounts that attribute attraction to accidental or non-accidental syncretism between forms that can serve
 361 as agreement controllers. Turkish provides a useful test case because the plural suffix -lAr appears both
 362 on verbs and on nouns, but only nominal -lAr can control agreement. If phonological overlap alone can
 363 activate controller-relevant cues, then plural-marked verbs embedded in reduced relative clauses should
 364 induce attraction effects even though they cannot syntactically control agreement.

365 Across both experiments, we found that Turkish attraction is determined by being a potential controller
 366 rather than merely resembling one. Participants did not produce or endorse attraction errors in sentences
 367 containing verbal attractors, and this absence of attraction persisted even when the same participants showed
 368 robust attraction with nominal attractors in the same session.

369 These results indicate that attraction depends on abstract feature overlap with potential controllers, not
 370 on surface-form similarity. This pattern converges with prior results in English and Turkish that failed
 371 to find attraction for pseudoplural or phonologically plural forms ([Bock and Eberhard, 1993](#); [Haskell and](#)
 372 [MacDonald, 2003](#); [Nicol et al., 2016](#)), and stands in contrast to findings from Russian ([Slioussar, 2018](#)).

373 In [Slioussar \(2018\)](#), genitive-marked singular nouns that were homophonous with nominative plurals elicited
 374 greater attraction effects than their genitive-plural counterparts. This is striking because the relevant nouns

375 lacked a plural feature that could percolate or serve as a retrieval cue. The effect was therefore interpreted
376 as evidence that comprehenders can use phonological form to activate abstract agreement features. However,
377 it is important to note that the evidence for phonological attraction in Russian rests on a small empirical
378 base. The production and comprehension experiments in (Slioussar, 2018) included only 32 participants
379 each, and the attraction effects were derived from a small number of error trials (13 in production and 18
380 in comprehension). Given the low number of critical observations, such effects are vulnerable to sampling
381 variability and may not generalize beyond that dataset.

382 The high-powered Turkish results challenge that interpretation. Despite identical surface overlap between
383 verbal and nominal plural morphology, phonological similarity alone did not yield attraction. This cross-
384 linguistic contrast suggests that form-based activation of agreement features is not a universal property of
385 the parsing system but, at best, depends on language-specific mappings between morphology and syntactic
386 function (Dillon and Keshev, 2024).

387 A more plausible account is that attraction is modulated by the availability of morphosyntactic features
388 that can signal controllerhood. Syncretism contributes to attraction only when one of the syncretic forms can
389 legitimately control agreement or share features with the target. In other words, it is not form overlap per
390 se, but feature ambiguity that matters. This interpretation aligns with cross-linguistic findings showing that
391 attraction is strongest when the attractor bears case or number morphology that is sometimes associated
392 with subjects or agreement controllers (Lago et al., 2019; Bhatia and Dillon, 2022; Bleotu and Dillon, 2024;
393 Hartsuiker et al., 2003). Earlier formulations of these models left open whether ‘looking like’ a controller
394 or ‘being able to be’ a controller was critical. The present results favor the latter: only morphologically
395 licensed controllers engage in attraction.

396 References

- 397 Acheson, D.J., MacDonald, M.C., 2011. The rhymes that the reader perused confused the meaning: Phonological effects
398 during on-line sentence comprehension. *Journal of memory and language* 65, 193–207.
399 Arehalli, S., Wittenberg, E., 2021. Experimental filler design influences error correction rates in a word restoration paradigm.
400 *Linguistics Vanguard* 7, 20200052. URL: <https://doi.org/10.1515/lingvan-2020-0052>,
401 doi:<http://dx.doi.org/doi:10.1515/lingvan-2020-0052>.
402 Avetisyan, S., Lago, S., Vasishth, S., 2020. Does case marking affect agreement attraction in comprehension? *Journal of
403 Memory and Language* 112, 104087. doi:<http://dx.doi.org/10.1016/j.jml.2020.104087>.
404 Bhatia, S., Dillon, B., 2022. Processing agreement in hindi: When agreement feeds attraction. *Journal of Memory and
405 Language* 125, 104322.
406 Bleotu, A.C., Dillon, B., 2024. Romanian (subject-like) dps attract more than bare nouns: Evidence from speeded
407 continuations. *Journal of Memory and Language* 134, 104445.
408 Bock, K., Cutting, J.C., 1992. Regulating mental energy: Performance units in language production. *Journal of Memory and
409 Language* 31, 99–127. doi:[http://dx.doi.org/10.1016/0749-596X\(92\)90007-K](http://dx.doi.org/10.1016/0749-596X(92)90007-K).
410 Bock, K., Eberhard, K.M., 1993. Meaning, sound and syntax in English number agreement. *Language and Cognitive
411 Processes* 8, 57–99. doi:<http://dx.doi.org/10.1080/01690969308406949>.
412 Bock, K., Miller, C.A., 1991. Broken agreement. *Cognitive Psychology* 23, 45–93.
413 doi:[http://dx.doi.org/10.1016/0010-0285\(91\)90003-7](http://dx.doi.org/10.1016/0010-0285(91)90003-7).
414 Copeland, D.E., Radvansky, G.A., 2001. Phonological similarity in working memory. *Memory & Cognition* 29, 774–776.
415 doi:<http://dx.doi.org/10.3758/BF03200480>.
416 Dillon, B., Keshev, M., 2024. Syntactic dependency formation in sentence processing: A comparative perspective, in:
417 Barbiers, S., Corver, N., Polinsky, M. (Eds.), *The Cambridge Handbook of Comparative Syntax*. Cambridge University
418 Press, Cambridge, pp. 1031–1069.
419 Drummond, A., 2013. *Ibex farm*. <Https://spellout.net/ibexfarm>.
420 Eberhard, K.M., 1999. The accessibility of conceptual number to the processes of subject–verb agreement in English. *Journal
421 of Memory and Language* 41, 560–578. doi:<http://dx.doi.org/10.1006/jmla.1999.2662>.
422 Eberhard, K.M., Cutting, J.C., Bock, K., 2005. Making syntax of sense: Number agreement in sentence production.
423 *Psychological review* 112, 531–559. doi:<http://dx.doi.org/10.1037/0033-295X.112.3.531>.
424 Engelmann, F., J ger, L.A., Vasishth, S., 2019. The effect of prominence and cue association on retrieval processes: A
425 computational account. *Cognitive Science* 43, e12800.
426 Ferreira, F., Bailey, K.G., Ferraro, V., 2002. Good-enough representations in language comprehension. *Current directions in
427 psychological science* 11, 11–15.
428 Franck, J., Soare, G., Frauenfelder, U.H., Rizzi, L., 2010. Object interference in subject–verb agreement: The role of
429 intermediate traces of movement. *Journal of memory and language* 62, 166–182.

- 430 Hammerly, C., Staub, A., Dillon, B., 2019. The grammatical asymmetry in agreement attraction reflects response bias:
 431 Experimental and modeling evidence. *Cognitive Psychology* 110, 70–104.
 432 doi:<http://dx.doi.org/10.1016/j.cogpsych.2019.01.001>.
- 433 Hartsuiker, R.J., Antón-Méndez, I., Van Zee, M., 2001. Object attraction in subject–verb agreement construction. *Journal of
 434 Memory and Language* 45, 546–572. doi:<http://dx.doi.org/10.1006/jmla.2000.2787>.
- 435 Hartsuiker, R.J., Schriefers, H.J., Bock, K., Kikstra, G.M., 2003. Morphophonological influences on the construction of
 436 subject–verb agreement. *Memory & Cognition* 31, 1316–1326. doi:<http://dx.doi.org/10.3758/bf03195814>.
- 437 Haskell, T.R., MacDonald, M.C., 2003. Conflicting cues and competition in subject–verb agreement. *Journal of Memory and
 438 Language* 48, 760–778. doi:[http://dx.doi.org/10.1016/S0749-596X\(03\)00010-X](http://dx.doi.org/10.1016/S0749-596X(03)00010-X).
- 439 Humphreys, K.R., Bock, K., 2005. Notional number agreement in English. *Psychonomic Bulletin & Review* 12, 689–695.
 440 doi:<http://dx.doi.org/10.3758/BF03196759>.
- 441 Kaan, E., 2002. Investigating the effects of distance and number interference in processing subject–verb dependencies: An
 442 ERP study. *Journal of Psycholinguistic Research* 31, 165–193. doi:<http://dx.doi.org/10.1023/A:1014978917769>.
- 443 Kush, D., Johns, C.L., Van Dyke, J.A., 2015. Identifying the role of phonology in sentence-level reading. *Journal of memory
 444 and language* 79, 18–29.
- 445 Lago, S., Graçanin-Yuksek, M., Şafak, D.F., Demir, O., Kirkici, B., Felser, C., 2019. Straight from the horse's mouth:
 446 Agreement attraction effects with Turkish possessors. *Linguistic Approaches to Bilingualism* 9, 398–426.
 447 doi:<http://dx.doi.org/10.1075/lab.17019.lag>.
- 448 Lago, S., Shalom, D.E., Sigman, M., Lau, E.F., Phillips, C., 2015. Agreement attraction in Spanish comprehension. *Journal
 449 of Memory and Language* 82, 133–149. doi:<http://dx.doi.org/10.1016/j.jml.2015.02.002>.
- 450 Lau, E., Rozanova, K., Phillips, C., 2007. Syntactic prediction and lexical surface frequency effects in sentence processing.
 451 University of Maryland Working Papers in Linguistics 16, 163–200.
- 452 Laurinavichyute, A., von der Malsburg, T., 2024. Agreement attraction in grammatical sentences and the role of the task.
 453 *Journal of Memory and Language* 137, 104525. URL:
<https://www.sciencedirect.com/science/article/pii/S0749596X24000287>,
 454 doi:<http://dx.doi.org/https://doi.org/10.1016/j.jml.2024.104525>.
- 455 Lewis, R.L., Vasishth, S., 2005. An activation-based model of sentence processing as skilled memory retrieval. *Cognitive
 456 Science* 29, 375–419.
- 457 Logačev, P., Vasishth, S., 2016. A multiple-channel model of task-dependent ambiguity resolution in sentence comprehension.
 458 *Cognitive Science* 40, 266–298.
- 459 Nicol, J.L., Barss, A., Barker, J.E., 2016. Minimal interference from possessor phrases in the production of subject–verb
 460 agreement. *Frontiers in Psychology* 7, 1–12. doi:<http://dx.doi.org/10.3389/fpsyg.2016.00548>.
- 461 Nicol, J.L., Forster, K., Veres, C., 1997. Subject–verb agreement processes in comprehension. *Journal of Memory and
 462 Language* 36, 569–587. doi:<http://dx.doi.org/10.1006/jmla.1996.2497>.
- 463 Pearlmuter, N.J., 2000. Linear versus hierarchical agreement feature processing in comprehension. *Journal of
 464 Psycholinguistic Research* 29, 89–98. doi:<http://dx.doi.org/10.1023/A:1005128624716>.
- 465 Pearlmuter, N.J., Garnsey, S.M., Bock, K., 1999. Agreement processes in sentence comprehension. *Journal of Memory and
 466 Language* 41, 427–456. doi:<http://dx.doi.org/10.1006/jmla.1999.2653>.
- 467 Rastle, K., Davis, M.H., 2008. Morphological decomposition based on the analysis of orthography. *Language and Cognitive
 468 Processes* 23, 942–971. doi:<http://dx.doi.org/10.1080/01690960802069730>.
- 469 Ryskin, R., Bergen, L., Gibson, E., 2021. Agreement errors are predicted by rational inference in sentence processing.
 470 Preprint available at OSF: <https://osf.io/uaxsq/>.
- 471 Schlueter, Z., Williams, A., Lau, E., 2018. Exploring the abstractness of number retrieval cues in the computation of
 472 subject–verb agreement in comprehension. *Journal of Memory and Language* 99, 74–89.
- 473 Siewierska, A., 2013. Verbal person marking (v2020.4), in: Dryer, M.S., Haspelmath, M. (Eds.), *The World Atlas of
 474 Language Structures Online*. Zenodo. URL: <https://doi.org/10.5281/zenodo.13950591>,
 475 doi:<http://dx.doi.org/10.5281/zenodo.13950591>.
- 476 Slioussar, N., 2018. Forms and features: The role of syncretism in number agreement attraction. *Journal of Memory and
 477 Language* 101, 51–63. doi:<http://dx.doi.org/10.1016/j.jml.2018.03.006>.
- 478 Smith, G., Vasishth, S., 2020. A principled approach to feature selection in models of sentence processing. *Cognitive Science*
 479 44, e12918.
- 480 Speer, S.R., Clifton, C., 1998. Plausibility and argument structure in sentence comprehension. *Memory & cognition* 26,
 481 965–978.
- 482 Tucker, M.A., Idrissi, A., Almeida, D., 2015. Representing number in the real-time processing of agreement: Self-paced
 483 reading evidence from Arabic. *Frontiers in Psychology* 6, 1–21. doi:<http://dx.doi.org/10.3389/fpsyg.2015.00347>.
- 484 Türk, U., 2022. Agreement attraction in Turkish. Ph.D. thesis. Bogaziçi University. İstanbul, Turkey.
- 485 Türk, U., Logačev, P., 2024. Agreement attraction in turkish: The case of genitive attractors. *Language, Cognition and
 486 Neuroscience* 39, 448–454.
- 487 Ulusoy, E., 2023. Connectivity and case effects in agreement attraction: The case of turkish.
- 488 Vigliocco, G., Butterworth, B., Semenza, C., 1995. Constructing subject–verb agreement in speech: The role of semantic and
 489 morphological factors. *Journal of Memory and Language* 34, 186–215. doi:<http://dx.doi.org/10.1006/jmla.1995.1009>.
- 490 Wagers, M.W., Lau, E.F., Phillips, C., 2009. Agreement attraction in comprehension: Representations and processes. *Journal
 491 of Memory and Language* 61, 206–237. doi:<http://dx.doi.org/10.1016/j.jml.2009.04.002>.