# Sensitivity to surface-level heuristics: A case from Turkish agreement attraction

## Within-experiment statistics in agreement attraction

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**Abstract**

Surface level does not affect it, but within-experiment statistics effect the findings.

*Keywords:* form-sensitivity, memory, agreement attraction

## 1. Introduction

Sentence processing is shaped not only by grammatical constraints but also by plausibility, frequency, and task-specific factors. Recent work shows that such influences can substantially modulate reading and judgment behavior (r (Laurinavichyute and von der Malsburg, 2024; Arehalli and Wittenberg, 2021; Hammerly et al., 2019; Logačev and Vasishth, 2016)). One domain where these effects are especially informative is *agreement attraction*, cases in which a verb erroneously agrees with a nearby noun rather than its grammatical subject, producing so-called grammaticality illusions (Bock & Miller, 1991; Pearlmutter, Garnsey, & Bock, 1999).

(1) * The key to the cabinets are rusty.

Agreement errors in sentences like (1) have been treated either as a failure of feature reconcilation or a failure of memory encoding. The former set of accounts explain these errors as a by-product of how number feature of a phrase is calculated in real-time (Bock and Miller, 1991; Eberhard et al., 2005; Hammerly et al., 2019). For example, Eberhard et al. (2005) argue that depending on conceptual number, morphophonological number marking, or syntactic dependencies within a phrase, speakers assign a probabilistic number value to phrases. The errors arise when additional plurality features from different sources end up contributing to the final number representation of a phrase. On the other hand, the latter set of accounts claim that the initial representation is not erroneous, but speakers are sometimes unable to correctly retrieve the controller

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(Wagers et al., 2009; Dillon et al., 2013). For example, Wagers et al. (2009) argue that the parser normally check the agreement relation by retrieving the relevant chunk in memory using the retrieval cues provided by the agreement probe. In sentences like (1), speakers occasionally retrieve the incorrect element due to the fact that neither nouns fully match the relevant cues.

Recent studies have asked whether the form of the attractor, its morphophonology or phonology, plays a role in attraction, above and beyond its abstract features. Several experiments have manipulated morphological case similarity between subjects and attractors, reasoning that syncretism or surface ambiguity could enhance competition during retrieval. For instance, German determiner–noun phrases that are ambiguous between nominative and accusative produce more agreement errors than unambiguous ones (Hartsuiker et al., 2003). In Russian, case syncretism between nominative plural and genitive singular forms (e.g., kraski/kraska) increases attraction errors and speeds ungrammatical verbs (Slioussar, 2018). However, these findings are not clear.

A separate line of work has tested purely phonological or orthographic overlap, showing that words that sound or look like plural forms can bias processing, though the evidence is mixed. Some studies report increased interference when attractors share plural-like endings or sound shapes (Haskell and MacDonald, 2003; Brehm et al., 2020), while others find no such effect when frequency and morphology are controlled (Bock and Eberhard, 1993). Overall, results remain inconsistent: surface overlap sometimes amplifies attraction but cannot reliably produce it without matching syntactic features.

In this paper, we test an unexplored question using Turkish, a language where verbal and nominal plural marking share the same surface form, the suffix –lAr. Unlike in languages where attraction and case syncretism involve ambiguity between morphosyntactic categories (e.g., nominative vs. accusative), Turkish allows us to isolate pure form overlap: both verbs and nouns carry –lAr, but only nominal plural introduces a number feature that can serve as an agreement controller. Verbal –lAr realizes agreement morphology, not an attracting feature. Thus, Turkish provides a rare opportunity to ask whether form-based overlap alone—in the absence of matching syntactic features—can produce attraction effects.

We use reduced relative clause (RRC) structures, in which the verb itself can appear as the attractor. This allows us to manipulate verbal vs. nominal plural morphology while holding other syntactic factors constant. Importantly, Turkish –lAr syncretism here is not feature-ambiguous (as in case syncretism); it is a form-only overlap that does not share case or argument status with the subject, but only number morphology. The key question is whether such form-based overlap is sufficient to trigger attraction-like acceptability increases for ungrammatical sentences.

To test this, we conducted two high powered speeded acceptability judgment experiments. Experiment 1 tested the form hypothesis directly by comparing un-

grammatical sentences with verbal-plural vs. verbal-singular attractors. Experiment 2 replicated this design but included additional nominal-attractor items from a previous Turkish attraction study (Türk and Logačev, 2024), allowing us to test whether the distribution of item types—and the presence of genuine attraction-inducing elements—modulates the outcome.

Across both experiments, we found no evidence that verbal –lAr induces attraction, even when canonical nominal attractors are present in the same session. This pattern aligns with prior findings that Turkish attraction is insensitive to morphological syncretism (Türk and Logačev, 2024) and suggests that surface-form overlap alone does not drive agreement illusions. Rather, Turkish attraction appears to depend on abstract feature overlap between potential controllers and agreement probes.

### *1.1. Form-related strategies*

Form-based overlap between elements in a sentence can influence how agreement dependencies are processed. A substantial body of work has shown that the parser and the production system are sensitive not only to syntactic or semantic relations but also to the surface form of words. Phonological and morphological similarities can bias memory retrieval or lead to partial feature activation. These effects have been taken to suggest that, under certain circumstances, speakers and comprehenders rely on shallow or heuristic cues to complete dependencies.

One line of research has examined whether purely phonological similarity between singular and plural forms can induce agreement attraction. Bock and Eberhard (1993) tested whether attractors that only sound plural, pseudoplurals such as *course*, increase agreement errors compared to true plural nouns. They reasoned that if participants rely on phonological cues rather than abstract features, words ending with plural-like sounds (/s/ or /z/) should behave like true plurals. Participants completed sentence preambles such as (2), where the head noun (*player*) was singular but the attractor varied in form.

(2) a. Pseudoplural Attractor
The player on the course …

b. Singular Attractor
The player on the court …

c. Plural Attractor
The player on the courts …

They found that pseudoplural attractors did not increase plural agreement rates. Later studies, however, provided evidence that overt morphological marking can enhance interference. Haskell and MacDonald (2003) reported that attractors with regular plural morphology were more likely to elicit plural verbs than irregular plurals, particularly when the head was collective. Brehm, Hussey, and Christianson (2020) extended this to comprehension: attractors

with plural-like endings facilitated processing in ungrammatical sentences, yielding faster reading times at the verb region. Related work in short-term memory and word recognition shows similar effects—items that overlap phonologically or morphologically are more confusable and more easily retrieved (Copeland & Radvansky, 2001; Rastle & Davis, 2008). Together, these findings indicate that phonological and morphological overlap can modulate interference during agreement computation by increasing the accessibility of plural-like representations, even when structural cues remain intact.

A different set of findings comes from research on case syncretism, which has been shown to affect how comprehenders interpret grammatical relations. In languages such as Japanese and Russian, sentences are processed more easily when case marking clearly distinguishes syntactic roles, whereas ambiguity arising from syncretic or overlapping markers slows comprehension and reduces accuracy (Yamashita, 1997; Kim, 1999; Logačev & Vasishth, 2012; Babyonyshev & Gibson, 1999). Fedorenko, Babyonyshev, and Gibson (2004), for example, found that Russian readers showed longer reading times when two noun phrases shared the same case ending, suggesting that overlapping case forms make it harder to maintain distinct syntactic representations.

The same pattern extends to agreement attraction, where syncretism can increase competition between a true controller and a distractor. In German, Hartsuiker et al. (2003) used the overlap between accusative and nominative determiners and compared these ambiguous forms to distinctively marked dative forms. Participants produced more agreement errors when the preambles contained two noun phrases whose determiners were not distinctively marked, as in (3a), compared to cases where the attractor could be distinguished by form alone, as in (3b). Crucially, this effect was limited to feminine nouns, the only gender showing nominative–accusative syncretism in plural forms.

(3) a. Die Stellungnahme gegen die
the.F.NOM.SG position against the.F.ACC.PL
Demonstration-en
demonstration-PL
'The position against the demonstrations'

b. Die Stellungnahme zu den Demonstration-en
the.F.NOM.SG position on the.F.DAT.PL demonstration-PL
'The position on the demonstrations'

When the determiner *die* can mark both nominative and accusative, the attractor becomes more easily confused with the subject, resulting in attraction. When the dative determiner *den* unambiguously marks case, the likelihood of an error decreases. This finding shows that morphological ambiguity at the level of form can increase interference even without structural ambiguity.

Even stronger evidence that surface-form similarity can override abstract features comes from Russian. Slioussar (2018) examined sentences in which

the attractor was genitive singular—a form homophonous with the nominative plural—and compared them to unambiguous genitive plurals. Across production, judgment, and reading studies, participants made more agreement errors and read ungrammatical verbs faster when the attractor was genitive singular, that is, grammatically singular but formally plural-like.

(4) a. Korobka dlya kraski byla/*byli
box.F.SG.NOM for paint.GEN.SG$_{=\text{NOM.PL}}$ be.PST.F.SG/*be.PST.F.PL
…

'A box for the paint(s) was/*were …'

b. Korobka dlya krasok byla/*byli
box.F.SG.NOM for paint.GEN.PL$_{\neq\text{NOM.PL}}$ be.PST.F.SG/*be.PST.F.PL
…

'A box for the paint(s) was/*were …'

The attractor in (4a) is syntactically singular, yet it increases the likelihood of plural agreement. The effect therefore cannot be attributed to genuine feature overlap. Slioussar argued that participants sometimes rely on surface-level cues that are easier to access than abstract morphosyntactic features, producing attraction patterns driven by form rather than by structure.

Across languages, phonological and morphological overlap can strengthen interference between nouns and verbs, though these effects are highly dependent on language-specific morphology and structural context. Turkish provides a particularly clear test case: its plural morpheme *-lAr* occurs both on nouns and verbs, creating surface-form overlap without shared number features. The Turkish experiments below use this property to test whether form-based overlap alone can elicit attraction.

### *1.2. Attraction Accounts*

Two main accounts have been proposed to explain agreement attraction effects: the Marking and Morphing model and the cue-based retrieval model. Both frameworks aim to capture why a plural attractor can interfere with the computation of agreement, but they differ in where the interference arises and in how they represent linguistic features.

Under Marking and Morphing (Bock and Eberhard, 1993; Eberhard et al., 2005), attraction results from spreading activation among number features during agreement encoding. The plural feature of a nearby noun can transiently activate the plural feature on the subject node, making a singular subject temporarily appear plural. The strength of this spreading activation decreases with syntactic distance, predicting stronger interference from local attractors. Because this account ties attraction to the activation of morphological features, it

could in principle accommodate effects of surface-form similarity. Morphological or phonological overlap between elements might increase activation strength or delay decay, thereby amplifying interference. However, the model does not include a mechanism for distinguishing between morphophonological and abstract feature overlap, and it provides no role for case information or other morphosyntactic cues beyond number. It also has difficulty explaining attraction from attractors that lie outside the subject phrase.

In contrast, cue-based retrieval accounts (e.g., Wagers et al., 2009; Dillon et al., 2013) locate attraction at the stage of memory retrieval, when the parser or production system attempts to recover the controller of agreement. Retrieval is guided by a set of cues such as number, case, and syntactic position. Interference arises when a non-controller partially matches these cues and is incorrectly retrieved. In this framework, surface-form overlap affects processing only if it contributes to cue overlap. For example, plural morphology or phonological endings could influence retrieval if the system treats them as diagnostic of plural number. Because the model allows cues to be weighted differently depending on their reliability, it naturally accounts for cross-linguistic variability in the role of case marking and other morphosyntactic features.

The two frameworks therefore make different predictions for the influence of surface similarity. Marking and Morphing could predict form-based attraction if overlapping phonological or morphological representations share activation nodes, whereas cue-based retrieval predicts form effects only when they are encoded as retrieval cues. Empirical results from languages with rich morphology support the latter view. Studies in English have shown limited effects of pseudoplurals and orthographic similarity, and cross-linguistic work in languages such as German, Russian, and Turkish indicates that agreement attraction depends on morphosyntactic feature overlap rather than on phonological form. In particular, Turkish provides a critical test case: the nominal and verbal plural morphemes are identical in form but differ in feature content, yet only nominal plural markers trigger attraction. This pattern is consistent with a feature-based account and suggests that surface-form similarity alone does not drive agreement attraction.

### *1.3. Turkish morpho-syntactic background*

Turkish provides a unique testing ground for distinguishing form-based and feature-based agreement processes because the same plural morpheme *-lAr* is used on both nouns and verbs. The morpheme marks plurality on nouns and third-person plural agreement on verbs, as shown in (5). Plural marking on the verb is optional when the plural subject is overt but obligatory when the subject is dropped. Singular subjects cannot co-occur with plural verbs.

(5) a. Çocuk-lar okul-a git-ti-ler.
child-PL school-DAT go-PST-PL
'The children went to school.'

b. * Çocuk okul-a git-ti-ler.
child school-DAT go-PST-PL
Intended: 'The child went to school.'

This surface identity between nominal and verbal *-lAr* allows a direct test of whether agreement attraction effects in Turkish depend on the *form* of the morpheme or its *syntactic feature*.

Turkish also allows *reduced relative clauses* (RRCs), where the relative clause consists only of a nominalized verb. The nominalizer *-dIK* bears agreement features and can co-occur with plural *-lAr*. In (6), the RRC verb functions as the modifier of the head noun, and the same *-lAr* morpheme appears on the embedded verb.

(6) a. [Tut-tuğ-u aşçı] mutfak-ta çalış-ıyor.
hire-NMLZ-POSS cook kitchen-LOC work-PROG
'The cook that (he) hired is working in the kitchen.'

b. [Tut-tuk-lar-ı aşçı] mutfak-ta çalış-ıyor.
hire-NMLZ-PL-POSS cook kitchen-LOC work-PROG
'The cook that they hired is working in the kitchen.'

Because RRCs are nominalized, they can also serve as *potential subjects* in a clause. The nominalized verb phrase heads a DP and can occupy subject position without an overt head noun, as in (7).

(7) [Gel-diğ-i] belli-değil.
come-NMLZ-POSS clear-NEG
'It is not clear that (he) came.'

[Git-tik-ler-i] duy-ul-du.
go-NMLZ-PL-POSS hear-PASS-PST
'It was heard that they went.'

These morphological and syntactic properties make Turkish suitable for contrasting nominal and verbal *-lAr*. In Experiments 1 and 2, the *-lAr* morpheme on reduced relative clause verbs served as a verbal attractor, while *-lAr* on nouns provided nominal attractors. This design tests whether agreement attraction in Turkish is driven by surface-form similarity or by abstract agreement features.

*1.3.1. Previous findings in Turkish attraction.*

Previous research in Turkish has shown that participants do similar errors in agreement attraction comprehension (Lago et al., 2019; Türk and Logačev, 2024; Ulusoy, 2023). Lago et al. (2019) demonstrated agreement attraction effects using genitive-possessive contructions in a speeded acceptability judgment.

Their sentences included a complex subjects 'milyonerlerin terzisi' (millionaires' tailor) similar to English saxon-genitives as in (8).

(8) * Milyoner-ler-in öğretmen-i mutfak-ta sürekli zıpla-dı-lar.
millionaire-PL-GEN fix-POSS kitchen-LOC non.stop jump-PST-PL
'Millionaires' fix jumped$_{pl}$ in the kitchen non-stop.'

Türk and Logačev (2024) showed that this effect survives even when the confounding form-ambiguity on the heads 'öğretmen-i' is resolved. The -i marking in Turkish is ambiguous between possessive and accusative case, and the accusative case cannot control agreement in Turkish. They conclude that Turkish speakers do not utilize the form-related features in processing. However, Ulusoy (2023) (Experiment 3) found that attraction effects disappeared when the case marking on the attractor, not the head as in Türk and Logačev (2024), is manipulated. In a series of experiments, they showed a nominative marked plural constituent (9a) can increase acceptability of ungrammatical sentences and decrease the reading difficulty compared to its singular constituent, however a similar effect does not arise with dative marked constituents (9b).

(9) a. * Kütüphaneci(-ler) çalışkan öğrenci-nin
librarian(-PL) hardworking student.SG-GEN
iste-dik-ler-i kitab-ı şimdi bul-du-lar.
want-NMLZ-PL-POSS book-ACC now find-PST-PL
'The instructors caught the child who the girl carelessly pushed.'

b. * Kütüphaneci(-ler)-e çalışkan öğrenci-nin
librarian-PL-DAT hardworking student.SG-GEN
iste-dik-ler-i kitap dün ver-il-di
want-NMLZ-PL-POSS book yesterday give-PASS-PST.
'The instructor caught the child who the girl carelessly pushed.'

Given that

- However, no work has directly tested whether verbal plural morphology can induce similar illusions, or how mixing different attractor types within an experiment affects the magnitude of attraction.

Turkish provides an especially informative case because both nominal and verbal plural markers are realized with the same morpheme, –lAr, yet only nominal plurals bear the syntactic features required for agreement. This allows us to ask whether participants rely on surface-form similarity or on abstract feature representations when evaluating agreement.

- Morphological properties
- Turkish marks number on both nouns and verbs using the identical plural morpheme –lAr.

- Only nominal plurals introduce number features that can agree with the verb; verbal –lAr expresses verbal agreement but is not a potential controller.
- Because of this homophony, Turkish allows form-overlap and feature-mismatch to be disentangled experimentally.

In our first experiment, we test whether plural marking on a verbal distractor—which is morphologically identical but syntactically irrelevant—can elicit attraction. In the second experiment, we combine these verbal distractor conditions with standard nominal attractor conditions to assess how their co-occurrence affects participants' judgments. If attraction effects reflect flexible, context-sensitive processing, the inclusion of verbal distractors should dilute or eliminate the illusion typically observed with nominal attractors.

Together, these experiments extend previous findings on agreement attraction and task sensitivity in two key ways. First, they show that surface-level overlap—even when morphologically identical—does not by itself produce agreement attraction, indicating that participants rely on abstract morphosyntactic features rather than phonological forms. Second, they reveal that participants are not only influenced by the global structure of an experiment (such as the proportion of fillers or grammatical items) but also by the presence of other condition types within the same task. In other words, attraction effects are attenuated when competing, non-attracting conditions are included, suggesting that agreement processing is dynamically tuned to the statistical context of the experiment itself.

### *1.4. Experimental logic and predictions*

- Goal 1: test whether purely form-based overlap (verbal –lAr) elicits attraction.
- Prediction: if attraction is driven by form, verbal plural distractors should yield higher "acceptable" rates for ungrammatical plurals.
- Alternative: if attraction depends on abstract features, no effect of verbal –lAr should appear.
- Goal 2: test whether the co-occurrence of different attractor types modulates attraction.
- Prediction: if participants adapt to the distribution of conditions, adding verbal distractors (which share the plural form but lack agreement features) should attenuate or eliminate the nominal-attractor illusion.
- Summary: These experiments jointly test whether agreement attraction in Turkish reflects shallow form matching or feature-based computation that is sensitive to the statistical context of the task.

## 2. Experiment 1: Testing Form-Driven Processing

### *2.1. Participants*

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

### *2.2. Materials*

We used 40 sets of sentences like (10), in which we manipulated (i) the number of the attractor and (ii) the number agreement on the verb. Both plural markings were marked with the suffix -ler/-lar, while the singular number and singular agreement were marked by its absence.

(10) a. Tut-tuğ-u aşçı mutfak-ta sürekli zıpla-dı.
hire-NMLZ-POSS cook[NOM] kitchen-LOC non.stop jump-PST
'The cook they hired$_{sg}$ jumped$_{sg}$ in the kitchen non-stop.'

b. * Tut-tuğ-u aşçı mutfak-ta sürekli zıpla-dı-lar.
hire-NMLZ-POSS cook[NOM] kitchen-LOC non.stop jump-PST-PL
'The cook they hired$_{sg}$ jumped$_{pl}$ in the kitchen non-stop.'

c. Tut-tuk-lar-ı aşçı mutfak-ta sürekli zıpla-dı.
hire-NMLZ-PL-POSS cook[NOM] kitchen-LOC non.stop jump-PST
'The cook they hired$_{pl}$ jumped$_{sg}$ in the kitchen non-stop.'

d. * Tut-tuk-lar-ı aşçı mutfak-ta sürekli
hire-NMLZ-PL-POSS cook[NOM] kitchen-LOC non.stop
zıpla-dı-lar.
jump-PST-PL
'The cook they hired$_{pl}$ jumped$_{pl}$ in the kitchen non-stop.'

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

### *2.3. Procedures*

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

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

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

### *2.4. Analysis and Results*

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

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

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

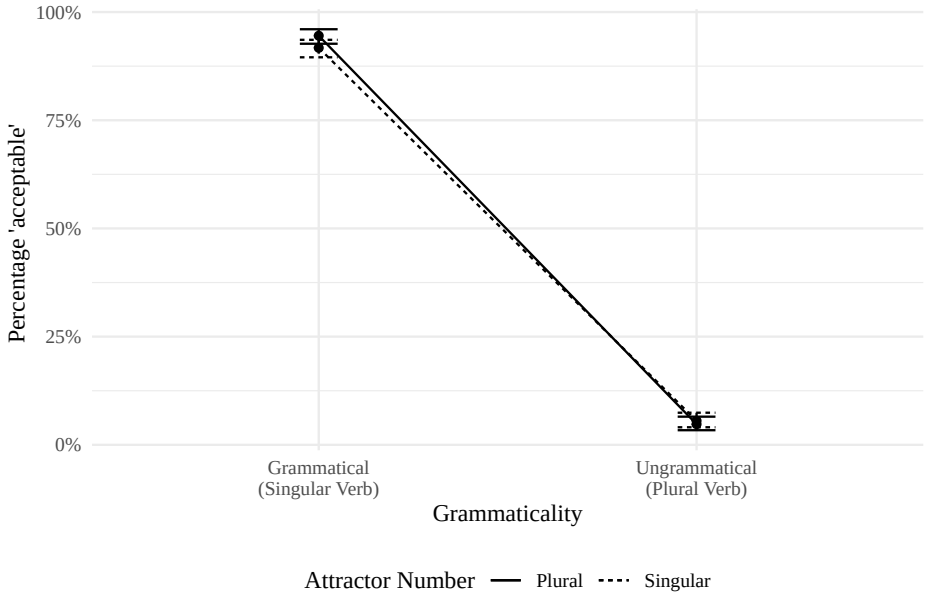


Figure 1: Mean proportion of 'acceptable' responses by grammaticality and attractor number. Error bars show 95% Clopper–Pearson confidence intervals.

These descriptive trends were confirmed by our Bayesian mixed-effects models implemented in brms, assuming a Bernoulli logit link. The model was fitted to the binary *yes/no* responses and included fixed effects for Grammaticality and Attractor Number and their interaction, and random intercepts and slopes for both subjects and items.

Posterior estimates are summarized in Figure 2. The model revealed a positive effect of grammaticality ($\beta$ = 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], P($\beta > 0.81$)). On the other hand, there was a small but positive interaction ($\beta$ = 0.66 [-0.02, 1.38], P($\beta > 0.97$)). To clarify the effects' presence in grammaticals only, we fitted two more models that is fitted to the subset of the data. While the model fitted to grammatical conditions only showed an effect of attractor number ($\beta$ = 0.51 [0.06, 1.00], P($\beta > 0.99$)), the model fitted to ungrammatical conditions did not provide evidence for the effect of number manipulation ($\beta$ = -0.05 [-0.45, 0.37], P($\beta > 0.99$)). These results suggest that the presence of a plural attractor did not increase the acceptability of ungrammatical sentences, nor was this relationship modulated by grammaticality.

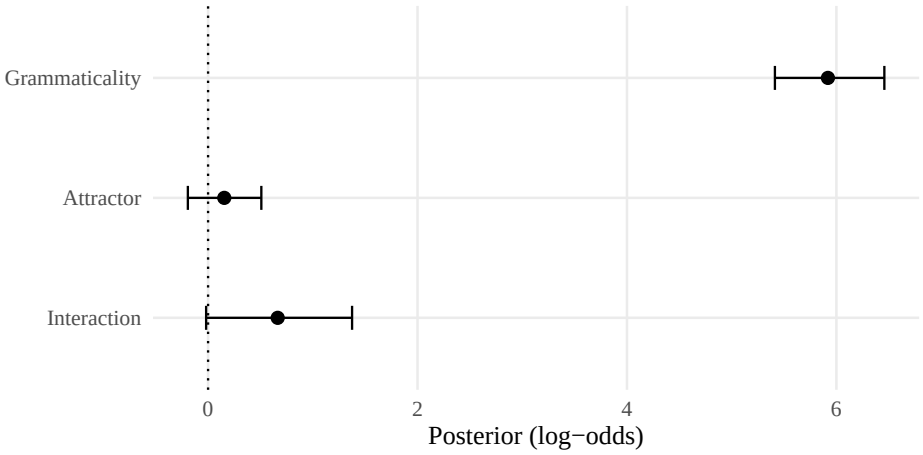


Figure 2: Posterior means and 95% credible intervals for fixed effects in the two Bayesian models. The x-axis shows the posterior mean (log-odds scale). The blue intervals correspond to the model in which a positive interaction was assumed, and the orange intervals to the model in which it was not.

### *2.5. Discussion*

- No attraction effect
- There is an unexpected effect, which is might be due to interaction between the plausability and the availability of a referent. While the plural morpheme can give a general reading, the singular RC probably requires an overt referent. It is outside of the scope of this paper.

However, both group of accounts generally are underspecified in terms of how meta-linguistic information should be integrated to the inter-sentential dependency mechanisms. Recently, a growing literature have been testing how different types of additional sources that are independent of the linguistic information affects these errors. Recent experiments show that even small changes in task expectations can alter attraction patterns. For example, Laurinavichyute and von der Malsburg (2024) found that varying the practice structure and task demands (reading vs. judgment) affected reading times at the verb in sentences as in (11). In a series of high-powered self-paced reading tasks, they found that when participants answered a comprehension question after each trial, reading times at the verb 'admires' did not differ between (11a) and (11b). However, when participants were asked to judge grammaticality instead, they spent more time reading the verb 'admires' in (11b), suggesting that processing mechanisms can change depending on the expected task.

(11) a. The singer that the actor openly admires apparently received broad international recognition.

b. The singers that the actor openly admires apparently received broad international recognition.

A related set of findings came from Hammerly et al. (2019). They challenge long-standing assumption that the agreement errors only surfaced in ungrammatical sentences such as (1), but not in grammatical sentences as in (12). It has been repeatedly shown that a plural noun increased participants' likelihood to erroneously judge ungrammatical sentences as grammatical; however, participants rarely misidentified grammatical sentences as ungrammatical even when there is an attractor. Hammerly et al. (2019) showed that similar effect surfaced in grammatical sentences when participants' a priori expectations about the experiment is altered. They manipulated the instructions and the number of ungrammatical in an experiment so that participants expected to see more ungrammatical sentences than grammatical sentences. With reduced bias towards grammaticality, they found that the presence of a plural nearby noun affected how speakers completed ungrammatical sentences (1) and grammatical sentences (12) [see TURK2022 for acceptability].

(12) The key to the cabinets is rusty.

## 3. Experiment 2: Testing Within-Experiment Statistical Sensitivity

```
                  response_yes
exp_condition     FALSE TRUE
  condition_gen_a   411   54
  condition_gen_b    61  404
  condition_gen_c   444   22
  condition_gen_d    45  424
  condition_rc_a    450   22
  condition_rc_b     29  440
  condition_rc_c    450   22
  condition_rc_d     29  433
  filler_g           96 1723
  filler_ung       1750  113
  practice          369  435
[1] "number of bad subjects: 3.000000"
```

### *3.1. Participants*

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

### *3.2. Materials*

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

### *3.3. Procedures*

The same procedure with Experiment 1 was used.

### *3.4. Analysis and Results*

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

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

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

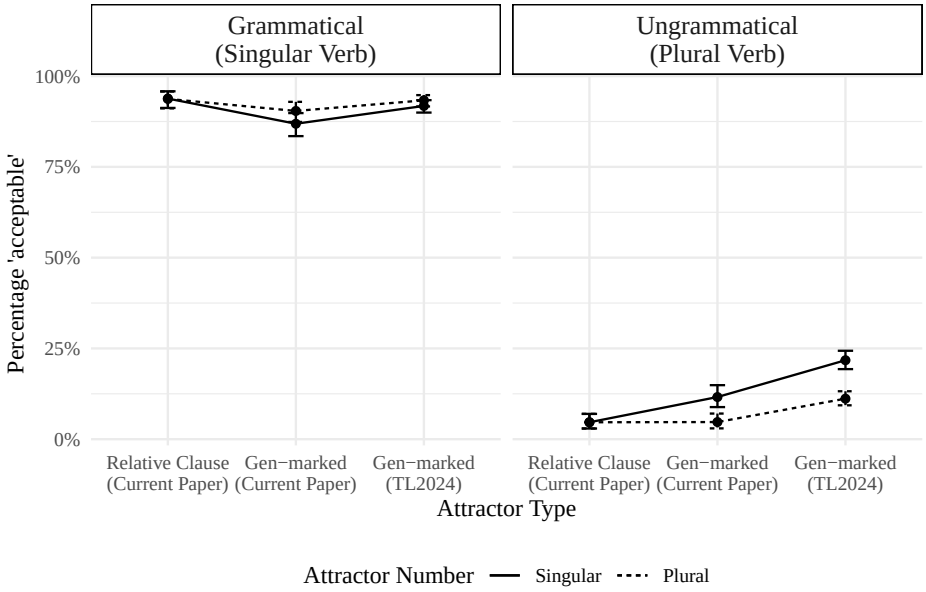


Figure 3: Mean proportion of 'acceptable' responses by grammaticality, attractor number and attractor type. Error bars show 95% Clopper–Pearson confidence intervals.

Our models also showed similar results, assuming a Bernoulli logit link. The model was fitted to the binary *yes/no* responses and included fixed effects for Grammaticality, Attractor Number, and Attractor Type and their interaction, along with random intercepts and slopes for both subjects and items. Since our

main question was whether within-experiment statistics affect the grammaticality magnitudes, we fitted another model with genitive marked nominals from data from our experiment and Türk and Logačev (2024).

Talk about the important points. not all of them. attraction effect existed. and it also manipulated as a three way which tells us that participant only did in a single type.

as for our second model, we present the illusion estimate as a function of experiment. Attraction:Current, Attraction:TL24

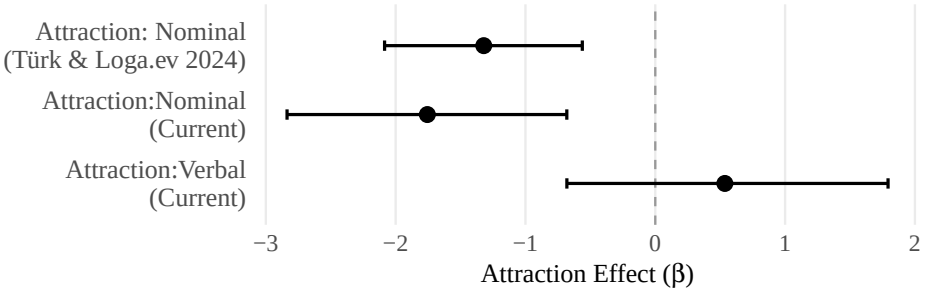


Figure 4: Posterior means and 95% credible intervals for fixed effects in the two Bayesian models. The x-axis shows the posterior mean (log-odds scale). The blue intervals correspond to the model in which a positive interaction was assumed, and the orange intervals to the model in which it was not.

### *3.5. Discussion*

- Goal: test whether attraction changes when both attractor types occur in one experiment.
- Participants: 95 Turkish speakers.
- Design: 2 × 2 × 2 (Grammaticality × Attractor Number × Attractor Type [nominal vs verbal]).
- Procedure & analysis: same as Experiment 1.
- Results:
  - Attraction replicated for nominal attractors (Δ  0.07).
  - Verbal attractors again showed null effect.
  - Global decline in yes-responses relative to earlier studies → participants became more conservative.
- Discussion:
  - Exposure to verbal conditions reduced attraction magnitude overall.
  - Indicates participants adapt to statistical properties of the task.
  - Aligns with learning-based cue-weighting accounts (Haskell et al. 2010).

## 4. General Discussion

- Synthesis:

  - No evidence for surface-form matching; effects are feature-based.
  - Attraction magnitude changes with condition distribution → adaptive tuning.
- Interpretation:
  - Supports an adaptive parser sensitive to within-experiment statistics.
  - Challenges "shallow" or "good-enough" accounts that attribute attraction to phonological overlap.
- Broader implication:
  - Agreement processing is flexible and probabilistic; illusions arise from learned cue validity.
- Limitations:
  - Syntactic depth asymmetry (verbal attractors more embedded).
  - Need future designs equating structure (e.g., embedded-object attractors).
- Conclusion:
  - Turkish attraction effects arise from abstract feature retrieval not surface level shallow form-matching.
  - The evaluation of abstract features are modulated by distributional learning within the experiment.

## References


Arehalli, S., Wittenberg, E., 2021. Experimental filler design influences error correction rates in a word restoration paradigm. Linguistics Vanguard 7, 20200052. URL: https://doi.org/10.1515/lingvan-2020-0052, doi:http://dx.doi.org/doi:10.1515/lingvan-2020-0052.

Bock, K., Eberhard, K.M., 1993. Meaning, sound and syntax in English number agreement. Language and Cognitive Processes 8, 57–99. doi:http://dx.doi.org/10.1080/01690969308406949.

Bock, K., Miller, C.A., 1991. Broken agreement. Cognitive Psychology 23, 45–93. doi:http://dx.doi.org/10.1016/0010-0285(91)90003-7.

Brehm, L., Hussey, E., Christianson, K., 2020. The role of word frequency and morpho-orthography in agreement processing. Language, Cognition and Neuroscience 35, 58–77. doi:http://dx.doi.org/10.1080/23273798.2019.1631456.

Dillon, B., Mishler, A., Sloggett, S., Phillips, C., 2013. Contrasting intrusion profiles for agreement and anaphora: Experimental and modeling evidence. Journal of Memory and Language 69, 85–103. doi:http://dx.doi.org/10.1016/j.jml.2013.04.003.

Drummond, A., 2013. *Ibex farm*. Https://spellout.net/ibexfarm.

Eberhard, K.M., Cutting, J.C., Bock, K., 2005. Making syntax of sense: Number agreement in sentence production. Psychological review 112, 531–559. doi:http://dx.doi.org/10.1037/0033-295X.112.3.531.

Hammerly, C., Staub, A., Dillon, B., 2019. The grammaticality asymmetry in agreement attraction reflects response bias: Experimental and modeling evidence. Cognitive Psychology 110, 70–104. doi:http://dx.doi.org/10.1016/j.cogpsych.2019.01.001.

Hartsuiker, R.J., Schriefers, H.J., Bock, K., Kikstra, G.M., 2003. Morphophonological influences on the construction of subject–verb agreement. Memory & Cognition 31, 1316–1326. doi:http://dx.doi.org/10.3758/bf03195814.

Haskell, T.R., MacDonald, M.C., 2003. Conflicting cues and competition in subject–verb agreement. Journal of Memory and Language 48, 760–778. doi:http://dx.doi.org/10.1016/S0749-596X(03)00010-X.

Lago, S., Gračanin-Yuksek, M., Şafak, D.F., Demir, O., Kırkıcı, B., Felser, C., 2019. Straight from the horse's mouth: Agreement attraction effects with Turkish possessors. Linguistic Approaches to Bilingualism 9, 398–426. doi:http://dx.doi.org/10.1075/lab.17019.lag.

Laurinavichyute, A., von der Malsburg, T., 2024. Agreement attraction in grammatical sentences and the role of the task. Journal of Memory and Language 137, 104525. URL: https://www.sciencedirect.com/science/article/pii/S0749596X24000287, doi:http://dx.doi.org/https://doi.org/10.1016/j.jml.2024.104525.

Logačev, P., Vasishth, S., 2016. A multiple-channel model of task-dependent ambiguity resolution in sentence comprehension. Cognitive Science 40, 266–298.

Slioussar, N., 2018. Forms and features: The role of syncretism in number agreement attraction. Journal of Memory and Language 101, 51–63. doi:http://dx.doi.org/10.1016/j.jml.2018.03.006.

Türk, U., Logačev, P., 2024. Agreement attraction in turkish: The case of genitive attractors. Language, Cognition and Neuroscience 39, 448–454.

Ulusoy, E., 2023. Connectivity and case effects in agreement attraction: The case of turkish.

Wagers, M.W., Lau, E.F., Phillips, C., 2009. Agreement attraction in comprehension: Representations and processes. Journal of Memory and Language 61, 206–237. doi:http://dx.doi.org/10.1016/j.jml.2009.04.002.