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

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Abstract

Linguistic illusion literature debates what information accesses memory representations. Prior work tests whether structural, semantic, or discourse cues guide subject-verb dependencies; however, it remains unclear whether native speakers rely on surface level heuristics, such as phonological information during dependency resolution. Traditionally, accidental phonological resemblance to plural ending (e.g., the /s/ in *cruise*) does not induce erroneous agreement in English, whereas resemblance correlating with controllerhood amplifies attraction across varies languages. Contradicting this generalization, Slioussar (2018) proposed that accidental phonological resemblance can mediate memory search for Russian subjects. Given the theoretical importance of this proposal and the lack of comparable effects in other languages such as Czech, we propose re-interpret previous findings under the light of a recently growing literature of association with being a possible controller. We test whether phonological overlap or association with controllerhood elicits erroneous agreement in Turkish. Turkish provides a critical test: both verbal and nominal elements can surface as subjects and the plural morpheme *-lAr* marks number in both of them, but only nominal plural *-lAr* controls verbal agreement. Two speeded acceptability studies show no attraction from plural-marked verbs (N = 80; N = 95) but robust attraction from genitive plural nouns. We report a first-of-its-kind dissociation under minimal manipulation: verbal attractors that can surface as subjects yet cannot control agreement do not induce attraction, whereas genitive plural nouns—which can be subjects and control in other environments—do. This pattern constrains retrieval processes by tying attraction to abstract controller features rather than surface phonology.

1 Introduction

Human sentence processing draws both on abstract grammatical features and heuristics that exploit surface regularities, such as plausibility (Speer and Clifton, 1998), frequency (Lau et al., 2007), and task-specific factors (Laurinavichyute and von der Malsburg, 2024; Arehalli and Wittenberg, 2021; Hammerly et al., 2019; Logačev and Vasishth, 2016). We focus on one such heuristic: over-reliance on surface form, evidenced when phonological similarity between sentence constituents is observed to modulate performance (Acheson and MacDonald, 2011; Kush et al., 2015; Copeland and Radvansky, 2001; Rastle and Davis, 2008).

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. These effects have been taken to suggest that, under certain circumstances, speakers and comprehenders rely on shallow or heuristic cues to complete dependencies. Acheson and MacDonald (2011), for example, found that participants showed slower reading times when the subjects of the two embedded clauses share phonological similarity (*baker-banker* in 1 vs. *runner-banker* in 2). Moreover, participants were less accurate in answering comprehension questions with phonological overlap present. 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).

(1) The baker that the banker sought bought the house.

(2) The baker that the banker sought bought the house.

However, it is unresolved whether this heuristic penetrates dependency resolution itself–including subject-verb agreement, pronoun resolution, or the licensing of negative polarity items–beyond general effects on reading ease and memory. A central question for understanding human cognition is what information is encoded and later available in memory during such dependency resolutions and how faithful these encodings are to the input. Errors in subject-verb agreement have been treated as a key domain for identifying mechanisms of linguistic representation and retrieval (Bock and Miller, 1991; Jäger et al., 2017; Smith and Vasishth, 2020a; Phillips et al., 2011). Classic findings demonstrate systematic errors in establishing number agreement between a verb and its agreement controller when an NP with a different number (the attractor) interferes. Speakers produce sentences like (3) or misclassify them as acceptable (Bock and Miller, 1991; Pearlmutter et al., 1999).

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

(4) The players on the courts are tired from a long-game.

Some accounts argue that detailed analyses are not always maintained when heuristics suffice, creating the opportunity for surface regularities to affect judgments (Ferreira et al., 2002; Futrell et al., 2020). For example, lossy-compression-style approaches assume that comprehenders maintain only an imperfect representation of the linguistic input, and that the parser relies on statistical regularities within the language to fill in the gaps (Futrell et al., 2020). In this model, the input as in (3) would be altered to a more statistically predictable form such as (4), which would be accepted as grammatical. On the other hand, many rational accounts of sentence processing argue that comprehenders maintain detailed and faithful representations of the input (Bock and Miller, 1991; Lewis and Vasishth, 2005). More specifically, cue-based retrieval approaches hold that constituents are stored with detailed abstract features and later accessed by matching retrieval cues, and that erroneous parses can occur when features conflict or interfere. In such accounts, the parser would maintain a detailed representation of the singular subject *player* and the plural attractor *courts*, and the error arises because the retrieval cues for agreement (+PL, +CONTROLLER) match both the singular subject and the plural attractor, leading to interference. However, it remains open whether phonological codes are used as such cues during syntactic dependency building (Lewis and Vasishth, 2005).

Despite much research on what factors modulate agreement errors, the role of phonology remains unclear. The few studies that bear directly on subject-verb agreement exhibit contradictory findings (Bock and Eberhard, 1993; Slioussar, 2018; Lacina and Chromỳ, 2022). Pseudoplural attractors whose final phone matches the plural suffix and string-ambiguous with other nouns (e.g. *cruise* vs. *crews*) do not increase agreement errors in production (Bock and Eberhard, 1993). Phonological overlap effects have been observed in other cases, but many of them involve additional shared morphological features such as case ambiguity with the controller in the sentence (Hartsuiker et al., 2003; Lago et al., 2019; Lacina and Chromỳ, 2022), although not all (Slioussar, 2018).

This raises the possibility that surface form affects the formation of agreement dependencies not directly through the use of number form as a retrieval cue, but indirectly, when the surface form is one that is more likely to be realized on agreement controllers.

We test this hypothesis by utilizing the surface-form overlap between the verbal and nominal morphological reflexes of agreement in Turkish. Turkish uses the same surface suffix, *-lAr*, for plural marking on nouns and for plural agreement on finite verbs. Crucially, strings bearing verbal *-lAr* can occur in subject position, yet they never control finite clause agreement; only nominal plurals do. These properties allow us to test whether form overlap is sufficient to drive attraction, or if the attractor must also be a possible controller (true of nouns but not verbs). Across two high-powered speeded acceptability experiments in Turkish we find that plural marking on an embedded verbal attractor does not increase acceptance of plural agreement on the matrix verb; such effects are only observed when the plural marker appears on a non-subject noun attractor. These results indicate that surface-form overlap alone does not function as a retrieval cue for agreement in Turkish. Dependency resolution relies on abstract features and structural relations, with phonology influencing processing primarily outside of retrieval.

In the rest of the introduciton, we review the role of certain surface cues in agreement attraction, namely case syncretism and pure phonological overlap. We then introduce the previous Turkish attraction studies

and brief sketch of the grammar that is relevant for our study. Finally, we present the current study and its predictions.

1.1 Background

It is reported that native speakers from 296 of out 378 languages surveyed exhibit systematic agreement between the verb and another constituent(s), such as subject, object, or both (Siewierska, 2013). However, this agreement process is not always error-free. In their seminal work, Bock and Miller (1991) demonstrated that participants systematically produce erroneous verb forms (*are*) when there is a nearby noun, an attractor, that has a mismatching number as in (5b) compared to their counterpart with singular attractor as in (5a). The effect of the number mismatching attractor, agreement attraction, was also found to be robust in comprehension (Nicol et al., 1997; Pearlmutter et al., 1999) of such sentences in various languages, including Arabic (Tucker et al., 2015), Armenian (Avetisyan et al., 2020), Hindi (Bhatia and Dillon, 2022), Spanish (Lago et al., 2015), Russian (Slioussar, 2018), and Turkish (Lago et al., 2019; Türk and Logačev, 2024; Ulusoy, 2023).

(5) a. Singular Attractor
The player on the court …

b. Plural Attractor
The player on the courts …

Many studies have investigated the various syntactic and semantic factors which make agreement errors more likely, which include hierarchical distance (Hartsuiker et al., 2001; Nicol et al., 1997; Kaan, 2002), linear distance (Bock and Cutting (1992); but see Pearlmutter (2000) and Kwon and Strut (2019)), semantic interactions of nouns involved (Eberhard, 1999; Vigliocco et al., 1995; Humphreys and Bock, 2005), and syntactic category of the phrase containing the attractor (Bock and Miller, 1991; Bock and Cutting, 1992). One widely accepted set of accounts that explained these errors are called retrieval based theories (Lewis and Vasishth, 2005; Wagers et al., 2009; Yadav et al., 2023). In these accounts, comprehenders maintain faithful linguistic representations; errors arise because the memory mechanisms used to identify the agreement controller mislead them. Under this approach, phrases are encoded in content-addressable memory as *chunks*—bundles of features including number, gender, and syntactic properties (Smith and Vasishth, 2020b). Comprehenders predict the number of the verb based on the noun phrases they process while reading the previous noun phrases. In grammatical sentences with singular verb agreement, the number prediction and the verb number match, which causes no processing difficulty. In contrast, when participants fail to find the predicted number morphology on the verb, a memory-retrieval process is initiated. This process activates the search for a chunk matching relevant cues for agreement controller.

1.1.1 Surface Heuristics: case syncretism and phonological overlap

What is the characteristics of cues which are found useful to be encoded? One line of work manipulated overt case marking on attractors, i.e. syncreticsm, to test whether morphophonological case is used for dependency resolution. Two grammatical forms are said to be syncretic if they are realized with the same overt morphology despite bearing different syntactic and semantic features. E.g., most noun phrases in English – such as *the cabinet* – are syncretic between nominative and accusative case marking. An exception are some pronouns which differ in their nominative and accusative forms, as with the first person pronoun *I* (nominative) vs. *me* (accusative).

This effect of case syncretism was tested in various languages by manipulating the overt case marking of controllers or attractors, reasoning that surface ambiguity could enhance competition during retrieval or interfere in production. For example, Hartsuiker et al. (2003) in a preamble completion task experiment used the overlap between accusative and nominative forms of feminine determiners in German 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 (6a), compared to cases where the attractor could be distinguished by form alone, as in (6b). Crucially, this

additive effect was limited to feminine nouns, the only gender showing nominative–accusative syncretism in plural forms while other nouns showed the base effect of plural.

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

Parallel results were found in comprehension studies in Czech. Chromỳ et al. (2023) conducted self-paced reading experiments manipulating the number of the attractor and the number of the verb across varies syntactic configurations. They found that the attraction effects, i.e. faster reading times at the ungrammatical verb when the attractor is plural, were only observed when the attractor was bearing a case syncretic with the nominative case as in (7), while finding no attraction effects in other experiments where the attractor was unambiguously marked. In a follow up experiment, Lacina et al. (2025) found similar effects in gender agreement within Czech, based on earlier Slovak production findings (Badecker and Kuminiak, 2007). They found a clear gender attraction effect, i.e. faster reading times at the ungrammatical verb when the attractor is of the same gender with the verb, but the head noun was not. More importantly, this effect was only present in cases where the attractor was syncretic in case-marking with the nominative case, which is the case of the agreement controller, but not when the attractor was unambiguously marked with a different case.

(7) * Složk-a pro archivářk-y nejspís bud-ou zahrnovat veškere nálezy.
file-NOM.SG for archiever-ACC.PL=NOM.PL probably will-NOM.PL include all findings
'A file for archievers will probably include all findings.'

Similarly, Slioussar (2018) found the effects of syncretism in Russian in both production, self-paced readings, and acceptability judgments. She compared sentences with genitive plural attractors, which are unambiguously marked, to sentences with accusative plural attractors, which are syncretic with nominative plural forms, while manipulating other factors such as the number of the attractor, the grammaticality of the sentence, and the presence of a singular subject. She found that sentences with accusative plural attractors yielded more plural completions, faster reading times at the plural verb and higher rates of acceptability compared to the sentences with unambiguous genitive plural attractors.

However, results from other case-marking languages are mixed. For instance, Franck et al. (2010) used French and compared the unambiguously accusative marked attractors to NPs with no overt case marking. They showed that when unambiguous marking increased the attraction effects substantially, contrary to the predictions of cue based retrieval. Avetisyan et al. (2020) observed that unambiguous case in Armenian modulated neither reading times nor error rates. Conversely, Lacina et al. (2025) found that attraction in Czech surfaced only when case morphology was ambiguous. These findings suggest that distinct case morphology is insufficient to predict interference, implicating language-specific distributions or heuristic processing.

The studies discussed above tested the effects of case syncretism, which is a morphophonological overlap that also correlates with the possibility of being a controller. In these cases, while the case of the attractor is ambiguous its number is not. Take the English word *cabinets* as an example. It is syncretic between nominative and accusative case, meaning that its surface form would not change depending on the syntactic case is assigned to it. However, it is not syncretic in number, as the plural form *cabinets* is distinct from the singular form *cabinet*, and this difference would surface as reflex on grammaticality in syntactic and semantic configurations where a certain number is expected, such as **few cabinet* and **a cabinets*.

A second line of work related to surface cues tests a case of accidental phonological overlap that does not itself change the relevant cues. Bock and Eberhard (1993) tested whether attractors that only sound plural,

pseudoplural singular attractors such as *cruise* as in (8), increase agreement errors compared to true plural nouns, such as *crews* in (5b). They reasoned that if participants rely on phonological cues rather than abstract number features, words ending with plural-like sounds (/s/ or /z/) should behave like true plurals. In their preamble completion study, they found that pseudoplural attractors did not induce agreement errors, which argues against a purely phonology-driven account of attraction in English.

(8) The player on the cruise …

(9) The player on the crews …

In contrast, Slioussar (2018) reported a contribution of surface-form overlap to agreement in Russian. Recall that she compared genitive and accusative marked attractors. In Russian, a subset of genitive singular nouns (10) is homophonous with nominative plural forms, while genitive plural forms (11) are not ambiguous in this way. In the experiments we previously mentioned, she found that sentences with genitive singular attractors whose form overlaps with nominative plural yielded more plural completions, faster reading times at the plural verb and higher rates of acceptability compared to the sentences with unambiguous genitive plural attractors. She took her results as evidence for a retrieval process in which the search for a controller is mediated through phonological form and relevant features like +NOM and +PL can be activated by simply a phonological overlap.

(10) Komnata dlja večerinki byli …
room.NOM.SG for party.GEN.SG = NOM.PL were
'The room for parties/party were …'

(11) Komnata dlja večerinok byli …
room.NOM.SG for party.GEN.PL≠NOM.PL were
'The room for parties/party were …'

However, another Slavic language Czech which shows the same ambiguity between the genitive singular and nominative plural forms was found to not show attraction effects by simple phonological overlap (Lacina and Chromỳ, 2022). These mixed findings in case-syncretism literature, English pseudoplural, and a failure to replicate in another Slavic language cast a shadow on phonological modulation explanation.

1.1.2 Accounting for syncretism and phonological-overlap

To the best of our knowledge, there is no attempt of explanation within Rational Accounts or Marking and Morphing accounts to explain the variety of findings in the literature regarding surface cues in agreement attraction. Below we outline existing models of the syncretism effects under a cue-based approach, and then how other account would approach these findings.

In canonical cue-based retrieval accounts, a dependency is formed via a content-addressable search for a relevant *chunk*, i.e. bundles of features for a given lexical item, that matches the retrieval cues provided by the verb (Lewis and Vasishth, 2005). When a verb encountered, a search is triggered for a chunk that matches the necessary features for agreement. In the case of English subject-verb agreement, the verb would provide cues such as +NOM and +PL, and the search would activate chunks that match these cues. If there is a singular subject and a plural attractor, both of which match the +NOM cue but only the plural attractor matches the +PL cue, then the retrieval process can be misled by the attractor, leading to agreement errors.[1] In this account, the case syncretism is expected to lead to difficulty in correctly determining the head due to the increased competition between chunks that shares relevant cues. On the other hand, when the attractor is not case-syncretic, the partial match between the retrieval cues and the attractor would be weaker, leading to less attraction effects (Smith and Vasishth, 2020a; Yadav et al., 2023).

Slioussar (2018) situated her findings within the cue-based retrieval accounts. She argued that the phonological overlap between the genitive singular and nominative plural forms can activate relevant features

[1] Lewis and Vasishth (2005) argue that the retrieval cues for case is not determined by the syntactic position or the abstract case features, but rather by the surface form of the noun phrase.

like +NOM and +PL in addition to +GEN and +SG, which would increase the likelihood of retrieving the attractor as a controller, leading to more agreement errors in cases where the attractor only matches with the +GEN and +PL cues (10). To the best of our knowledge, this is the only account that directly exploits the co-activation of chunks through phonological overlap to explain the effects of syncretism. However, Slioussar's (2018) mechanism aligns closely with foundational principles of word recognition and working memory. Models of continuous speech parsing (e.g., McClelland and Elman, 1986, Norris (1994)) have long established that phonological string overlap automatically triggers the transient activation of embedded or competing lexical chunks (Shillcock, 1990). Furthermore, the broader working memory literature demonstrates that phonological similarity creates significant interference during retrieval (Baddeley, 1966; Conrad, 1964; Acheson and MacDonald, 2009)

However, the same surface-form overlap did not give rise to attraction effects in Czech, another Slavic language Lacina and Chromỳ (2022). These mixed findings in case-syncretism literature, English pseudoplural, and a failure to replicate in another Slavic language cast a shadow on phonological modulation explanation.

An alternative account posits that attraction errors arise not from phonological co-activation of competing parses, but from the use of language-general statistical heuristics. Under this view, comprehenders probabilistically associate certain surface cues—word order, case syncretism, or the presence of certain morphemes—with controllerhood, the property of being a possible agreement controller. In cases of syncretism, then, certain noun phrases might carry an increased association with controllerhood due to the distribution of such forms in the language. For example, Lago et al. (2019) argue that Turkish speakers retrieve genitive-marked attractors as controllers because genitive case controls agreement in embedded clauses, even though it cannot do so in matrix clauses. The syncretism between the nominal modifier and the embedded subject is thus phonological rather than functional, and attraction arises because Turkish speakers associate genitive-marked nominals with being controllers.

Converging evidence for this sensitivity to "looking like a controller" comes from Romanian and Hindi (Bhatia and Dillon, 2022; Bleotu and Dillon, 2024). Bleotu and Dillon (2024) found that Romanian attractors induced agreement errors only when they surfaced with a determiner, as opposed to bare forms. Since only nouns bearing a determiner can control agreement in Romanian, they argue that participants associate the presence of a determiner with controllerhood. In Hindi, Bhatia and Dillon (2022) found that plural-marked attractors were erroneously retrieved as controllers only when the attractor also served as an agreement controller within the embedded clause—independent of whether its syntactic role was that of an object or a subject. They argue that participants track controllerhood within a sentence rather than relying on language-general distributional statistics alone. Nevertheless, this finding also demonstrates that agreement processes are sensitive to the abstract feature of being a controller.

Further evidence comes from English. In a series of six experiments, Schlueter et al. (2018) showed that the coordinator *and* when coordinating two singular noun phrases induces attraction even in the absence of overt plural morphology *-s*, because they argue *and* is statistically associated with plurality. Crucially, not only conjoined singular noun phrases lacking overt plural morphology are good candidates for attraction, but the coordinator *and* alone can induce the effect when it conjoins two adjectives modifying a singular noun (e.g., *the slogan about the loyal and caring husband*). They argue that participants exploit the statistical association between *and* and plurality, which leads them to accept ungrammatical sentences containing a plural auxiliary. Taken together, these explanations across languages and structures suggest that the cue–chunk match is not strictly categorical but can be influenced by statistical associations within a language (Engelmann et al., 2019). Importantly, the Hindi findings indicate that the human parser is sensitive to the abstract notion of being a controller, and not merely to language-general co-occurrence statistics.

A similar account extends to Russian. While genitive-marked nouns can serve as subjects in negative inversion constructions, they do not control verbal agreement in these contexts. Crucially, however, they remain active controllers within the noun phrase, triggering number or gender marking on modifiers (e.g., surfacing as feminine *ni odnoy* with a feminine head, contrasting with masculine *ni odnogo* in 12) (Babby, 2001; Partee and Borschev, 2004). In contrast, Czech does not allow genitive subjects, and thus not license these controller properties in subject positions.

(12) ..., tam ne rabotaet ni odnogo inženera.
..., there NEG works not one.M.SG.GEN engineer.M.SG.GEN
'..., there hasn't been a single engineer working there.'

1.1.3 Sketch of Turkish and Attraction in Turkish

Turkish offers a useful test case because genitive-marked nominals can carry controller-like cues in some structures, while verbal agreement is morphologically rich and overt. In genitive-possessive NPs (roughly analogous to English Saxon genitives), the possessor bears genitive case and the head noun bears possessive morphology.

Using this construction, Lago et al. (2019) reported robust attraction: participants accepted ungrammatical plural agreement more often when the possessor was plural (13) than when it was singular (14).

(13) Teknisyen-ler-in eğitmen-i olağanüstü hızlı koş-tu-lar.
technician-PL-GEN instructor-POSS extraordinary fast run-PST-PL
'The technicians' instructor ran$_{PL}$ extraordinarily fast.'

(14) Teknisyen-in eğitmen-i olağanüstü hızlı koş-tu-lar.
technician-GEN instructor-POSS extraordinary fast run-PST-PL
'The technician's instructor ran$_{PL}$ extraordinarily fast.'

Türk and Logačev (2024) asked whether this attraction might be partly driven by a local parsing ambiguity in the original materials. In Lago et al. (2019), many head nouns were consonant-final, so the head suffix *-i* was syncretic between 3sg possessive and accusative. This creates a potential misparse in which the genitive possessor is temporarily treated as a clause-level subject and the head as an object, which could artificially increase the possessor's controller-like status.

To test this ambiguity account, Türk and Logačev (2024) used vowel-final heads that disambiguate the two morphemes: 3sg possessive surfaces as *-si*, whereas accusative surfaces as *-yi*. The logic was straightforward: if attraction in Turkish genitive-possessive NPs mainly comes from this local ambiguity, then attraction should be substantially reduced when the head morphology is unambiguous.

The attraction effect persisted. Plural genitive possessors still increased ungrammatical acceptability, and the magnitude was comparable to Lago et al. (2019). This result argues against an ambiguity-only explanation and suggests that genitive-marked possessors carry controller-relevant cues independently of that local form overlap.

Ulusoy (2023) extended this literature to configurations where the attractor is not in the same phrase as the controller. Using matrix-clause subjects as attractors for embedded verbal agreement (15), she found more errors with plural than singular attractors. At the same time, ungrammatical acceptance was relatively high in both conditions, despite cross-linguistic evidence that such structural separation usually reduces attraction (Bock and Cutting, 1992; Franck et al., 2002). Taken together, Turkish studies establish reliable attraction with plural genitive cues, but they leave open which cues are doing the work: surface form, controllerhood, or both.

(15) * Kütüphaneci-ler [çalışkan öğrenci-nin iste-dik-ler-i] kitab-ı şimdi
librarian-PL hardworking student.SG-GEN want-NMLZ-3SG-POSS book-ACC now
bul-du-lar.
find-PST-3PL
'The librarians found the book that the hardworking student wanted now.'

1.2 This study

Motivated by these alternative accounts and conflicting findings (Bock and Eberhard, 1993; Lacina and Chromỳ, 2022) along with the theoretical importance of such proposal, we test the phonological modula-

tion hypothesis in two high-powered experiments: whether a syntactically ineligible controller, but still a possible subject, can induce attraction solely through morphophonological overlap matching the agreement suffix in form and semantics. To this end we capitalize on the shared surface form of verbal and nominal plural marking (*-lAr*) in Turkish to target this question. We use reduced relative clauses (RRCs) where the plural-marked verb appears as the attractor (16). Crucially, this *-lAr* syncretism is not feature-ambiguous; it is a form-only overlap lacking the possibility of being a potential controller. Even when a headless RRC alone surfaces as a subject, it cannot control agreement (17).

(16) Gör-dük-ler-i çocuk koş-tu-(*lar).
go-NMLZ-PL-POSS kid[NOM] run-PST-(*PL)
'The kid that (they) saw ran.'

(17) Gör-dük-ler-i koş-tu-(*lar).
go-NMLZ-PL-POSS run-PST-(*PL)
'(The kid) that (they) saw ran.'

In Experiment 1, we tested the form hypothesis by comparing sentences with verbal attractors to sentences with canonical nominal attractors in Turkish. Experiment 2 then tested the form hypothesis more directly by only using verbal attractors. We expected that if surface-overlap can modulate relevant memory representations for dependency resolutions, we would see similar attraction results with nominal and verbal attractors. However, if participants are tracking an higher order cue that is relevant for being a possible controller, then the verbal attractors, due to their inability to control agreement, would not introduce agreement attraction effects even though their high morpho-phonological similarity.

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 in general attraction literature and Turkish agreement attraction, namely surface-form overlap alone does not derive agreement illusions. Rather, attraction appears to depend on abstract feature overlap between potential controllers and agreement probes, and possibly statistical associations between the strings and their controllers. In this light, findings of Slioussar (2018) are best analyzed as a possible increased association between genitive marking and possible subjecthood and being an agreement controller, which is not possible in Czech, and thus no attraction (Lacina and Chromỳ, 2022). By doing so, we hope to clarify how cue-mechanisms are employed and the role of phonological overlap in sentence processing.

2 Experiment 1: Testing Surface-Form Overlap

2.1 Participants

We recruited 95 undergraduate students to participate in the experiment in exchange for course credit. Participants self-identified as native Turkish speakers (0 non-native entries in metadata), with an average age of 21 years (range: 18-30).

Preprocessing followed `exclude_bad_subjects_8()`. Subject-level screening used two discrimination checks: $\Delta_{gen} = p(yes \mid gen\_d) - p(yes \mid gen\_c)$ and $\Delta_{rc} = p(yes \mid rc\_d) - p(yes \mid rc\_c)$, with failure defined as values less than or equal to 0.25. Under the current conjunctive implementation, participants are excluded only if both checks fail. In this sample, 1 participant(s) failed the gen check, 2 failed the rc check, and 0 failed both (excluded at subject level).

At the trial level, reaction-time trimming removed 229 trials (120 with RT $<=$ 200 ms; 109 with RT $>=$ 4999 ms; 2.71% of all trials). Practice and missing-response trials were then removed (855 practice trials; 59 non-practice missing responses). The analyzed dataset contained 95 participants and 7422 observations.

2.2 Materials

We used 40 sets of sentences like Table 1, in which we manipulated (i) the number of the attractor, (ii) the type of the attractor, and (iii) the number agreement on the verb. Both plural markings were marked with the suffix *-lAr*, while the singular number and singular agreement were marked by its absence.

Table 1: Experimental conditions. The Attractor was manipulated for number and type. The Verb was manipulated to match or mismatch the head noun (always singular), creating Grammatical and Ungrammatical conditions.

			Grammaticality (Verb Suffix)	
Attr. Type	**Attr. Num**	**Attractor**	**Grammatical**	**Ungrammatical (*)**
Verbal	SG	Tut-tuğ-u *hire-NMLZ-POSS*	zıpla-dı *jump-PST*	*zıpla-dı-lar *jump-PST-PL*
	PL	Tut-tuk-lar-ı *hire-NMLZ-PL-POSS*	zıpla-dı *jump-PST*	*zıpla-dı-lar *jump-PST-PL*
Nominal	SG	Milyoner-in *millionaire-GEN*	zıpla-dı *jump-PST*	*zıpla-dı-lar *jump-PST-PL*
	PL	Milyoner-ler-in *millionaire-PL-GEN*	zıpla-dı *jump-PST*	*zıpla-dı-lar *jump-PST-PL*

(18) *Verbal Attractor Conditions*
[Attractor] aşçı mutfak-ta sürekli **[Verb]**
hire-NMLZ-(PL)-POSS cook kitchen-LOC non.stop jump-PST-(PL)
'The **[**$_{Attr.}$ **hired**$_{pl}$**/hired**$_{sg}$**]** cook **[**$_{Verb}$ **jumped**$_{pl}$**/jumped**$_{sg}$**]** in the kitchen non-stop.'

(19) *Nominal Attractor Conditions*
[Attractor] aşçı-sı mutfak-ta sürekli **[Verb]**
millionaire-(PL)-GEN cook-POSS kitchen-LOC non.stop jump-PST-(PL)
'The **[**$_{Attr.}$ **millionaires'/millionaire's]** cook **[**$_{Verb}$ **jumped**$_{pl}$**/jumped**$_{sg}$**]** in the kitchen non-stop.'

Verbal attractor conditions featured complex subject NPs containing a bare head noun and a reduced relative clause acting as the attractor (e.g., 'tuttukları aşçı', 'the hired cook'). Because nominal plural marking is mandatory and the head noun was always singular, plural verb agreement rendered these sentences ungrammatical. Nominal attractor conditions, featuring nominal attractors such as 'milyonerlerin aşçısı' ('the millionaires' cook') were taken from Türk and Logačev (2024). To prevent participants from associating plural verbs with ungrammaticality, fillers were balanced between grammatical sentences with plural verbs and ungrammatical sentences with singular verbs.

2.3 Procedures

The experiment was conducted online via Ibex Farm (Drummond, 2013), lasting approximately 25 minutes. After providing informed consent and demographic details, participants read instructions and completed nine practice trials.

Each trial began with a 600 ms blank screen, followed by a centered, word-by-word RSVP presentation (30 pt font, 400 ms duration, 100 ms inter-stimulus interval). Upon the prompt, participants judged sentence acceptability as quickly as possible by pressing 'P' (acceptable) or 'Q' (unacceptable). A red warning message appeared during practice trials—but not experimental trials–if responses exceeded 5,000 ms. Participants pressed the space bar to advance to the next item.

The study included 40 experimental and 40 filler sentences. Experimental items were distributed across four lists using a Latin-square design, ensuring each participant viewed only one list containing one version

of each item.

2.4 Analysis and Results

Participants showed high accuracy in both grammatical (M = 0.95, CI = [0.94,0.96]) and ungrammatical filler sentences (M = 0.06, CI = [0.05,0.07]), 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 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.

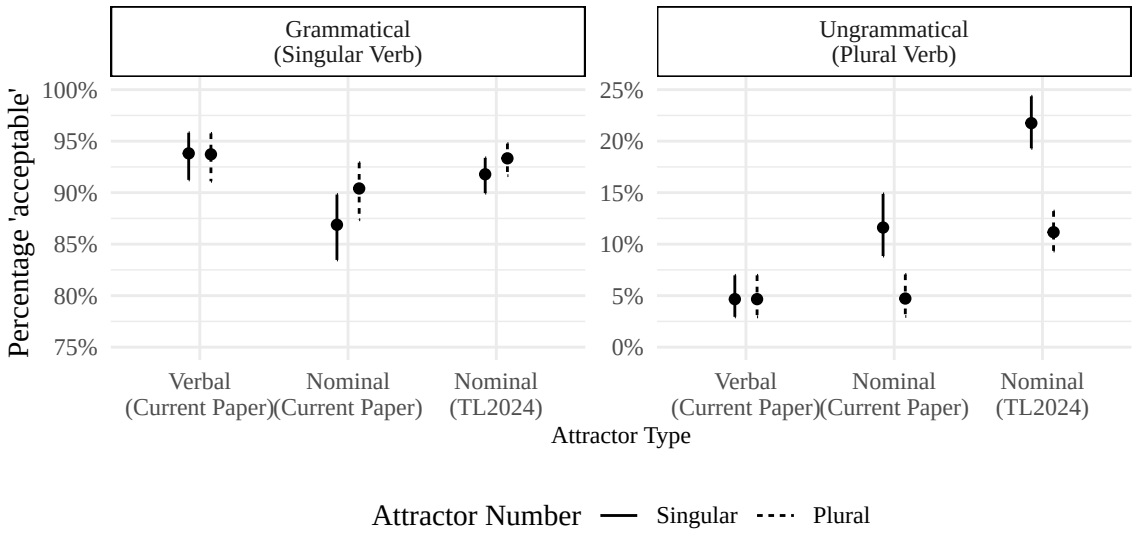

Figure 1: Mean proportion of 'acceptable' responses by grammaticality, attractor number and attractor type. Error bars show 95% Clopper–Pearson confidence intervals.

Our model-based analysis targeted the same question as the descriptive results: whether verbal attractors induce attraction. We fitted a Bayesian mixed-effects logistic regression to binary *yes/no* responses, combining the present dataset with the nominal-attractor dataset from Türk and Logačev (2024). The fixed-effects structure included Grammaticality, Attractor Number, Attractor Type, and all interactions; the random-effects structure included by-subject and by-item intercepts and slopes justified by the design. Grammaticality and Attractor Number were sum coded (grammatical = 0.5, ungrammatical = -0.5; plural = 0.5, singular = -0.5). Attractor Type (Nominal-Current, Nominal-TL24, Verbal) was encoded with two orthogonal Helmert contrasts: `RC_vs_Gens` (Verbal vs. the average of both nominal conditions) and `GenCurrent_vs_GenTL24` (the two nominal datasets against each other). This coding allows direct decomposition of (i) attraction within each attractor type and (ii) between-type differences in attraction magnitude.

We present posterior summaries of estimated regression effects from our model in Figure 2. Our model showed a robust attraction in both nominal attractor cases, with strongly negative effects for our nominal items (M = -1.45, CI = [-2.12, -0.78], P(<0) = >0.99) and items from Türk and Logačev (2024) (M = -1.16, CI = [-1.63, -0.69], P(<0) = >0.99). More importantly, our model found no evidence for an attraction in verbal attractor conditions (M = 0.07, CI = [-0.73, 0.87], P(<0) = 0.44), verifying our observations in the descriptive statistics. We did not find an evidence for a difference in magnitude of

attraction between the two nominal-type attractors was not found (M = -0.29, CI = [-1.11, 0.53], P(<0) = 0.72), suggesting the presence of an additional conditions did not affect attraction magnitudes. Finally, we found strong evidence for a decreased overall acceptability for nominal items in our experiment (M = -1.09, CI = [-1.77, -0.44], P(<0) = >0.99), suggesting the within-experimental distribution did affect overall acceptability, but not attraction.

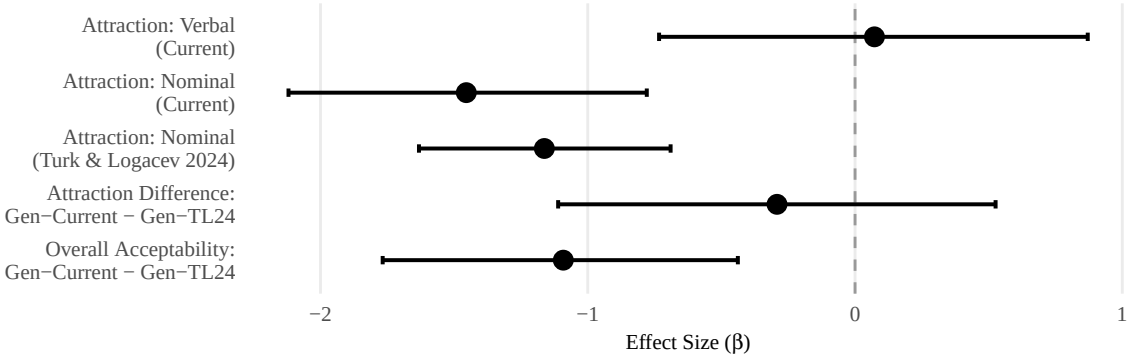

Figure 2: Posterior summaries of attraction-related effects. Points indicate posterior means, and horizontal bars show 95% credible intervals on the log-odds (β) scale. Attraction was estimated as the interaction between grammaticality and attractor number within each attractor type. Negative values indicate stronger attraction (a reduced ungrammaticality penalty in plural-attractor conditions). Dashed line denotes zero (no effect).

2.4.1 Bayes Factor Analysis for Null Effects

To provide formal evidence for the absence of attraction with verbal attractors, we computed Bayes Factors using the Savage-Dickey density ratio method (Wagenmakers et al., 2010). This approach quantifies the evidence for the null hypothesis (no effect) relative to the alternative.

Bayes-factor computation for this section is temporarily deferred. We will report BF_{01} estimates for the verbal-vs-nominal attraction contrast in a later revision.

2.5 Discussion

Experiment 1 found no evidence that phonological overlap between nominal and verbal plural morphemes in Turkish induces attraction. Participants reliably rejected ungrammatical sentences with plural-marked verbal attractors, contrasting with the canonical attraction effects observed for nominal attractors. This indicates that the verbal plural marker *-lAr* does not generate interference comparable to nominal plurals.

Our results and between-experiment comparisons indicate that within-experiment statistics—specifically, exposure to verbal attraction items—did not substantially reduce attraction magnitude. However, overall acceptability for nominal attractor sentences was lower than in Türk and Logačev (2024). This aligns with prior work showing that trial distributions modulate judgments. While previous studies drove this effect via instructions or fillers (Hammerly et al., 2019; Arehalli and Wittenberg, 2021), we demonstrate that experimental conditions and the presence of an effect in a condition subset also modulate overall acceptability, but surprisingly not the attraction.

A potential concern is that our mixed design—combining canonical nominal attractors with verbal ones—influenced response patterns. The presence of robust nominal attraction may have altered participant strategies, potentially masking weaker verbal effects (Hammerly et al., 2019; Türk, 2022). To determine if the absence of verbal attraction in Experiment 1 was genuine rather than a distributional artifact, Experiment 2 removed all nominal attractors. This design tests whether the null effect persists when verbal morphology is the sole potential source of interference.

2.5.1 Null-effect inference plan for Experiment 1

Because the critical claim in Experiment 1 is a null effect for verbal attractors, we will make the reporting workflow explicit after model reruns. The goal is to show not only that a point-null is plausible, but also that any remaining non-zero effect is too small to support an attraction account.

We will add the following transparency details:

1. **Procedure details.** We will report trial counts per condition, randomization/counterbalancing scheme, exclusion criteria with retained proportions, and whether any trial-level filtering changed the condition balance.
2. **Contrast definitions.** We will report the exact coding used in the model: Grammaticality and Attractor Number sum-coded at +/-0.5, and Attractor Type represented with two orthogonal Helmert contrasts (`RC_vs_Gens`, `GenCurrent_vs_GenTL24`).
3. **Model specification.** We will provide the fitted formula, priors, sampling settings, convergence checks (R-hat, ESS, divergences), and posterior predictive checks.
4. **Target estimand.** We will define verbal attraction as the model-implied Grammaticality x Attractor Number interaction within the verbal condition, computed from posterior draws (the `eff_rc` quantity in the current analysis script).
5. **Null-effect evidence bundle.** We will report posterior mean and 95% CrI for verbal attraction, BF_{01} for the same estimand, posterior mass in a prespecified ROPE around zero, and a prior-sensitivity check (narrow, medium, wide priors).

To keep this section concrete, we will use a short reporting template once reruns are complete:

For verbal attractors, the attraction estimand was `beta = [M]`, 95% CrI `[L, U]`, with posterior probability `P(beta < 0) = [p]`. A Savage-Dickey test on the same estimand yielded `BF~01~ = [x]`, indicating [strength] evidence for the null. Under prior-sensitivity analyses ([prior set 1], [prior set 2], [prior set 3]), BF_{01} remained in the [range] range. The posterior mass inside the ROPE `[a, b]` was `[r]`%, supporting the interpretation that any residual verbal-attractor effect is practically negligible.

This fuller reporting makes the Experiment 1 null claim transparent and sets up Experiment 2 as a planned test of robustness under a cleaner design.

3 Experiment 2: Isolating Verbal Attractors

3.1 Participants, Materials, and Procedure

80 new undergraduate students who are native Turkish speakers (M = 21, range: 18 – 31) were recruited. We utilized the same verbal attractor items and fillers from Experiment 1, removing all nominal attractor trials. The experimental procedure was identical to Experiment 1.

3.2 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 3 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]).

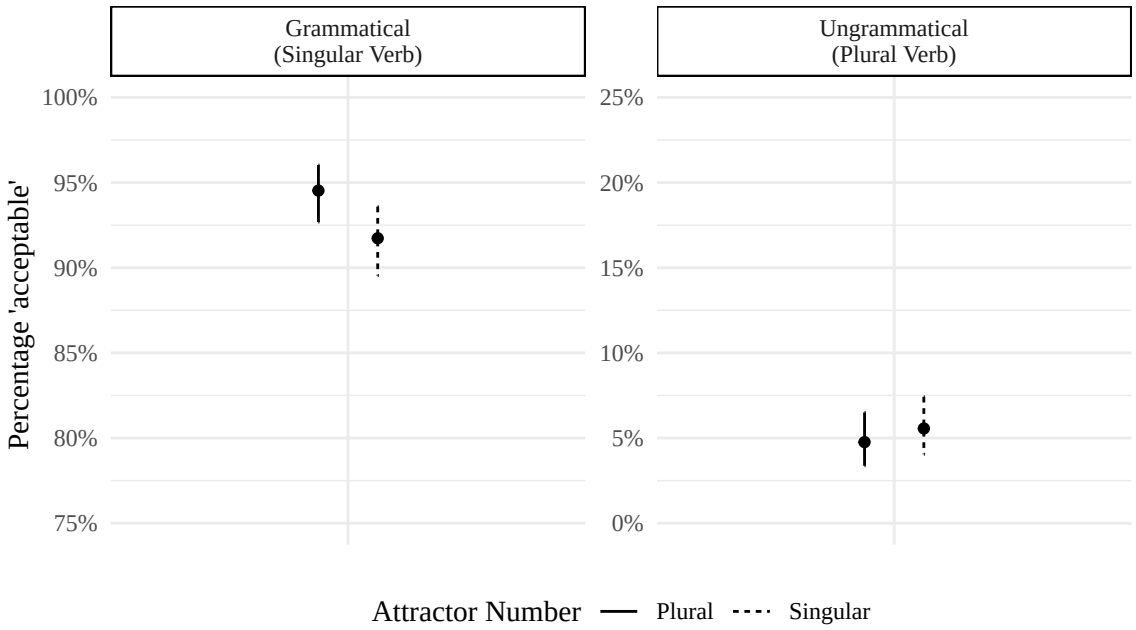

Figure 3: Mean proportion of 'acceptable' responses by grammaticality and attractor number. Error bars show 95% Clopper–Pearson confidence intervals.

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 4. The model revealed a positive effect of grammaticality (β = 5.92 [5.42, 6.46], P(β > 1.00)), but no reliable main effect of attractor number (β = 0.15 [-0.19, 0.51], P(β > 0.81)). On the other hand, there was a small but positive interaction (β = 0.67 [-0.01, 1.38], P(β > 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 (β = 0.51 [0.06, 1.00], P(β > 0.99)), the model fitted to ungrammatical conditions, attraction relevant conditions, did not provide evidence for the effect of number manipulation (β = -0.05 [-0.45, 0.37], P(β > 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.

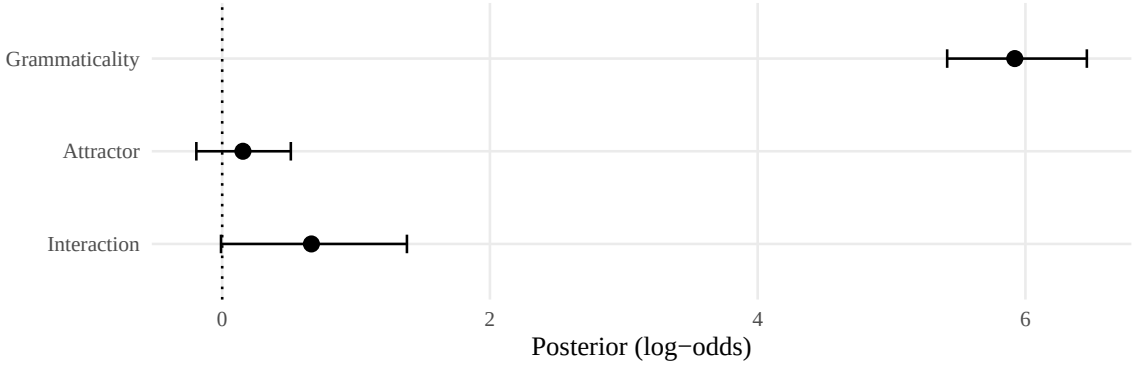

Figure 4: Posterior means and 95% credible intervals for fixed effects in the two Bayesian models. The x-axis shows the posterior mean (log-odds scale). The blue intervals correspond to the model in which a positive interaction was assumed, and the orange intervals to the model in which it was not.

3.2.1 Bayes Factor Analysis for Null Effects

To quantify evidence for the absence of attraction effects, we computed Bayes Factors using the Savage-Dickey density ratio method (Wagenmakers et al., 2010). This approach compares the posterior density at the null value (zero) to the prior density at the same point, providing a ratio of evidence for the null hypothesis (BF_{01}).

Bayes-factor computation for this section is temporarily deferred. We will report BF_{01} estimates for the interaction and main-effect tests in a later revision.

3.3 Discussion

Experiment 2 replicated the verbal attractor conditions from Experiment 1 in isolation and again revealed no evidence for agreement attraction driven by verbal plural markers. Ungrammatical sentences with plural marked main verbs were rejected at similar rates regardless of whether the reduced clause verb bore plural *-lAr* or not, and there were no reliable effects of attractor number or interactions involving attractor number. This confirms that the absence of a verbal attraction effect in Experiment 1 was not due to the presence of nominal attractor items or to within experiment item statistics.

Unexpectedly, grammatical sentences with singular attractors were judged less acceptable than those with plural attractors. This effect is unlikely to reflect agreement attraction, since it arises in the opposite direction. One possibility is that it results from an interaction between plausibility and referential availability. The plural morpheme can license a more general interpretation by allowing an unspecific reference, whereas the singular reduced relative clause more strongly invites a specific referent, which may be less accessible in the context of the task. We do not pursue this explanation further, as it falls outside the scope of the present paper.

4 General Discussion

Summary of findings

Contextualizing of the findings

Theories of surface overlap

We investigated whether surface-overlap advantage seen in reading times and comprehension questions can bleed into dependency resolution. Recent work by Slioussar (2018) argued that an accidental surface-overlap with a nominative plural form may result in activation of relevant cues even though the syntactic analysis of such a noun is clearly genitive singular. However, modulation of agremeent-relevant cues seems to be gated by being a possible controller in other relevant work in syncretism, and similar manipulations in English and Czech were unable to find a phonological modulation.

Using two speeded acceptability judgment experiments, we disentangled the statistical property of being a controller from a surface overlap. Turkish provides a useful test case because the plural *-lAr* appears both on verbs and on nouns, but only noun phrases can control agreement. If phonological overlap alone can activate controller-relevant cues, then plural-marked verbs in reduced relative clauses should induce attraction effects even though they never control agreement.

Across both experiments, we found that Turkish attraction is determined by being a potential controller rather than merely resembling one. Participants did not accepted ungrammatical sentences with containing plural verbal attractors more often than their singular counterparts. This absence of attraction persisted with or without a robust attraction with nominal attractors in the same session.

These results indicate that attraction depends on abstract feature overlap with potential controllers, not on surface-form similarity. This pattern converges with prior results in English and Czech that failed to find attraction for pseudoplural or phonologically plural forms (Bock and Eberhard, 1993; Haskell and

MacDonald, 2003; Nicol et al., 2016; Lacina and Chromỳ, 2022), but appears to stand in contrast to findings from Russian (Slioussar, 2018).

While the most obvious difference is syntactic—our non-attracting elements were verbs, whereas the attracting elements in Russian were nouns (Slioussar, 2018)—this distinction alone is insufficient, as prior work shows that even pseudoplural nouns in English and the same surface-overlap in Czech fail to attract (Bock and Eberhard, 1993; Lacina and Chromỳ, 2022). We propose instead that the parser 'gates' its search based on an element's abstract potential to be a controller. The Russian genitive noun, despite its surface form, is recognized as an element that can control agreement in other constructions, thus passing this abstract gate. Our Turkish verbal attractors or Czech genitive nouns, by contrast, lack this potential entirely; they can never be controllers. They therefore fail this gating, and no attraction is observed, despite the perfect phonological overlap.

This interpretation aligns with cross-linguistic findings showing that attraction is strongest when the attractor bears case or number morphology that can be associated with subjects or agreement controllers (Lago et al., 2019; Bhatia and Dillon, 2022; Bleotu and Dillon, 2024). In other words, it is not form overlap per se, but feature ambiguity or a statistical association with controllerhood that matters. Earlier formulations of these models left open whether 'looking like' a controller or 'being able to be' a controller was critical. The present high-powered results from Turkish favor the latter: only morphologically licensed controllers, or those with a genuine abstract potential to be one, engage in attraction.

5 Appendix

Acknowledgment

This project heavily benefited from discussions with Pavel Logacev. I am also thankful first and foremost Ellen Lau, along with Colin Phillips, Brian Dillon, and Radim Lacina for their comments on the manuscript.

Data availability

Materials, code and data available at: PSYARXIV LINK.

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