

SHORT ARTICLE

Agreement Attraction in Turkish: The Case of Genitive Attractors

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ABSTRACT

Speakers have been shown to find sentences with erroneous agreement acceptable under certain conditions. This so-called agreement attraction effect has also been found in genitive-possessive structures such as “*the teacher’s brother*” in Turkish (Lago et al., 2019), which is in contrast to its absence in similar constructions in English (Nicol et al., 2016). It has been hypothesized that this discrepancy is a result of the association between genitive case marking and subjecthood in Turkish. We test an alternative explanation according to which Lago et al.’s findings are due to a potential confound in their experiment, as all subject head nouns were locally ambiguous between possessive and accusative case. The results of our speeded acceptability judgment experiment suggest that the presence of case ambiguity does not affect agreement attraction, and thus suggests that genitive NPs may function as attractors in Turkish due to the association between genitive case and subjecthood.

KEYWORDS

Agreement attraction; syncretism; Turkish; sentence processing; number

1. Introduction

Speakers often fail to accurately process grammatical dependencies between different parts of a sentence (e.g., Gibson & Thomas, 1999; Phillips, Wagers, & Lau, 2011). For example, in (1), the auxiliary verb *were* erroneously agrees with the agreement-wise

irrelevant attractor noun phrase headed by *cabinets* instead of the agreement controller headed by *key*. A number of previous studies in comprehension (Nicol, Forster, & Veres, 1997; Pearlmutter, Garnsey, & Bock, 1999; Wagers, Lau, & Phillips, 2009) showed that participants found sentences like (1) acceptable more often and read them faster compared to their counterparts with a singular attractor. This phenomenon, known as *agreement attraction* (Bock & Miller, 1991) has been attested in a number of languages, such as in Arabic (Tucker, Idrissi, & Almeida, 2015), Armenian (Avetisyan, Lago, & Vasishth, 2020), German (Lago & Felser, 2018), Hindi (Bhatia & Dillon, 2020), Serbian (Ristic, Molinaro, & Mancini, 2016), Slovak (Badecker & Kuminiak, 2007), Spanish (Lago, Shalom, Sigman, Lau, & Phillips, 2015), and recently in Turkish (Lago et al., 2019).

- (1) * The key to the cabinets were rusty from many years of disuse.

Lago et al. (2019) demonstrated that genitive possessors (such as *painters in the painters' rival*) effect agreement attraction effects in Turkish. However, this finding appears to be at odds with Nicol, Barss, and Barker's (2016) results, who failed to find a similar effect in English. Lago et al. (2019) hypothesize that Turkish possessor noun phrases, unlike their English counterparts, may function as agreement attractors because Turkish genitive NPs may function as subjects of non-finite clauses in Turkish (Göksel & Kerslake, 2005; Kornfilt, 2011). As a result, Turkish genitive NPs may match the subjecthood feature used in the cue-based retrieval of a verb's subject (Arnett & Wagers, 2017; Lewis & Vasishth, 2005; Wagers et al., 2009).

In this paper, we test an alternative explanation of Lago et al.'s (2019) findings which is related to an instance of local ambiguity in **their** experimental sentences, as a result of which all subject head nouns were ambiguous between possessive and accusative case.

2. Agreement Attraction in Turkish

Turkish is an SOV word order language with overt case marking (Göksel & Kerslake, 2005; Kornfilt, 2011, 2013). For example, the possessor in the Turkish construction in

(2), which is similar to the Saxon Genitive, is marked with genitive case, while the head noun is marked with possessive case. Importantly, the possessive case marker coincides in form with the accusative case marker when the noun stem ends in a consonant: This is because in Turkish, case markers have different forms depending on whether the last sound of the stem is a vowel. In order to break up vowel-vowel clusters, Turkish uses epenthetic consonants such as *s*, *y*, or *n*. For example, the genitive case can surface as *-nin* or as *-in*, depending on the last consonant of the stem. The forms of the possessive marker and the accusative case are identical except for the epenthetic consonant. This means that they surface as *-i* in consonant-ending words, but as *-si* and *-yi* respectively in vowel-ending words.

- (2) [[teknisyen-in] eğitmen-i]
 technician-GEN instructor-POSS
 “the instructor of the technician”

Lago et al. (2019) demonstrated an agreement attraction effect in Turkish genitive-possessive constructions in a speeded acceptability judgment study with sentences like (3), in which the number of the attractor and the verb was manipulated. The resulting 2x2 design, indicated by brackets and slashes in (3), consisted of two grammatical conditions, in which the verb agreed **in number** with the singular subject head noun, and two ungrammatical conditions, in which the verb carried plural agreement, and thus did not agree with the subject. In ungrammatical sentences, they found a higher percentage of *acceptable* responses when the genitive attractor was plural than when it was singular, indicating agreement attraction. No such effect was found in grammatical sentences.

- (3) Teknisyen-{ler/Ø}-in eğitmen-i olağanüstü hızlı
 technician-{PL/SG}-GEN instructor-POSS extraordinarily fast
 koş-tu-{lar/Ø}.
 run-PST-{PL/SG}
 “The technician’s/technicians’ instructor **ran{PL/SG}** extraordinarily fast.”

Lago et al. (2019) hypothesized that these effects originated from how case and number information **are** encoded and retrieved: According to Lewis and Vasishth’s (2005) cue-based retrieval model, phrases are encoded in a content-addressable mem-

ory as bundles of features called *chunks* which include information like number, gender, case, and syntactic function (e.g., Smith & Vasishth, 2020). Under Lago et al.’s (2019) proposal, participants predict the number of the verb based on the noun phrases they process while reading the subject. 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 two cues: the subjecthood feature ([+SUBJECT]) and the plural feature ([+PL]). While neither of the available noun phrases matches this specification in ungrammatical agreement attraction sentences, each of the NPs headed by *technician* and *instructor* matches one of these cues. While this partial match mostly results in participants finding the sentence ungrammatical, they may retrieve the attractor *technicians* on some trials. Lago et al. (2019) argue that this erroneous retrieval may be facilitated by the genitive case marking on the attractor, because genitive NPs can function as subjects of embedded clauses in Turkish. Due to the ubiquity of genitive subjects, attractors marked with genitive case are a priori likely to be agreement controllers.

However, a potential problem with the stimuli in the Lago et al. (2019) study is that the stems of all head nouns such as *eğitmen-i* (*‘instructor’*) in (3) were consonant-ending, making their possessive forms ambiguous between possessive and accusative case due to case syncretism between them in vowel-ending stems (Göksel & Kerslake, 2005, pp. 66–67). As a result, the head noun (*‘instructor’*) in (4) can be disambiguated towards possessive case as in (4a), or towards accusative case as in (4b), where the genitive-marked noun functions as an embedded subject, and the matrix subject is omitted due to pro-drop. We also calculated the relative probability of having an accusative marked noun compared to an possessive marked noun following genitive marking. Data from annotated treebanks from Universal Dependencies v2.9 (Çöltekin, 2015; Kuzgun et al., 2020; Sulubacak et al., 2016; Türk et al., 2021, 2019) showed that the relative probability of encountering accusative marking after the genitive-marked noun is 0.21.

(4) a. POSSESSIVE INTERPRETATION

Teknisyen-in eğitmen-i koş-tu.
technician-GEN instructor-POSS run-PST
“The technician’s instructor ran.”

b. ACCUSATIVE INTERPRETATION

Teknisyen-in eğitmen-i kov-duğ-un-u gör-dü-m.
technician-GEN instructor-POSS fire-NMLZ-POSS-ACC see-PST-1SG
“I saw the technician firing the **instructor**.”

Because accusative NPs cannot function as subjects in Turkish, it is possible that Lago et al.’s finding of agreement attraction effects in sentences like (3) are not due to the genitive attractors’ association with subjecthood, but rather due to the head nouns’ *reduced association with subjecthood* due to its ambiguity.

Because sentences like (3) are locally ambiguous, participants may initially adopt an incorrect analysis of the genitive-possessive structure on some trials, and encode the genitive-marked first noun as the subject of an embedded verb and the ambiguous second noun as an accusative object. Under the assumption that remnants of an incorrect analysis affect the parsing process even after a successful reanalysis (Staub, 2007), the initial association between the genitive noun phrase and subjecthood may lead an agreement attraction effect. In contrast, this account predicts that the agreement attraction effect should be either significantly reduced or entirely absent when the head noun is unambiguous, as the function of the genitive noun phrase is disambiguated early, thus preventing potential digging-in effects (Tabor & Hutchins, 2004). We tested this hypothesis in a speeded-acceptability experiment with sentences similar to Lago et al.’s (2019), but with unambiguously marked vowel-ending head nouns.

3. The Present Study

The present study tested the predictions of the case syncretism account as an alternative explanation of the previously found agreement attraction effect in Turkish. To avoid the ambiguity present in Lago et al. (2019), we used vowel-ending head nouns such as *terzi* (‘tailor’), for which the possessive marker surfaces as *-si* and is distinct from the accusative (*-yi*). We hypothesized that if the morpho-phonological

ambiguity was a key factor in agreement attraction in Turkish, unambiguous sentences like ours in (5) should not elicit attraction effects.

- (5) a. *PLURAL ATTRACTOR, UNGRAMMATICAL (PLURAL VERB)
- | | | | |
|---|------------------|------------|----------------|
| [Milyoner-ler-in | terzi-si] | tamamen | gereksizce |
| millionaire-PL-GEN | tailor-POSS | completely | without.reason |
| kov-ul-du-lar. | | | |
| fire-PASS-PST-PL | | | |
| “The millionaires’ tailor were fired for no reason at all.” | | | |
- b. PLURAL ATTRACTOR, GRAMMATICAL (SINGULAR VERB)
- | | | | | |
|--|------------------|------------|----------------|-------------------|
| [Milyoner-ler-in | terzi-si] | tamamen | gereksizce | kov-ul-du. |
| millionaire-PL-GEN | tailor-POSS | completely | without.reason | fire-PASS-PST |
| “The millionaires’ tailor was fired for no reason at all.” | | | | |
- c. *SINGULAR ATTRACTOR, UNGRAMMATICAL (PLURAL VERB)
- | | | | | |
|---|------------------|------------|----------------|-----------------------|
| [Milyoner-in | terzi-si] | tamamen | gereksizce | kov-ul-du-lar. |
| millionaire-GEN | tailor-POSS | completely | without.reason | fire-PASS-PST-PL |
| “The millionaire’s tailor were fired for no reason at all.” | | | | |
- d. SINGULAR ATTRACTOR GRAMMATICAL (SINGULAR VERB)
- | | | | | |
|--|------------------|------------|----------------|-------------------|
| [Milyoner-in | terzi-si] | tamamen | gereksizce | kov-ul-du. |
| millionaire-GEN | tailor-POSS | completely | without.reason | fire-PASS-PST |
| “The millionaire’s tailor was fired for no reason at all.” | | | | |

3.1. Participants

We recruited 118 undergraduate students to participate in the experiment in exchange for course credit. All participants were native Turkish speakers, with an average age of 20 (range: 18 – 32). The experiment was carried out following the principles of the Declaration of Helsinki and the regulations concerning research ethics at Boğaziçi University. All participants provided informed consent before their participation and their identity **were** completely anonymised.

3.2. Materials

We used 40 sets of sentences like (5), in which we manipulated (i) the number of the attractor noun and (ii) the number agreement on the verb. Plural number and plural agreement were both marked with the suffix *-ler/-lar*, while the singular number and

singular agreement were marked by its absence. We used the experimental items from Lago et al. (2019) as a starting point for all items. We substituted ambiguous nouns for unambiguous alternatives, and in some cases, modified other parts of the sentence for plausibility reasons.

All sentences started with a complex subject NP like *milyonerlerin terziisi* “the millionaires’ tailor,” in which the genitive possessor functioned as the attractor, and the head noun carried an unambiguous possessive case marker. 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. Moreover, the semantic relationship between the possessor and the head noun was kept as it is in Lago et al.’s (2019) original study and genitive-possessive structures can be paraphrased using *’s* or *of* in English. The distribution of the verb types matched that of the original study, with twenty unergatives, eighteen unaccusatives, and two optionally transitive verbs. Pre-verbal adverbials also consisted of 2-3 words (15 characters on average).

One example set of experimental items is in (5). The subject phrase is marked with square brackets, and the dependency between the subject head and the matrix verb is signaled using bold-face.

We hypothesized that the experimental sentences in (5) might elicit a simple response strategy based on verb number because all ungrammatical sentences end with a plural-agreement-bearing verb. In contrast, all grammatical sentences end with a verb that lacks plural agreement, thus singular. As a result, some participants may resort to classifying sentence acceptability based on their last word after repeated exposure to sentences like (5). In order to preclude such a response strategy, we designed 40 filler sentences that would render it ineffective. We included 20 grammatical sentences like (6a) with plural and 20 ungrammatical sentences like (6b) with a singular verb. Filler items resembled experimental sentences in that they started with a complex genitive-possessive noun phrase. In contrast to the experimental items, however, the complex NPs were the subject of an adverbial clause instead of the main sentence. In grammatical fillers like (6a), we have used pro-dropped subjects, which enabled us to use plural verbs without having ungrammatical sentences.

- (6) a. GRAMMATICAL FILLER (PLURAL VERB)
- [Sosyolog-un **öğrenci-si**] konuş-unca tutarsızlık açığ-a
sociolog-GEN student-POSS speak-WHEN inconsistency open-DAT
çıkardılar.
deduct-PST-PL
“When the student of the sociologist spoke, they revealed an inconsistency.”
- b. *UNGRAMMATICAL FILLER (SINGULAR VERB)
- [Dansöz-ün **koca-sı**] var-inca kapı sakince **açtı.**
dancer-GEN husband-POSS arrive-WHEN door slowly open-PST
Intended: “When the husband of the dancer came, the door opened slowly.”

3.3. Procedure

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 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.

3.4. Analysis

In order to test whether the morphological ambiguity present in the Lago et al. (2019) sentences affected the presence or magnitude of the agreement attraction effect, we analyzed the data from the present experiment and compared our results to Lago et al.'s (2019) results, by including Lago et al.'s (2019) data in our Bayesian GLM and using the experiment as an additional factor in the analysis.

Prior to the analysis, we removed the data for all participants who failed to show sufficient sensitivity to the effect of grammaticality in singular attractor conditions, i.e., when no agreement attraction was expected. Specifically, we removed all participants for whom the difference in the percentage of *yes* responses between conditions with singular attractors (5d) and (5c) fell below the threshold of 0.1 percentage points. We also excluded trials in which the participants missed the response deadline. As a result, we excluded 3.39% of the trials from our experiment and 2.27% of the Lago et al.'s (2019) trials.

We analyzed responses using two Bayesian GLMs assuming a Bernoulli-distributed response with a probit link function. We used the R packages *brms* (Bürkner, 2018) and *rstan* (Stan Development Team, 2019) to fit Bayesian hierarchical models (e.g., Gelman & Hill, 2007; Nicenboim & Vasishth, 2016). We analyzed only experimental sentences and used (i) grammaticality of the sentence, (ii) attractor number, and (iii) presence of morphological ambiguity (i.e., experiment), as well as all their interactions as predictors. We used by-participant and by-item intercepts and slopes for all predictors and their interaction. All factors were sum-coded. A Student's *t*-distribution ($\nu = 3$, $\mu = 0$, $\sigma = 2.5$), a normal distribution ($\mu = 0$, $\sigma = 1$), a Cauchy distribution ($(\mu = 0, \sigma = 1)$) and a LKJ distribution ($\eta = 2$) were used for our intercept, slopes of predictors, standard deviations of random effects, correlation coefficients in interaction models respectively as priors.

Because the magnitude of the agreement attraction effect can be operationalised either as the interaction between grammaticality and the presence of a plural attractor, or as the effect of a plural attractor in ungrammatical sentences, we used a second model with predictors (ii) and (iii) and their interaction to analyze responses to ungrammatical conditions only.

In the results section, we provide summaries of the coefficient posterior distributions. For our model, we ran 4 chains with 1000 warm-up iterations and 1000 sampling iterations. The data for our study, along with our analysis scripts can be found at <https://osf.io/hegmd/>.

3.5. Results

Figure 1 shows the average proportions of “acceptable” responses by experimental condition in our experiment with unambiguous possessive marking, side by side with Lago et al.’s findings. It shows that ungrammatical sentences with plural attractors are rated as acceptable more often ($M = 0.24$, $SE = 0.01$) than their counterparts with singular attractors ($M = 0.14$, $SE=0.01$). The magnitude of the effect (0.10) was in line with the findings reported in Lago et al. (2019), where the difference was also 0.11. Accuracy rates for grammatical conditions were nearly equal ($M = 0.92$ and 0.91 , $SE = 0.01$ and 0.01 , for singular and plural attractors respectively).

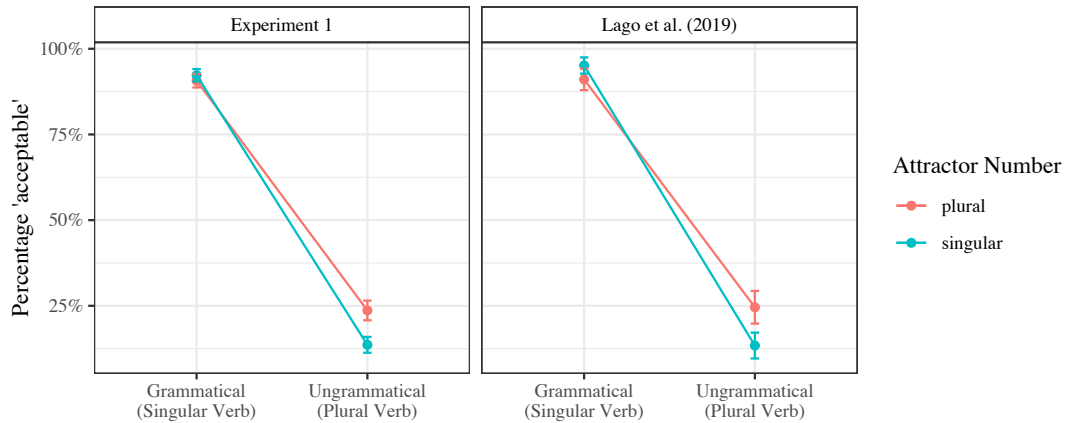


Figure 1. The average percentage of acceptable responses according to the experimental conditions in our study and Lago et al. (2019). Error bars signal standard errors calculated following Cousineau et al. (2005); Morey et al. (2008).

Figure 2 shows estimates and 95% credible intervals of a Bayesian GLM with a probit link function. The main effect of grammaticality ($\hat{\beta} = 3.01$; $CI = [2.76; 3.27]$; $P(\beta < 0) < .001$) indicates that, on average, participants were quite good at distinguishing between grammatical and ungrammatical sentences. Meanwhile, the negative interaction between grammaticality and attractor number ($\hat{\beta} = -0.71$;

$CI = [-1.00; -0.44]$; $P(\beta < 0) > .999$) indicated a larger difference (positive) effect of plural attractors in ungrammatical conditions, and thus a number agreement attraction effect. There was weak evidence for a negative three-way interaction between the presence of ambiguity, ungrammaticality, and attractor number ($\hat{\beta} = -0.29$; $CI = [-0.81; 0.20]$; $P(\beta < 0) = .88$), which was largely driven by differences in the effect of attractor number in *grammatical conditions*, as the magnitude of the effect in the ungrammatical conditions was identical in both experiments (). This is consistent with the estimates of the model based on ungrammatical sentences in Figure 3, which show no indication of an interaction between ambiguity and the presence of a plural attractor ($\hat{\beta} = 0.06$; $CI = [-0.25; 0.37]$; $P(\beta < 0) = .36$). It also showed a main effect of plural attractor ($\hat{\beta} = 0.50$; $CI = [0.32; 0.67]$; $P(\beta < 0) < .001$). Taken together, the coefficients indicated a substantial agreement attraction effect regardless of the presence of local ambiguity.

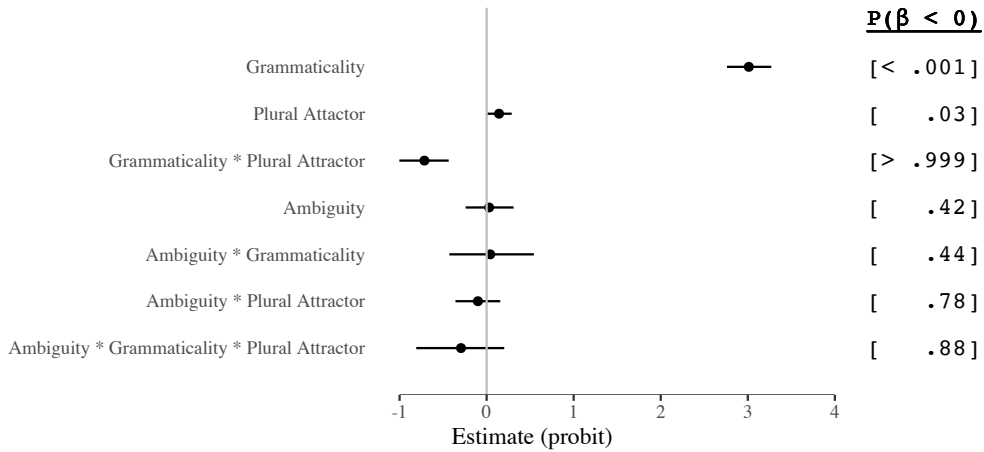


Figure 2. Estimates and 95% credible intervals for the probit regression coefficients for the model of responses in our experiment and Lago et al. (2019).

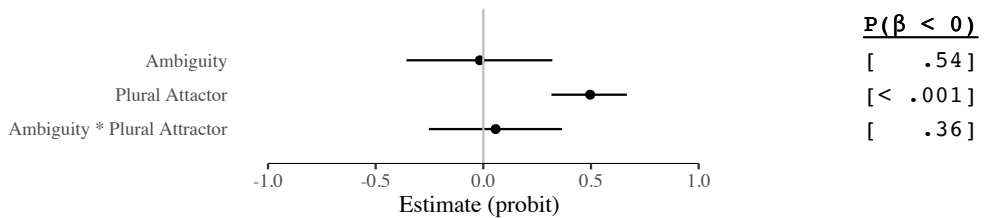


Figure 3. Estimates and 95% credible intervals for the probit regression coefficients for the model of responses to **ungrammatical sentences** in our experiment and Lago et al. (2019).

4. Discussion & Conclusion

We re-examined the findings of Lago et al. (2019) and investigated the contribution of a possible confound to their finding of an agreement attraction effect in genitive-possessive constructions in Turkish. Our main question was whether Lago et al.’s (2019) findings can be explained by an alternative hypothesis: Because in their experimental sentences, all head nouns were locally ambiguous between the possessive and the accusative case (a non-subject case in Turkish), we hypothesized that this may have weakened the strength of association between the subject head noun and the subjecthood feature. If Turkish agreement attraction effects in genitive-possessive structures resulted from this ambiguity, we expected the absence of agreement attraction effects when the case of the head noun was unambiguous.

Our experimental findings were comparable to Lago et al. (2019): We observed that the presence of a plural attractor increased the rate of erroneous “acceptable” responses in ungrammatical sentences. Importantly, we did not find an effect of case ambiguity: While our model based on all experimental conditions indicated a weak three-way interaction between ambiguity, grammaticality, and attractor number, a model based on ungrammatical sentences only demonstrated that this is due to a difference in acceptability rates in grammatical conditions. This model showed no evidence of an interaction between attractor number and ambiguity, indicating no evidence of a modulation of the effect size of the agreement attraction effect by the presence of a local case ambiguity. Although the 95% credible interval for the interaction term was relatively wide, our findings indicate the presence of a substantial agreement attraction effect regardless of the presence of local ambiguity. Thus, we successfully replicated the findings of Lago et al. (2019) with disambiguated head nouns.

Taken together, our results suggest (i) that agreement attraction effects in Turkish are not due to a reduced association between case-ambiguous nouns and the subjecthood features, and (ii) that local ambiguities, such as case syncretism, do not appear to play a role in agreement attraction. Participants do not appear to rely on form-related cues in their decision-making processes and instead use of abstract linguistic features as retrieval cues.

Abbreviations

DAT = dative, GEN = genitive, NMLZ = nominaliser, PASS = passive, PL = plural, POSS = possessive, PST = past, SG = singular, WHEN = when.

Authors' Contributions

Utku Türk conceived the initial version of the presented idea. Both authors designed the experiment together. Utku Türk wrote the stimuli and conducted the experiment. The statistical analysis was carried out by Pavel Logačev; Utku Türk prepared all summaries and plots. Utku Türk wrote the first draft of the manuscript and both authors edited it subsequently.

Data Availability Statement

All data and R code used in the data analysis is available at <https://osf.io/hegmd/>.

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