

# Effect of order of mention and grammatical role on pronoun resolution in Georgian

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**Abstract.** Experimental evidence on pronoun resolution has shown that speakers have difficulties in interpreting ambiguous referential. The current study, conducted with speakers of Georgian, targeted factors, which might differentially impact the resolution of ambiguous pronouns. Specifically, we investigated the effect of grammatical role parallelism and order of mention of an antecedent. Results of eye-tracking data reveal an overall bias towards the object antecedent irrespective of the subject or object pronoun. In addition, the effect of grammatical role parallelism were decreased inspections of the object antecedent shortly after encountering the subject pronoun. The results from the sentence-completion test further corroborate the effect of grammatical role parallelism for subject pronouns by showing a greater resolution towards the subject antecedent.

**Keywords:** pronoun resolution, grammatical parallelism, eye-tracking, offline sentence-completion test

## 1 Introduction

It is well known that pronoun interpretation is guided by the complex interactions of multiple cues. Factors shown to influence pronoun resolution range from topicality, first/second mention [1, 2] and discourse status [3, 4] to positional [5, 6] and grammatical role parallelism [6, 7]. Particularly, this final aspect has garnered increasing interest in the ongoing investigation on pronoun resolution [8, 9]. For example, a recent study [10] investigated grammatical role parallelism in German with highly proficient L2 speakers (Georgian L1). Findings from this study revealed that L2 speakers showed a bias towards the object antecedent compared to L1 speakers, when resolving the ambiguous pronouns.

In the current study, our goal was to examine how the aspects of order of mention and grammatical role parallelism influence pronoun interpretation in Georgian, a language that is not well-studied with respect to anaphora resolution. Furthermore, we aimed to determine whether the previously found object bias preference [10] would be replicated with speakers in their native language.

Georgian is a language with a variable word order, where six distinct word order permutations are possible. Of these, subject-object-verb and subject-verb-object word orders occur most frequently (11) with the subject preceding the

predicate (e.g., [12, 13]). Grammatical role is indicated with the morphological case marking of the noun phrases.

By conducting an eye-tracking experiment and an offline sentence completion experiment, we examined the resolution of ambiguous pronouns towards antecedents in sentences such as (e.g., *post'alion-i*, Lit. "the postman-NOM" and *mezrvaur-s*, Lit. "the sailor-DAT", see Table 1). The role of grammatical parallelism was tested by introducing the subsequent sentence with a pronoun either as the subject (*is*, "he") or as the object (*mas*, "him") (Table 1). With these experiments we aimed to collect behavioural and offline data in a language that is less well-studied with respect to pronoun processing.

## 2 Methods

**Participants:** Twenty four Georgian speakers (13 females, 11 males; age range: 18 to 26;  $M = 21.2$  years,  $SD = 2.27$  years), students of universities in Tbilisi and Batumi, took part in the experiment. All participants were paid 10 Lari for their participation. They all had normal or corrected-to-normal vision, and were unaware of the purpose of the experiment.

**Materials:** The same visual stimuli was used as in the previous study [10]. These consisted of three simply structured images displayed on the computer screen: two human or animal agents and one inanimate item or place (see Figure 1). For the linguistic materials, new sentences were recorded spoken by two female native Georgian speakers (see Table 1). The critical antecedent sentences were in the subject-verb-object word order, followed by a sentence with a subject or an object pronoun at the initial place in the sentence. The pronoun itself was ambiguous as either antecedent was a plausible referent (i.e., the postman and the sailor). In addition to the 20 critical items, we created 40 filler items. Thus, each pseudo-randomised list contained every critical item in one of the two conditions and all fillers.

**Procedure:** Using a Tobii Eye-tracker device, the gaze of each participant was successfully calibrated prior to beginning the experiment. During the eye-tracking section, the participants' task was to carefully watch the depicted images and listen to one of the sentences in Table 1, while their eye-movements were recorded. After completing the eye-tracking study, participants completed an offline sentence-completion test. In this test, power-point slides displayed the images of the critical items. The introductory and following antecedent sentence were shown in their entirety below the images on the slide; however, the third sentence ended directly after the pronoun. Participants were asked to manually write down to which of the antecedent characters they thought the pronoun referred to.

**Analyses and results:** Figure 2a shows the time course of participants' eye fixations, which includes the 200 milliseconds before and 1200 milliseconds after the pronoun onset. The data represent the proportion of looks to the antecedents. The solid line shows trials with the subject pronoun condition and the dotted line indicates trials with the object pronoun condition. The solid vertical line at 0 ms indicates the onset of the pronouns. For the offline data (Figure 2b),

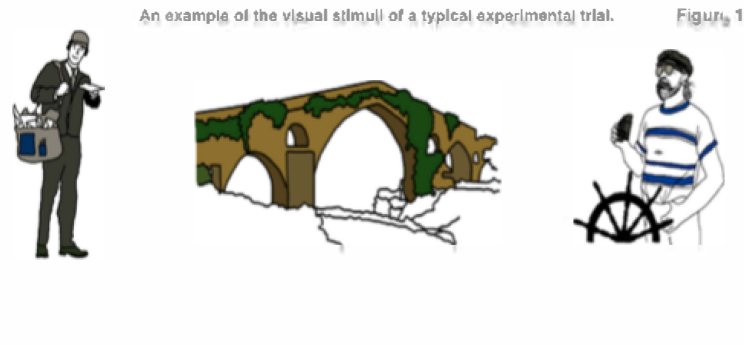
bar charts were created on the basis of the frequency of resolving the pronouns towards the subject and object antecedents.

Eye-tracking results revealed that the divergence of looks to the subject and object antecedents as a function of grammatical role parallelism began at around 200 ms after the pronoun onset. Notwithstanding the overall preference towards the object antecedent, the subject antecedent was selected more often in the subject pronoun condition than in the object pronoun condition. The effect of grammatical parallelism seems to last about 400 ms, before the lines in both conditions came close to each other. In the offline test, participants also resolved the subject antecedent more often when they read subject pronouns, whereas no preferential bias was shown in the object condition.

**Discussion:** The current eye-tracking study and sentence completion test examined the effects of the grammatical role and order of mention of antecedents on pronoun processing in Georgian [5, 6]. Antecedent sentences with subject-verb-object word order followed by sentences beginning with the subject or the object pronoun composed the two contexts under investigation (see Table 1). The eye-tracking findings indicate that after encountering the subject or object pronouns, listeners showed the use of grammatical role parallelism particularly for the subject pronoun. The early application of the grammatical parallelism might be explained by the frequency of the first mention of the subjects in Georgian (e.g., [11]), and are in line with previous research that showed the use of grammatical cues (e.g., [8, 9, 10]). The overall strong preference towards the object antecedent is somehow surprising but it is in line with findings with speakers of Georgian in L2 language [10]. One of the explanations why Georgian speakers favour the object antecedent in pronoun resolution in comparison with other findings (in other languages i.e. [4,8,9]) might be the syntactic ergative features, as the subject role in the language is shared between the nominative and ergative cases depending on series of screeves. However, further experimental data needs to be gathered to confirm this assumption. The offline sentence-completion experiment partly supports the eye-movements' data. As participants did relate the subject pronoun to the subject antecedent strongly, their response pattern in the object pronoun did not reveal any preference.

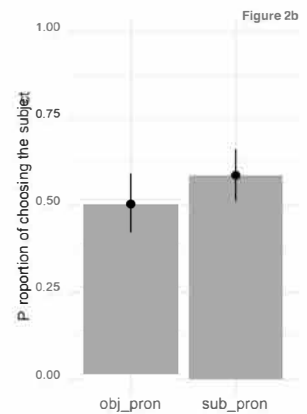
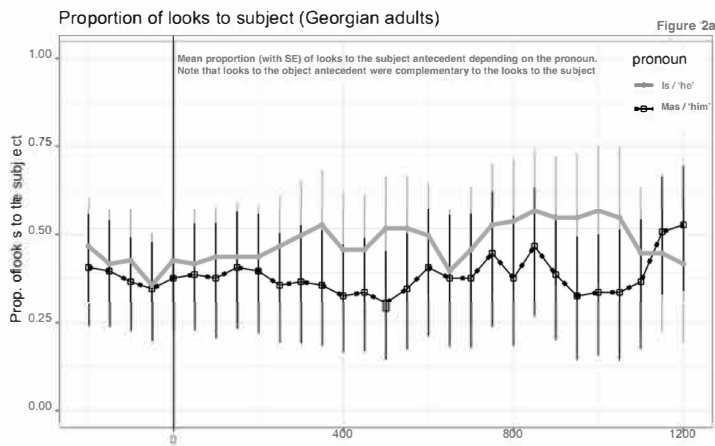
Summarising our results, we found evidence for the application of grammatical role parallelism in both pronoun conditions, fully in the online study and partly in the sentence-completion test. The eye-tracking data showed a bias towards the object antecedent that replicated previous findings with Georgian speakers in their L2. The differences between online and offline results in the application of grammatical parallelism suggests that the cues might be ranked differently due to experimental methodology.

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**Table 1.** Example experimental sentences and conditions.

Conditions	Sentences
Introduction	მეზღაური და ფოსტალიონი თანხმდებიან ზღვაზე შეხვედრაზე. Lit. „The sailor and the postman arrange to meet on the shore.“
SVO, SubjPron	a). ფოსტალიონი იხმობს მეზღაურს ხიდის წინ. ის მოიქცა მამაცურად. Post'alion-i ixmobs mezღvaur-s xidis c'in. Is moikca mamacurad Lit. „The postman-NOM calls the sailor-DAT in front of the bridge. He-NOM behaved brave“
SVO, ObjPron	b). ფოსტალიონი იხმობს მეზღაურს ხიდის წინ. მას ახარებს სიურპრიზი. Post'alion-i ixmobs mezღvaur-s xidis c'in. Mas axarebs siurp'rizi Lit. „The postman-NOM calls the sailor-DAT in front of the bridge. Him-DAT gladdened the surprise.“



## References

- [1] Bosch, and Umbach (2007); [2] Järvikivi, et al., (2017); [3] Bosch, et al., (2003); [4] Kaiser and Trueswell (2008); [5] Chambers and Smyth (1998); [6] Smyth (1994); [7] Frazier, et al., (2000); [8] Poirier et al., (2012); [9] Sauermaun and Gagarina (2017); [10] Abashidze, et al., (2022); [11] Apridonidze (1986); [12] Asatiani and Skopeteas (2012); [13] Harris (2000);