Computing object agreement in Georgian is easier than computing subject agreement

Steven Foley & Matt Wagers (UC Santa Cruz)
srfoley@ucsc.edu

Introduction • Verbal agreement is well studied in sentence processing, but research has focused almost exclusively on agreement dependencies between verbs and their subjects. Just a handful of studies have compared subject–verb and object–verb agreement (all on Basque). Results from both production [1] and ERP studies [2, 3] suggest that the two types of dependencies are processed qualitatively differently in that language.

The present study explores this claim in Georgian, to test whether asymmetries in processing subjects vs. objects are grounded in the syntactic representation per se, or from the mapping of morphological cues to argument features. This language makes for a particularly good testing ground, since its agreement morphemes 'invert' their roles in certain contexts: affixes that usually index subjects will occasionally index objects, and vice versa. It is thus possible to tease apart whether perceptual difficulty arises from an agreement dependency's syntactic properties (if it tracks a subject or object), or from its morphological properties (if it involves a more or less frequent mapping between morphemes and syntactic roles). Based on a speeded acceptability task, we find that processing difficulty seems to depend on both these factors: intuitively, agreement errors are harder to detect if they involve the rarer morphosyntactic mapping; and, counterintuitively, harder if they track subjects.

Design • Georgian verbs agree with both their subjects and objects, but agreement morphemes can be mapped to syntactic roles in two different ways, depending on the verb's tense. Most tenses exhibit the Normal Mapping (1): one set of affixes ('Set A', including the prefix *v*–) indexes subjects, and another ('Set B', including *m*–) indexes objects. In contrast, the perfect tenses exhibit the Inverse Mapping (2): now Set A morphemes indicate objects, and Set B morphemes indicate subjects. We tested Georgian speakers' sensitivity to agreement in an acceptability judgement study (N_{SUBJ}=55). 64 item-sets were constructed in a 2×2×2 design, crossing agreement <u>Controller</u> (1st/2nd-person *Subject*, *Object*), agreement <u>Mapping</u> (*Normal, Inverse*), and <u>Grammaticality</u> (✓*Grammatical*, **Ungrammatical*). A sample itemset is given in (3). Word order (SOV or OSV) was counterbalanced across itemsets. Stimuli were presented via RSVP; and participants gave a speeded judgement, followed by a confidence rating.

Results • There were more errors in Inverse Mapping conditions ($p < .01$), and — perhaps surprisingly — there were also slightly more errors in Subject Controller conditions ($p < .10$). In judgment times, we found that ungrammatical conditions were fastest to be judged correctly ($t = 3.5$), and that ungrammatical *object* conditions were recognized even faster ($t = 3.3$). An ROC curve analysis [4] showed that d_a, a robust measure of sensitivity, is highest for normal object agreement, and lowest for inverse subject agreement (full details omitted; see Table 1).

Discussion • The fact that speakers are less sensitive to grammaticality when inverse agreement is used is genial to many approaches, because the Inverse Mapping is less common and more morphosyntactically marked. But, the fact that object agreement is more reliably processed than subject agreement in Georgian is prima facie a challenge for existing findings, where subject agreement often seems to be easier. Yet we remain skeptical of positing inherent complexity differences between subject/object agreement. In further analyses, we examined the effects of temporary ambiguities in our stimuli stemming from word order and case syncretisms in pronouns. We found that object agreement was overall best discriminated in S**OV** clauses [d_a: 1.47], and subject agreement in O**SV** clauses [d_a: 1.44] — both orders in which the argument that controls an agreement prefix is linearly most local, and/or where uncertainty due to pronominal case syncretism may be alleviated by morphological cues from a preceding co-argument. Generally, we conjecture that object agreement will be correctly computed more often because there are fewer case values compatible with being an object [cf. 5]. There are thus fewer incremental hypotheses to resolve, rightly or wrongly. This is an open area for future investigation in Georgian.

(1) **Normal Agreement Mapping — Set A (*v*– …) = S.AGR; Set B (*m*– …) = O.AGR**

a. *me* *datv-s* ***v**-naxav.*
1SG(.NOM) bear-DAT **1SG.SET.A**-see.FUT
'I will see see the bear.'

b. *datv-i* *me* ***m**-naxavs.*
bear-NOM 1SG(.DAT) **1SG.SET.B**-see.FUT
'The bear will see me.'

(2) **Inverse Agreement Mapping — Set A (*v*– …) = O.AGR; Set B (*m*– …) = S.AGR**

a. *me* *datv-i* ***m**-inaxavs.*
1SG(.DAT) bear-NOM **1SG.SET.B**-see.PERF
'I have seen see the bear.'

b. *datv-s* *me* ***v**-unaxivar.*
bear-DAT 1SG(.NOM) **1SG.SET.A**-see.PERF
'The bear has seen me.'

(3) **Sample Stimuli**

a. 1st/2nd-person subject, Normal agreement
me *kal-s* *ṭq̇e-ši* {✓*vnaxav*, **mnaxavs*}.
1SG(.NOM) woman-DAT forest-in {see:FUT.1>3, *see:FUT.3>1}
'I will see the woman in the forest.'

b. 1st/2nd-person subject, Inverse agreement
me *kal-i* *ṭq̇e-ši* {✓*minaxavs*, **vunaxivar*}.
1SG(.DAT) woman-NOM forest-in {see:PERF.1>3, *see:PERF.3>1}
'I have seen the woman in the forest.'

c. 1st/2nd-person object, Normal agreement
kal-i *me* *ṭq̇e-ši* {✓*mnaxavs*, **vnaxav*}.
woman-NOM 1SG(.DAT) forest-in {see:FUT.3>1, *see:FUT.1>3}
'The woman will see me in the forest.'

d. 1st/2nd-person object, Inverse agreement
kal-s *me* *ṭq̇e-ši* {✓*vunaxivar*, **minaxavs*}.
woman-DAT 1SG(.NOM) forest-in {see:PERF.3>1, *see:PERF.1>3}
'The woman has seen me the forest.'

Controller	Mapping	Gram.	Accuracy	RT	d_a
Subject	Normal (3a)	✓	63%	1059 (36)	**1.2** [1.1, 1.4]
		*	83%	1019 (34)	
	Inverse (3b)	✓	60%	1016 (34)	0.9 [0.7, 1.1]
		*	79%	1059 (35)	
Object	Normal (3c)	✓	65%	1046 (35)	**1.3** [1.1, 1.5]
		*	86%	901 (31)	
	Inverse (3d)	✓	64%	1071 (34)	1.2 [1.0, 1.4]
		*	82%	956 (33)	

Table 1: *Percent correct, mean judgement reaction time in ms (SEs), and d_a calculated from an unequal-variance binormal ROC curve (95% C.I.s, via bootstrap)*

References • [1] Santesteban, M., et al. 2013. *JML*, 68:160–179. [2] Zawiszewski, A., & A. D. Friederici. 2009. *Brain Research*, 1284:161–179. [3] Chow, W. Y., et al. 2018. *Cortex* 99, 319–329. [4] Macmillan, N.A. & Creelman, C. D. 2005. *Detection theory: A user's guide*. Psychological Press. [5] Skopeteas, S., et al. 2012. In *Case, Word Order and Prominence*. Springer.