Grammatical agreement can direct eye movements: Evidence from monolingual and bilingual processing in Russian

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Listeners use linguistic (verb affordances, thematic roles, etc.) and non-linguistic information (task effects and personality characteristics) to predict the potential referents in a visual scene. A few studies have been conducted to measure predictive processing of such morphosyntactic features as gender and case, but effects of grammatical agreement in gender and especially in number have yet to be investigated. Here we ask whether agreement in number and gender (subject-predicate and modifier-noun) can cause anticipatory eye movements to the referent that is yet to come in monolingual and bilingual heritage spoken language comprehension.

The participants were 25 monolingual and 25 bilingual heritage Russian speakers who learned Russian as their first language but switched to English when their families immigrated to the U.S. Participants' eye movements were recorded as they viewed 30 visual displays with 4 animated pictures. Each picture depicted the same event (e.g., flying) using different agents. In the Fem-UNAMB condition, the Target *ptica* 'bird$_{FEM}$' contrasted in gender with two objects (a balloon and a plane, both masc) and the third picture in plural (clouds, PL). In the Fem-AMB condition, there was a Competitor of the same gender (a rocket). The gender of the Target was crossed with referential ambiguity, i.e., Gender of the Target (masc vs. fem) x Referent (UNAMB vs. AMB). The 5th Plural condition used 2 objects (clouds) as Target without gender. The participants listened to the sentences in (1)-(2) and clicked on the Target (the bird or the clouds). The inverse word order Locative-V-Adj-N ensured that the pre-nominal number and gender agreement markers were available twice (on the V and Adj) in all five conditions and *prior* to the N referent, but their first occurrence was ~600 ms *earlier* in the PL and UNAMB conditions.

(1) **FEM:** *Po nebu letel**a*** *serebrist**aja*** *ptic**a**.* **MASC:** *Po nebu letel* *serebrist**yj*** *samolet.*
In sky was flying$_{Fem-Sg}$ silver$_{Fem-Sg}$ bird$_{Fem-Sg}$ In sky was flying$_{Masc-Sg}$ silver$_{Masc-Sg}$ plane$_{Masc-Sg}$

(2) **PL:** *Po nebu leteli* *serebrist**ye*** *oblak**a**.*
In sky were flying$_{Pl}$ silver$_{Pl}$ clouds$_{Pl}$

The monolinguals were at ceiling for accuracy (0.04% errors) and significantly faster (by ~470 ms) (Table 1) than the heritage speakers (5.7% errors in the gender but not in the number condition).For the number agreement, total proportions of looks during the Adj region indicate that both monolingual (48.07%) and bilingual (44.67%) participants were able to rapidly compute the Target from the V agreement alone. For gender agreement, similar but overall weaker predictive effects were found in the Fem-UNAMB condition (38.17% vs. 37.63%). However, bilinguals didn't use gender agreement in Masc-UNAMB; they also exhibited a significantly longer competition than monolinguals in both AMB conditions. Thus, number cues (available in Russian and English) were informative of the identity of the upcoming N referent whereas gender cues were used differentially. These findings provide a novel evidence for predictive effects of morphosyntactic cues on eye movements, but show that number and gender can be processed differently based on the degree of their perceptual salience.

Table 1. Accuracy, RTs, and Looks to Target during the Adjective Region

	MONOLINGUAL			BILINGUAL		
	Accuracy (%)	RTs (ms)	Looks to T (%)	Accuracy (%)	RTs (ms)	Looks to T (%)
PLURAL	99.4	4040	48.07	100	4594	44.67
UNAMBIGUOUS:						
Fem	100	4249	38.17	98.67	4695	37.63
Masc	99.3	4140	37.65	90.71	4600	24.66
AMBIGUOUS:						
Fem	99.4	4293	34.73	92.62	4716	26.45
Masc	100	3987	33.11	92.50	4457	29.02