Neural correlates of expectation violations and discourse updating: The case of Bulgarian object agreement

Paul Compensis, Petra B. Schumacher (University of Cologne)

A core feature of language is to identify as quickly and unambiguously as possible *who did what to whom* and to keep track of participating referents as discourse unfolds. Thereby, the processing of argument structure is driven by contextual predictions as well as cue-based attention shifts. In order to facilitate predictions or highlight attention shifts, most languages use word order, case and/ or verb agreement, indicating to the listener which role a referent currently fulfils in a sentence. While order, case and subject-verb agreement received considerable attention in empirical linguistics, object agreement still requires experimental investigation.

In Bulgarian, objects in pre-verbal position are frequently marked with an object clitic (traditionally known as clitic doubling, CLD) [1]. Interestingly, these clitics can either serve as stand-alone pronouns in subject-clitic-verb (SCV) constructions (a) or as object agreement markers co-referring to an object NP in the same sentence (b). However, in line with the *subject-first preference* [2] we assume that in the case of two equally ranking referents an initial NP is always interpreted first as the subject of a sentence. In the case of CLD, the presence of the object agreement marker should enforce a reanalysis towards an object-initial interpretation. However, due to the normatively marked nature of CLD in Bulgarian, the validity of the object agreement marker as an attentional cue in role interpretation is a matter of debate. In order to test the online processing of CLD, we conducted an ERP study in which we contrasted SCV and CLD to reference mismatches (RFM, example c) and agreement violations (AGV, example d).

Previous ERP research found that cross-linguistically RFM and AGV typically engender an N400 followed by a late positivity (LPS) [3]. In general, the N400 component correlates with stimulus predictability in language processing [4] and particularly with expectation-based linking mechanisms with respect to referents [5]. The LPS is associated with reanalysis, also during referent shifts and discourse updating [5]. We assumed that CLD engenders a similar pattern due to its lower cue availability (reflected in the N400 pattern) and subsequent reanalysis (reflected in the LPS). However, these effects should be less pronounced in comparison to AGV and RFM.

In our ERP study, 20 participants read a context sentence introducing two referents of different gender and a target sentence (in either of the four conditions) presented as RSVP for 450 ms per word. Each target sentence started with a NP referring to one of the two referents from the context sentence. By manipulating grammatical gender of the clitic and the verbal ending, either the object or the subject agreement marker or both agreed with the gender of the first or second referent (or potentially with a third, non-specified referent), leading to the four conditions exemplified in (a-d). This allowed for testing expectation violations and discourse updating for both agreement types. 40 stimuli per condition were presented in segments and ERPs were measured time-locked to both agreement markers. After pre-processing, we calculated linear mixed-effect models with mean fitted values from 0 to 1000 ms in steps of 100 ms as dependent variable and CONDITION as fixed factor as well as two continuous factors SAGITTALITY and LATERALITY.

As predicted, the initial occurrence of the divergent clitic (in RFM and CLD) engendered an N400-LPS pattern at the position of the clitic (***ja/go***), indicating an expectation violation followed by an attempt to resolve the interpretation by searching for a new referent. At the subject agreement position (*napusna-**l/la***), a graded N400 effect (SCV < CLD < RFM < AGV) and a graded LPS effect (SCV < RFM/CLD < AGV) emerged for the non-canonical conditions. Thus, this study replicated previous findings concerning AGV and RFM and, in addition, showed that reanalysis towards an object-initial order by means of an object agreement marker (CLD) causes a smaller expectation violation than RFM and AGV, also reflecting some cue availability of CLD, but also causes discourse updating that is comparable to the establishment of reference to a non-specified referent (as in RFM).

Example stimuli for the four conditions (with clitic and agreement positions in bold):

Context sentence: Did you hear the news about Petar and Marija?

(a) Subject-Clitic-Verb (SCV)
Petar **ja** e napusna-**l** sled sporovete.
*Petar.M **she.ACC** leave-**PTCP.M** after the argument.*
'Petar left her after the argument.'

(b) Clitic doubling/ Object agreement (CLD)
Petar **go** e napusna-**la** sled sporovete.
*Petar.M **he.ACC** leave-**PTCP.F** after the argument.*
'She left (him) Petar after the argument.'

(c) Reference mismatch (RFM)
#Petar **go** e napusna-**l** sled sporovete.
*Petar.M **he.ACC** leave-**PTCP.M** after the argument.*
'Petar left him after the argument.'

(d) Agreement violation (AGV)
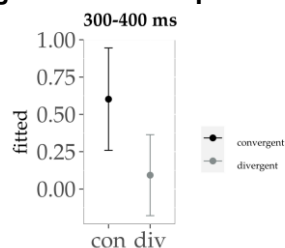*Petar **ja** e napusna-**la** sled sporovete
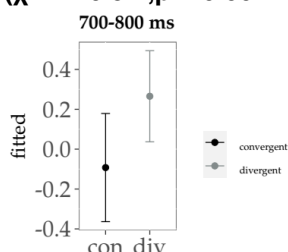*Petar.M **she.ACC** leave-**PTCP.F** after the argument*
'Petar (she) left her after the argument.'

ERP effect plots in relevant time windows:
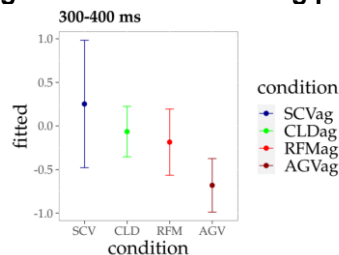
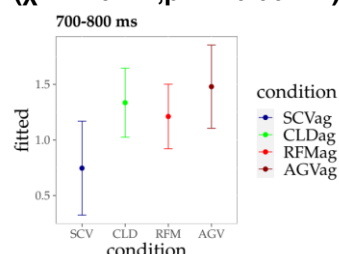**Object agreement/ clitic position**

(χ2 = 10.32 ,p = 0.001**)

(χ2 = 6.34 ,p = 0.012*)

Subject agreement/ verbal ending position

(χ2 = 26.11 ,p = < 0.001***)

(χ2 = 24.8 ,p = < 0.001***)

Grand-average ERPs at electrode Pz:
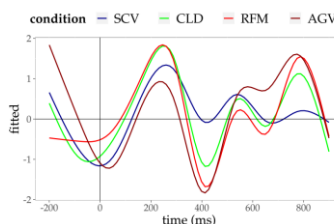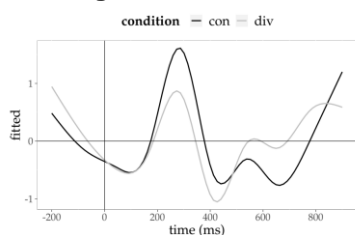
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