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ERP indexes of number attraction and word order during correct verb agreement production

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ABSTRACT

Successful subject-verb agreement production requires retrieving the verbal forms that agree with the features of the subject head noun and not of other nouns in the sentence. We investigate, for the first time, the electrophysiological indexes of number attraction and word order during agreement production. Twenty-four Basque native speakers were tested while producing auxiliary verbs during sentence completion of transitive sentence preambles involving singular subjects and singular or plural objects in canonical (SOV) and non-canonical (OSV) structures. ERP results yielded a larger production P2 (pP2) amplitude for mismatching than matching objects in SOV sentences, and larger negativity for OSV than SOV in number matching condition. We explain these results in terms of distinct contributions of number and word order during correct agreement production, with the pP2 indexing morphosyntactic retrieval difficulty of agreement-inflection, and the frontal negativity reflecting word order effects during monitoring the correctness of the selected verbal form.

1. Introduction

Morphosyntactic processes that involve computations of subject-verb number agreement are a core aspect of everyday language (see Acuña-Fariña, 2009; Fleischer, Rieken, & Widmer, 2015 for reviews). To investigate this syntactic phenomenon, most psycholinguistic production studies have used error-elicitation tasks manipulating the number and/or position of a subject and a local noun or object (e.g., Bock & Miller, 1991; Bock & Eberhard, 1993; see Vigliocco & Hartsuiker, 2002, for a review). These studies have demonstrated that plural nouns (attractors) that are not the subject head (e.g., local nouns within the subject noun phrase (NP) or objects) can interfere in the agreement process resulting in subject-verb agreement "attraction" errors (e.g., **The key to the cabinets are…*; Bock & Miller, 1991). Explanations of the origin of this effect have mainly considered the difference between the morphological number of the subject noun and that of the-closest-to-the-verb noun (e.g., Bock & Miller, 1991; Haskell & MacDonald, 2003).

According to the Marking and Morphing model (Eberhard, Cutting, & Bock, 2005), agreement occurs in two stages: During Marking, the number of the subject NP is determined based on the notional number of its referent. Later, during the structural integration that binds lexical and structural forms, the number morphology of the agreeing verb (or pronoun) is selected through Morphing. Non-semantically based attraction effects occur during Morphing, when the number mismatching information of a non-subject head noun merges with the number of the subject head and the outcome of this morphing process is copied to the agreeing verb. The likelihood of the number features of a noun to percolate to the verb instead of those of the subject head is modulated by morphosyntactic markedness: plural nouns are more likely to pass their number to a verb than unmarked singular nouns (Bock & Eberhard, 1993; Eberhard, 1997), and hierarchical factors: the closer the attractor noun is hierarchically to the head the stronger the attraction effect (e.g., Franck, Vigliocco, & Nicol, 2002; Gillespie & Pearmutter, 2011).

Proximity of the attractor to the verb and word order factors also modulate attraction as shown by Haskell and MacDonald (2005), who investigated the role of linear proximity of the attractor in relation to the verb by employing disjunctive structures. They demonstrated that the verb tended to acquire the singular or plural number properties of its closest noun, both when the noun preceded (*Can you tell me whether the horses or the clock is/are red?*) and followed the verb (*Is/are the horses or the clock red?*). That is, speakers tended to agree with *clock* in the former structure and with *horses* in the latter. This was interpreted as evidence for a single-stage approach to agreement processing (Pickering, Branigan, & McLean, 2002), whereby linear order

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information is available when agreement is computed.

Subject-verb agreement errors can be also elicited by object nouns, as suggested by Santesteban, Pickering, and Branigan (2013), who tested the effects of linear proximity and word order on attraction in Basque, a free word-order, head-final language, where the verb agrees in number both with the subject and the object. Subject and object agreement is morphologically unmarked for singular but distinctive for plural morphemes (e.g., *-te* for 3rd person plural subjects and *-it-* for 3rd person plural objects: e.g., S_{SG}-O_{SG} = *du*; S_{PL}-O_{SG} = *dute*; S_{SG}-O_{PL} = *ditu*; S_{PL}-O_{PL} = *dituzte*). During sentence completion with singular or plural subjects and objects, with canonical SOV or non-canonical OSV order, participants produced more errors in plural subject-verb and object-verb agreement when the two arguments mismatched than matched in number. This showed that non-subject arguments can elicit subject-verb attraction effects (see also, Feiz & Cowles, 2019; Hartsuiker, Antón-Méndez, & Van Zee, 2001). Overall, participants produced more errors in OSV than SOV order, but this order effect interacted with agreement-type, with more subject-verb than object-verb agreement errors in SOV sentences, and more object-verb than subject-verb agreement errors in OSV sentences. These findings revealed both proximity (more errors were elicited by linearly intervening than non-intervening attractors) and word order effects (more errors in OSV than in SOV), indicating that agreement is computed over ordered syntactic representations. The Marking and Morphing model straightforwardly accounts for subject-verb errors elicited by nouns inside the subject NP, but does not account for proximity effects and errors elicited by objects.

Cue-based retrieval models (Badecker & Kuminiak, 2007) explain these effects in terms of interference, assuming that all activated nouns interfere during the retrieval from memory of the agreement controller. All active nouns bearing subjecthood cues similar to those of the agreement controller (i.e., animacy, case marking, being a sentence-initial argument, etc.) can be erroneously selected due to similarity-based interference. Assuming that agreement is encoded over syntactically ordered structures, nouns linearly closer to the verb than the controller can elicit errors due to their higher activation. Similarly, since sentence-initial arguments usually receive subjecthood cues, erroneous cue-retrieval probability increases in non-canonical OSV sentences.

The findings reviewed above indicate that verbal agreement is affected by both linear proximity and word order, yet the methodology of error elicitation does not allow sketching the time course during which agreement encoding might be affected by word order. Identifying the way syntactic processes and computations take place in real time cannot only inform models of sentence comprehension and production and their interrelationship, but also allow the use of this knowledge cross-linguistically to build a picture of commonalities and differences among languages with different morphosyntactic properties.

The few behavioural studies that have examined the effects of attraction on correct number agreement have shown that response times increase when there is a mismatch in number between an attractor and a head noun, both in two-response-choice tasks (Staub, 2009, 2010) and in fragment completion (Haskell & MacDonald, 2003). These studies have attributed the slowdown of correct responses to the same factors that are responsible for the occurrence of errors: difficulty in processing number mismatch and syntactic depth, or in processing conceptual and grammatical information. However, to date, we are blind to the timing at which these difficulties arise during correct agreement computation. Although models are not explicit about it, the Marking and Morphing model suggests that agreement encoding begins before word order is defined, while the cue-based retrieval model assumes that elements linearly closer to the verb will be more active and suitable to attract errors, suggesting that agreement occurs over ordered syntactic representations. The present ERP study sought to further investigate whether and when word order affects attraction.

In identifying relevant ERP components, one might anticipate the involvement of the production P2 (pP2) that is found to respond to lexical access processes in speech production (e.g. Ganushchak, Christoffels, & Schiller, 2011; Strijkers & Costa, 2011). Around 200 ms after picture presentation, naming low-frequency words elicits more positive amplitudes than naming high-frequency words. The pP2 has been interpreted to index lexical retrieval difficulty and lexical competition during picture naming (Costa, Strijkers, Martin, & Thierry, 2009), since it is also sensitive to cognate and language effects in bilingual naming (Strijkers, Baus, Runnqvist, FitzPatrick, & Costa, 2013; Strijkers, Costa, & Thierry, 2010), as well as to semantic interference (Costa et al., 2009). We hypothesized that the pP2 might also be sensitive to morphological retrieval. Hence, we expected attraction effects to modulate the pP2, reflecting lexical and/or number-cue competition processes during agreement encoding.

Experimental evidence regarding the ERP signature of attraction effects in subject-verb agreement during comprehension is rather scarce. Comprehension of verb agreement violations, compared to correct agreement, elicits LAN/N400-P600 components (see Molinaro, Barber, & Carreiras, 2011 for a review). However, comprehension of agreement violations in sentences containing number mismatching attractors elicits smaller LAN/N400/P600 components than in sentences with number matching attractors (e.g., Chen, Shu, Liu, Zhao, & Li, 2007; Santesteban, Zawiszewski, Erdocia, & Laka, 2017; Shen, Staub, & Sanders, 2013; Tanner, Nicol, & Brehm, 2014). These studies have also reported asymmetrical attraction effects, with plural attractors eliciting different ERP components than singular ones only in ungrammatical sentences.[1] The cue-retrieval model accounts for this asymmetry by assuming that retrieval processes are mainly triggered when ungrammaticality is detected (Wagers, Lau & Phillips, 2009).

Hence, if plural attractors interfere in singular agreement production, it might be hypothesized that after verb morphology is selected, correctness is monitored by self-monitoring mechanisms similar to the cue-retrieval mechanisms engaged in comprehension (Lewis & Vasishth, 2005; Wagers et al., 2009). This fits the integrated account of production and comprehension proposed by Pickering and Garrod (2013), according to which instances of production also involve comprehension processes. Hence, attraction effects might elicit frontal negativities (between 300 and 500 ms). In comprehension, these negativities have been reported to index syntactic binding failure during agreement checking (Hagoort, Wassenaar, & Brown, 2003), as well as syntactic structure active maintenance and thematic-role assignment costs (Martin-Loeches, Muñoz, Casado, Melcón, & Fernández-Frías, 2005). Importantly, Erdocia, Laka, Mestres-Missé, and Rodríguez-Fornells (2009) have demonstrated that Basque verbs elicit frontal negativities when they disambiguate syntactically ambiguous sentences with non-canonical OSV readings but not with SOV readings, reflecting a word order-related memory load cost associated with syntactic reanalysis. Zawiszewski and Friederici (2009) have also shown that non-canonical OSV sentences are more difficult to comprehend in Basque than canonical SOV sentences, as the former elicit a larger broad negativity than the latter.

Since sentence preamble comprehension and auxiliary verb production processes were entwined in the present study, we predicted the presence of ERP components linked to both modalities. More specifically, we looked at the effects of number mismatch between a subject and an object noun (singular subject vs. singular or plural object), and canonical vs. non-canonical (SOV vs. OSV) word order on attraction in Basque. Crucially, we examined the influence of these factors in correct agreement production, a facet of language processing scarcely studied to obtain information about the challenges posed to agreement computation in normal production.

[1] Chen et al. (2007) reported that plural attractors elicited an N400 compared to singular attractors in non-native English speakers, but this effect was not found in English native speakers.

2. Methods

2.1. Participants

Twenty-four native speakers of Basque (mean age = 21 (SD = 2); 11 males), undergraduate students at the University of the Basque Country.

2.2. Materials and procedure

Experimental materials consisted of 144 preambles (72 were adapted from Santesteban et al., 2013), involving transitive verbs. Each preamble contained a third person singular animate subject and a third person singular or plural animate object NP with a demonstrative, a quantifier or a numeral and a noun. Four experimental conditions were created by crossing two factors: Object-Number (Singular vs. Plural) and Word-Order (SOV vs. OSV) (expected correct response in brackets; see Appendix for a full list of sentences):

1. *Margolari hark pirata bat marraztu…(du)* (Singular Object – SOV order)
2. *Pirata bat margolari hark marraztu…*(*du)* (Singular Object – OSV order)
   "That painter has$_{SG\text{-}OBJ}$ drawn a pirate".
3. *Margolari hark pirata hauek marraztu…(ditu)* (Plural Object - SOV order)
4. *Pirata hauek margolari hark marraztu…(ditu)* (Plural Object – OSV order)
   "That painter has$_{SG\text{-}OBJ/PL\text{-}OBJ}$ drawn these pirates".

Additionally, we created 240 filler sentences: 120 involved intransitive verbs (72 contained singular and 48 plural subjects). The remaining 120 fillers involved transitive verbs (48 plural subjects and singular objects, 48 plural subjects and objects, and 24 singular subjects and objects). Four lists were created containing 384 sentences each: 144 experimental (36 per condition) and 240 fillers. Each participant was presented with one of these lists (each item presented once per list). Six additional sentences were used as practice trials.

Participants sat comfortably in a quiet room and were asked to read silently preambles displayed word-by-word for 350 ms (ISI = 250 ms) in the middle of a 17-inch PC screen. After the 350 ms presentation of the verb, a question mark was presented prompting participants to complete the sentence by producing the corresponding auxiliary verb (*du* or *ditu*, for sentences with singular or plural objects, respectively). A fixation cross (+) presented for 1000 ms indicated the beginning of each trial. Materials were pseudo-randomized so that no two experimental sentences were displayed consecutively. The 384 sentences were distributed over four blocks. Each session lasted about 90 min including three breaks.

2.3. EEG recording

The electroencephalogram was recorded from 32 scalp electrodes mounted in an Acti-Cap International (Inc.; 10–20 system). All electrodes were referenced to left and right mastoids and re-referenced off-line to the nasal-bone electrode. The vertical and horizontal electro-oculograms were recorded from electrodes located below and at the outer canthus of the right eye. The EEG recordings were amplified with a BrainAmp DC amplifier (Brain Products, München, Germany) using a high-cut-off of 1000 Hz, a time constant of 10 s (0.016 Hz), and a sampling rate of 500 Hz. Electrode impedance was kept below 10 kΩ at all scalp and mastoid sites as well as at the eye electrodes. An off-line filter bandpass of 0.1–35 Hz (half-amplitude cut-offs, 24 dB) and 50 Hz Notch filter was applied. Head movements and other artifacts were manually removed before applying ICA-based eye-blink correction.

2.4. Scoring and data analysis

Experimental sessions were digitally recorded and transcribed. Response times were registered by the Presentation 16.3 software through an AKG D44S CCS dynamic microphone. Participants' responses were scored as *correct* for correctly inflected verbs; *agreement errors* for verbs disagreeing in number with the subject; and *miscellaneous errors* for any other error (e.g., no response or use of wrong auxiliary verb).

Linear mixed effects were performed for the analyses of accuracy and response latencies (including only correct responses). Accuracy (correct vs. incorrect agreement) or log-transformed response time dependent variables were fitted with linear mixed models including crossed random and fixed effects (Baayen, 2008). Object-Number (singular vs. plural), Word-Order (SOV vs. OSV), and their interactions were included in the models as sum coded fixed factors. The maximal random effect structures justified by χ^2-test model comparison without high-correlation problems (< 0.7) were used. All analyses were carried out in R (v.3.1.2; R Core Team, 2020), using the lme4 (v.1.1-21; Bates, Maechler, Bolker, & Walker, 2015) and lmerTest (v.3.1-0; Kuznetsova, Brockhoff, & Christensen, 2017).

For the electrophysiological data, ANOVAs were performed over correct responses (with SPSS 24). To avoid the inclusion of EMG due to articulatory movements, segments were constructed from 200 ms before and 400 ms after the onset of the main verb (baseline correction = -200–0), which is a general limitation of production studies. Trials associated with each condition were averaged for each participant. Given our predictions regarding the nature of the ERP components for comprehension and production, statistical analyses were performed using the 180–240 ms (pP2) and 300–400 ms (negativity) time windows over midline electrodes only. Three regions of interest (ROI) were generated: Mid-Frontal (FC1, Fz, FC2), Mid-Central (CP1, Cz, CP2) and Mid-Parietal (P3, Pz, P4). The analysis included 3 within-participant factors: Object-Number (Singular vs. Plural), Word-Order (SOV vs. OSV), and Region (Mid-Frontal vs. Mid-Central vs. Mid-Parietal). Step-down MANOVA analyses were conducted to analyze the source of significant interactions ($p < 0.05$).

Behavioural and EEG raw data and behavioural data analysis scripts are publicly available at https://doi.org/10.17605/OSF.IO/B4RX2

3. Results

3.1. Accuracy

The maximal random effect structure included a by-participant Word-Order random slope. The analysis yielded significant Object-Number ($\beta = -0.294$, SE = 0.100, $z = -2.920$, $p = 0.003$) and Word-Order effects ($\beta = 0.659$, SE = 0.181, $z = 3.643$, $p < 0.001$), with participants producing more subject-verb agreement errors in sentences containing plural than singular objects, and in sentences with SOV than OSV order (see Table A). The interaction was also significant ($\beta = -0.740$, SE = 0.101, $z = -7.319$, $p < 0.001$), with more errors in SOV sentences with singular than plural objects ($\beta = 0.403$, SE = 0.190, $z = 2.120$, p = 0.034), and with more errors in OSV sentences with plural than singular objects ($\beta = -1.024$, SE = 0.184, $z = -5.547$, p < 0.001).

3.2. Response latencies

Responses faster than 50 or slower than 2500 ms or exceeding a threshold of 2.5 SDs by condition were excluded from the analysis (6.9% of the data). The maximal random effect structure included by-participant Object-Number and Word-Order random slopes. The analyses revealed significant main effects of Object-Number ($\beta = 0.015$, SE = 0.007, $t = 2.07$, $p = 0.050$) and Word-Order ($\beta = 0.019$, SE = 0.007, $t = 2.58$, $p = 0.016$), with participants responding more

Table A
Raw count of subject-verb agreement errors and correct responses (percentages in brackets are calculated excluding miscellaneous responses) plus miscellaneous responses across all subjects and reaction times for correct responses in each experimental condition. SE = Standard Error.

Object Number	Singular Object		Plural Object	
Word Order	SOV	OSV	SOV	OSV
Accuracy				
Subject-agreement errors	82 (9.6%)	9 (1.1%)	38 (4.5%)	58 (6.9%)
Correct responses	773 (90.4%)	843 (98.9%)	806 (95.5%)	782 (93.1%)
Miscellaneous responses	9	12	20	24
Response Times (ms)				
Correct responses	545 (SE = 14)	559 (SE = 14)	555 (SE = 16)	585 (SE = 18)

slowly in sentences with plural than with singular objects (570 vs. 552 ms, respectively) and in sentences with OSV than SOV order (572 vs. 550 ms). The interaction was not significant ($\beta = 0.007$, SE = 0.004, $t = 1.60$, $p = 0.109$).

3.3. ERP results

Miscellaneous/erroneous responses (7.3%) and epochs with artifacts (14.1%) were rejected, resulting in the exclusion of 21.4% (SE = 1.53) of the total trials. A mean of 27 trials per condition remained for analyses: $SO_{SG}V$ = 27.7 (5.1); $SO_{PL}V$ = 28.9 (5.7); $O_{SG}SV$ = 29.3 (5.6); $O_{PL}SV$ = 27.4 (5.3).

The analysis of the 180–240 ms time window (pP2) showed a significant Object-Number effect ($F(1, 23) = 4.410$, $p = 0.047$), revealing larger positivity for sentences with plural than singular objects (2.89 μV vs. 2.34 μV) (see Fig. A). There was also an Object-Number by Word-Order by Region interaction ($F(2,46) = 9.38$; $p = 0.004$). Further analyses did not show Word-Order effects in any region. However, Object-Number pP2 effects were found in SOV sentences over mid-central ($F(1,23) = 5.85$, $p = 0.024$) and mid-parietal ($F(1,23) = 7.93$, $p = 0.01$) regions, with larger positivity for sentences with plural than singular objects (mid-central: 3.37 μV vs. 2.16 μV; mid-parietal: 2.68 μV vs. 1.32 μV).

The analysis of the 300–400 ms time window revealed a marginal Word-Order effect ($F(1,23) = 3.69$, $p = 0.067$), with OSV sentences eliciting larger negativity than SOV sentences (-0.15 μV vs. 0.38 μV). There was also an Object-Number by Word-Order by Region interaction ($F(2, 46) = 8.81$, $p = 0.003$), with a Word-Order effect (larger negativity for OSV than SOV sentences) only in sentences with singular objects over mid-frontal electrodes ($F(1,23) = 5.20$, $p = 0.032$), and a marginal Object-Number effect (a tendency for larger positivity in sentences with plural than singular objects) in SOV sentences in the mid-parietal region ($F(1,23) = 4.21$, $p = 0.051$).

4. Discussion

The present study showed a slowdown in sentence completion latencies when object and subject mismatched in number, replicating behavioural agreement attraction effects (Staub, 2009, 2010). Auxiliary verb production was also slower in non-canonical OSV than in canonical SOV structures, reflecting extra demands imposed on the processor. In line with previous findings, the non-canonical OSV condition yielded more errors with plural than with singular objects. However, contrary to our expectations and the findings of Santesteban et al. (2013), in SOV sentences the opposite pattern emerged: participants were less accurate when producing the auxiliary verb preceded by a singular than by a plural object. We tentatively attribute this result to the potential ambiguity of the two determiners used in the materials (*honek* 'this', *horrek* 'that') which, in the Biscayan (oral) variety of Basque, could have a plural reading and some participants might have interpreted the first constituent (S) as plural instead of as singular. This might also reflect a speed-accuracy tradeoff, with more errors produced in the condition with faster response latencies (SOV, singular object). However, such a tradeoff does not account for the full pattern of results, because speakers did not make fewer errors in the condition with slower responses (OSV, plural object). Since our focus of interest is on correct agreement, we do not further discuss these accuracy patterns.

Regarding the ERP correlates of subject-verb agreement production an early positive component was shown between 180 and 240 ms and a negative one between 300 and 400 ms. The former object-number related positivity is assumed to reflect retrieval difficulty of correct agreement-inflectional morphemes especially in contexts with mismatching activated features. The latter word order related negativity is assumed to index argument order monitoring processes of the linearization of inflectional morphemes when the appropriate auxiliary verb form is built, with larger costs of linearization in non-canonical than in canonical sentences. This negativity was only present with singular objects, in canonical SOV sentences, with singular objects eliciting larger negativities than those with non-canonical order, number mismatching objects, or both. This suggests that both argument order and agreement monitoring occur at the same time.

In order to produce a correctly inflected verb that agrees with its arguments the processor has to compute an appropriate structure and specify the features that will be mapped onto the verb. In sentence completion, the speaker has to figure out the role of each argument in a given preamble and mark the auxiliary verb with the corresponding agreement features while also maintaining this representation in memory. At an electrophysiological level, the demanding aspects of these processes and the challenges posed by number mismatching plural objects in SOV structures were resolved at an early stage as reflected by the pP2. Producing a correctly inflected verb was costlier when the (plural) object mismatched in number with the (singular) subject than when it did not. This might correspond to the Morphing stage at which the Marking and Morphing model (Eberhard et al., 2005) assumes that lexical and structural forms are integrated and number morphology is selected. It might also correspond to the stage at which cue-retrieval models assume that number cues of the head are retrieved and the verb form is selected from memory while avoiding interference from co-activated nouns bearing subjecthood cues.

Additionally, the processing cost of the non-canonical argument linearization emerged during a later stage (300–400 ms) only in sentences with singular objects, reflected in a larger frontal negativity for non-canonical OSV than for canonical SOV sentences. Assuming that comprehension and production processes are intertwined (Pickering & Garrod, 2013), this frontal negativity may index larger costs of monitoring the correctness of the selected verbal form in OSV than in SOV sentences. Since in OSV sentences the object bears subjecthood positional cues, the cost to identify and monitor the number cues of the subject matching the number features of the selected verb form increases. Hence, these findings suggest that word order affects later agreement monitoring processes during production and that these cue-retrieval monitoring processes are also triggered during grammatical processing (see Martin, Nieuwland, & Carreiras, 2012 for evidence that cue-retrieval is also triggered in grammatical sentences during the

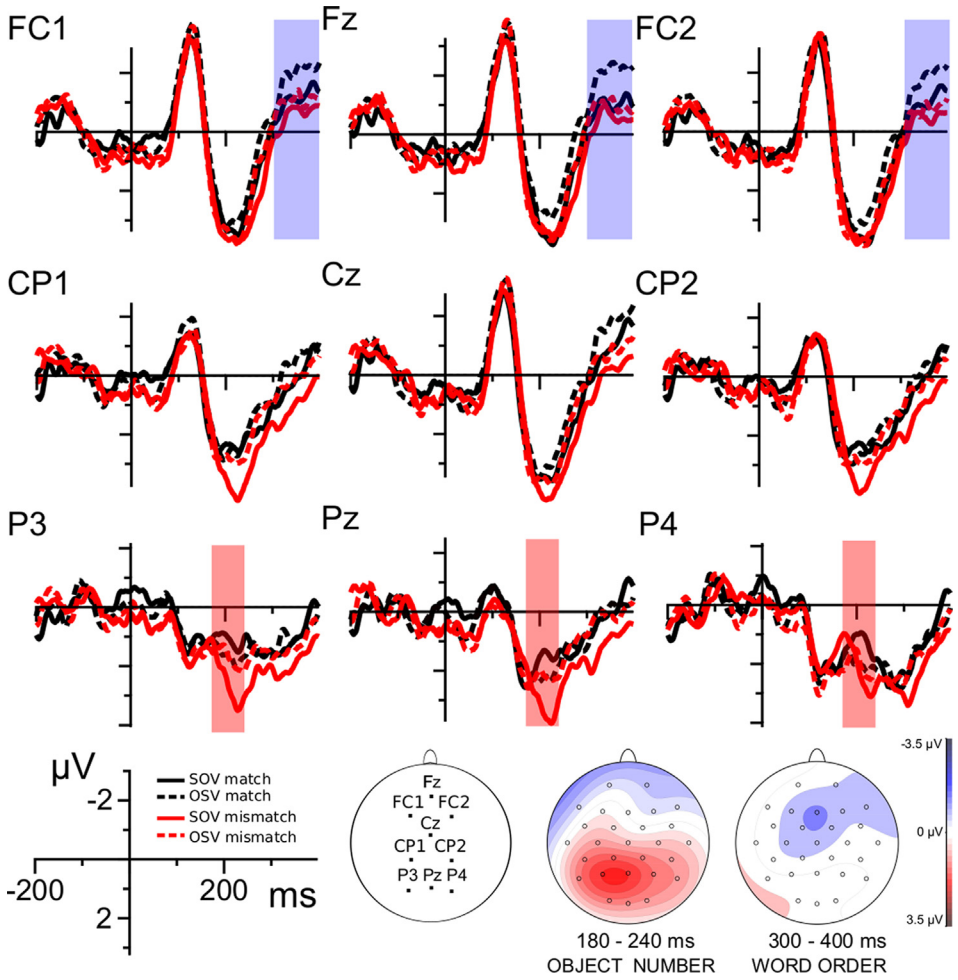

Fig. A. ERPs elicited at the critical verb preceding the to-be-produced auxiliary verb and topographical amplitude difference map for the Object-Number effect between 180 and 240 ms and for the Word-Order effect between 300 and 400 ms.

comprehension of ellipsis).

Our findings provide further evidence on processing mechanisms of verb agreement computation (comprehension and production) in morphologically rich languages such as Basque by taking into account the interplay of both the order of arguments and their morphological characteristics (number feature). Our pattern of results is fully supported by data from other studies in Basque with word order and number agreement manipulations (Erdocia et al., 2009; Zawiszewski & Friederici, 2009), with a larger negativity for non-canonical OSV than for canonical SOV structures in the first constituent position (S vs. O), as well as in the main verb position. However, those studies did not control for morphological specifications of the intervening arguments (number), and in that sense the current study presents novel findings revealing the interaction of both morphological characteristics and word order factors during verb agreement computation.

Our findings suggest that the parser makes use of different sources of information at different stages in time, with an initial stage at which competing (number) features are selected, and a later stage at which correct attribution of inflectional features for subject and object arguments is monitored. Although our results might not provide direct support for any model, the initial stage is compatible with the morphing phase of the Marking and Morphing model (Eberhard et al., 2005). The later stage is compatible with a cue-retrieval-type monitoring process, whereby agreement encoding occurs by means of managing the activation of the dependent arguments' cues (e.g., number) as well as the degree of association strength between those cues and the target verb, which can be modulated by subjecthood (animacy) or word order (Lewis & Vasishth, 2005).

Taken together, our data contribute to a growing number of studies investigating the interplay of morphological and syntactic cues during verb agreement computation and indicate that both types of information are used differently at early and later stages of processing. As this is the first study to inform accounts of correct subject-verb number agreement production at an electrophysiological level, certainly more research is needed for the construction of a comprehensive view of such a routine yet so complex cognitive process.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Materials used in the Experiment. All sentence preambles are presented in SOV word order (e.g., *Ehiztari batek basurde hori/hiru basurdeak hil…*du/ditu*,* "A hunter (has) killed that wild boar/the three wild boars"), with singular object NPs before the slash (3rd and 4rd word; *basurde hori,* "that wild boar") and plural object NPs after the slash (5th and 6th word: *hiru basurdeak,* "the three wild boars"). The OSV word order condition of each sentence was created by placing the object NPs before the subject NP: e.g., *Basurde hori/Hiru basurdeak ehiztari batek hil…,* "A hunter (has) killed that wild boar/the three wild boars"). Following each sentence preamble, participants were asked to complete the sentence with the corresponding verb auxiliary form (*du* or *ditu*, for sentences with singular or plural objects, respectively). In the present experimental context, since participants were required to produce an auxiliary verb that would end the sentence, SOV and OSV order could only have one interpretation. English translations of sentences (in perfect tense) are presented in italics. Note that the auxiliary *(has)* added in the translation assumes that a correct response is given. Since Basque is not gender marked, all names of professionals are translated as female (e.g., policewoman):

1. Ehiztari batek basurde hori/hiru basurdeak hil…
   A hunter (has) killed that wild boar/the three wild boars
2. Antzezle horrek andere bat/andere guztiak marraztu…
   That actor (has) drawn a lady/all the ladies
3. Bizardun horrek erizain hura/erizain guztiak atxilotu…
   That bearded man (has) detained that nurse/all the nurses
4. Apaiz hark atso hura/atso guztiak babestu…
   That priest (has) defended that old woman/all the old women
5. Entrenatzaile batek korrikalari hau/korrikalari batzuk agurtu…
   A coach (has) saluted that runner/some runners
6. Arkitekto batek ertzain hori/ertzain guztiak salatu…
   An architect (has) reported that policeman/all the policemen
7. Entrenatzaile hark jokalari hau/jokalari guztiak aurkeztu…
   That trainer (has) presented this player/all the players
8. Kazetari hark enpresari hau/enpresari guztiak salatu…
   That journalist (has) reported this businesswoman/all the businesswomen
9. Zaldi horrek ertzain bat/ertzain guztiak zauritu…
   That horse (has) injured a policewoman/all the policewomen
10. Gidari batek hizlari hura/bost hizlariak aurkitu…
    A driver (has) found that speaker/the five speakers
11. Politikari batek apaiz bat/apaiz guztiak askatu…
    A politician (has) released a priest/all the priests
12. Bizilagun horrek eskultore hau/hamabi eskultoreak zoriondu…
    That neighbor (has) congratulated this sculptor/the twelve sculptors
13. Aurrelari batek entrenatzaile hura/entrenatzaile guztiak aurkeztu…
    A striker (has) presented that coach/all the coaches
14. Ertzain honek lapur hori/hogei lapurrak atxilotu…
    This policeman (has) arrested that thief/the twenty thieves
15. Erizain hark txirrindulari hori/txirrindulari batzuk zoriondu…
    That nurse (has) congratulated that cyclist/some cyclists
16. Pailazo batek boxeolari bat/boxeolari gehienak marraztu…
    A clown (has) drawn a boxer/most of the boxers
17. Fiskal hark alkate bat/alkate guztiak galdekatu…
    That district attorney (has) interrogated a mayor/all the mayors
18. Oinezko horrek atezain hori/sei atezainak ikusi…
    That pedestrian (has) seen that porter/those porters
19. Arotz honek iturgin bat/iturgin gehienak esnatu…
    This carpenter (has) woken up a plumber/most plumbers
20. Fraide hark bekatari hau/bekatari gehienak kritikatu…
    That friar (has) criticized this sinner/most sinners
21. Txori batek langile bat/langile guztiak esnatu…
    A bird (has) woken up a worker/all the workers
22. Fiskal horrek gazte hau/hogei gazteak auziperatu…
    That district attorney (has) put on trial this youngster/the twenty youngsters
23. Sendagile honek gaixo hura/gaixo guztiak ikaratu…
    This doctor (has) frightened that patient/all the patients
24. Margolari horrek ikasle hura/bost ikasleak goraipatu…
    That painter (has) cheered that student/the five students
25. Aizkolari honek txakur hori/sei txakurrak askatu…
    This woodchopper (has) let that dog/the six dogs loose
26. Korrikalari hark aurkari bat/aurkari guztiak harrapatu…
    That runner (has) trapped a rival/all the rivals
27. Epaile hark gidari bat/hogei gidariak galdekatu…
    That lawyer (has) interrogated a driver/the twenty drivers
28. Andere honek bizardun hori/bizardun guztiak marraztu…
    This woman (has) drawn that bearded man/all the bearded men
29. Preso honek sukaldari hau/sukaldari gehienak kritikatu…
    This prisoner (has) criticized this cook/most of the cooks
30. Turista hark urpekari bat/hamabi urpekariak jipoitu…
    That tourist (has) beaten up a diver/the twelve divers
31. Arrantzale honek epaile hau/bost epaileak salbatu…
    This fisherwoman (has) rescued this judge/the five judges
32. Margolari hark pirata bat/hamabi piratak marraztu…
    That painter (has) drawn a pirate/the twelve pirates
33. Polizia horrek bahitzaile bat/hogei bahitzaileak atxilotu…
    That policewoman (has) arrested a kidnapper/the twenty kidnappers
34. Arraunlari honek igerilari hori/hamar igerilariak agurtu…
    This rower (has) saluted that swimmer/the ten swimmers
35. Tabernari honek bezero hori/bezero batzuk kanporatu…
    This barwoman (has) expelled that customer/some customers
36. Ume hark pailazo hau/hogei pailazoak besarkatu…
    That child (has) hugged this clown/the twenty clowns
37. Gaixo honek mediku hori/hiru medikuak besarkatu…
    This patient (has) hugged that doctor/the three doctors
38. Polizia hark kazetari hori/kazetari guztiak galdekatu…
    That policewoman (has) interrogated that journalist/all the journalists
39. Soldadu honek herritar bat/hamabi herritar zauritu…
    This soldier (has) wounded an inhabitant/the twelve inhabitants
40. Iheslari honek herritar hura/hiru herritarrak engainatu…
    That fugitive (has) deceived that citizen/the three citizens
41. Eskiatzaile honek gidari hori/sei gidariak aurkitu…
    That skier (has) found that driver/the six drivers
42. Alkate batek enpresari hori/sei enpresariak engainatu…
    A mayor (has) deceived that businesswoman/the six businesswomen
43. Idazkari honek gizon hori/zortzi gizonak laztandu…
    This secretary (has) caressed that man/the eight men
44. Kazetari hark zaindari bat/zortzi zaindariak babestu…
    That journalist (has) protected a caretaker/the eight caretakers
45. Enpresari honek igeltsero hura/bost igeltseroak kontratatu…
    This businesswoman (has) hired that bricklayer/the five bricklayers
46. Dendari honek langile bat/langile gehienak lasaitu…
    This shopkeeper (has) calmed a worker/most workers
47. Neska honek ikasle hura/zazpi ikasleak kritikatu…
    This girl (has) criticized that student/the seven students
48. Neska honek artzain hura/artzain batzuk ikusi…
    This girl (has) seen that shepherd/some shepherds
49. Igerilari honek epaile hura/hamabi epaileak salbatu…
    This swimmer (has) rescued that judge/the twelve judges
50. Pirata horrek enbaxadore bat/enbaxadore gehienak atxilotu…
    That pirate (has) arrested an ambassador/most ambassadors
51. Mendizale horrek eskiatzaile bat/zortzi eskiatzaileak aurkitu…
    That mountaineer (has) found a skier/the eight skiers
52. Entzule hark alkate bat/hamar alkateak gonbidatu…
    That listener (has) invited a mayor/the ten mayors
53. Ikusle hark aktore hau/aktore batzuk musukatu…

That spectator (has) kissed this actor/some actors

54. Ikusle honek arraunlari hura/arraunlari gehienak iraindu…
This spectators (has) insulted a rower/most rowers
55. Langile hark arkitekto hori/hamabi arkitektoak salatu…
That worker (has) insulted that architect/the twelve architects
56. Basurde honek mutil hura/mutil guztiak izutu…
This wild boar (has) scared that boy/all boys
57. Mago horrek pailazo bat/pailazo batzuk engainatu…
That magician (has) deceived a clown/some clowns
58. Bezero horrek neska bat/neska guztiak besarkatu…
That customer (has) hugged a girl/all girls
59. Irabazle horrek arraunlari hura/arraunlari guztiak agurtu…
That winner (has) saluted that rower/all rowers
60. Atso batek enpresari hau/enpresari guztiak zirikatu…
An old lady (has) provoked this businesswoman/all businesswomen
61. Arraunlari batek arrantzale hori/zazpi arrantzaleak goraipatu…
A rower (has) insulted that fisherwoman/the seven fisherwomen
62. Alkate horrek bozeramaile hura/zortzi bozeramaileak engainatu…
That mayor (has) deceived that spokeswoman/the eight spokeswomen
63. Enbaxadore honek turista hura/sei turistak babestu…
This ambassador (has) defended that tourist/the six tourists
64. Txirrindulari honek irabazle hura/irabazle guztiak zoriondu…
This cyclist (has) congratulated that winner/all the winners
65. Aktore horrek ikusle hori/ikusle guztiak ikaratu…
That actor (has) frightened that spectator/all the spectators
66. Moja hark ume bat/ume guztiak agurtu…
That nun (has) saluted a child/all the children
67. Ume horrek txori bat/hamar txoriak salbatu…
That child (has) rescued a bird/the ten birds
68. Haur batek polizia hau/hamabi poliziak harritu…
A child (has) surprised this policewoman/the twelve policewomen
69. Oinezko hark mendizale hura/bost mendizaleak aurkitu…
That pedestrian (has) found that mountaineer/the five mountaineers
70. Etorkin honek kazetari hori/hiru kazetariak salatu…
This immigrant (has) denounced that journalist/the three journalists
71. Gidari horrek oinezko bat/oinezko guztiak hil…
That driver (has) killed a pedestrian/all the pedestrians
72. Kazetari batek abeslari hura/zazpi abeslariak auziperatu…
A journalist (has) put on trial that singer/the seven singers
73. Mutil batek aizkolari hau/aizkolari gehienak gonbidatu…
A boy (has) invited this woodchopper/most woodchoppers
74. Zaindari horrek haur hura/hamar haurrak garbitu…
That caretaker (has) cleaned that child/the ten children
75. Bertsolari hark txistulari hau/hogei txistulariak kontratatu…
That troubadour (has) hired this flautist/the twenty flautists
76. Langile batek idazkari hura/idazkari batzuk lasaitu…
A worker (has) calmed down that secretary/some secretaries
77. Boxeolari hark entrenatzaile hori/entrenatzaile gehienak zauritu…
That boxer (has) wounded that trainer/most trainers
78. Dantzari honek abeslari hori/zazpi abeslariak musukatu…
This dancer (has) kissed that singer/the seven singers
79. Oilo horrek arotz hori/hamar arotzak esnatu…
That chicken (has woken) woke up that carpenter/the ten carpenters
80. Gazte hark agure hura/hogei agureak lurperatu…
That youngster (has) buried that old man/the twenty old men
81. Musikari hark mago hura/mago guztiak auziperatu…
That musician (has) put on trial that magician/all the magicians
82. Herritar batek zaldi hori/hiru zaldiak lotu…
An inhabitant (has) tied up that horse/the three horses
83. Igerilari horrek ikusle hura/ikusle batzuk liluratu…
That swimmer (has) charmed that spectator/some spectators
84. Bozeramaile honek hautetsi bat/zazpi hautetsiak aurkeztu…
This spokeswoman (has) presented a town councillor/the seven town councillors
85. Ikasle hark ume hura/ume batzuk garbitu…
That student (has) bathed that child/some children
86. Ikusle honek antzezle bat/antzezle gehienak txalotu…
This spectator (has) applauded this actor/most actors
87. Irakasle batek ume hori/ume gehienak garbitu…
A teacher (has) bathed that child/most children
88. Emakume honek ume hori/zortzi umeak lasaitu…
This woman (has) calmed down that child/the eight children
89. Hautetsi horrek soldadu hori/zortzi soldaduak hil…
That town councillor (has) killed that soldier/the eight soldiers
90. Enpresari hark politikari bat/politikari gehienak zirikatu…
That businesswoman (has) annoyed a politician/most politicians
91. Bizilagun hark gidari hura/hiru gidariak iraindu…
That neighbor (has) offended that driver/the three drivers
92. Zuzendari honek musikari hori/sei musikariak txalotu…
This director (has) applauded that musician/the six musicians
93. Aktore horrek jarraitzaile hura/jarraitzaile guztiak musukatu…
That actor (has) kissed that spectator/all the spectators
94. Artzain honek txakur hura/zazpi txakurrak laztandu…
This shepherd (has) caressed that dog/the seven dogs
95. Pilotari hark atzelari hau/atzelari guztiak mehatxatu…
That pelota player (has) threatened this defender/all the defenders.
96. Aurkari horrek igerilari bat/hamar igerilariak kanporatu…
That rival (has) expelled a swimmer/the ten swimmers
97. Nekazari hark otso bat/otso batzuk lurperatu…
That farmer (has) buried a wolf/some wolves
98. Garbitzaile batek erizain hori/sei erizainak ezagutu…
A cleaner (has) met that nurse/the six nurses
99. Abeslari batek neska hau/neska guztiak musukatu…
A singer (has) kissed this girl/all the girls
100. Txakur batek katu hura/hiru katuak izutu…
A dog (has) frightened that cat/the three cats
101. Epaile batek abokatu hau/bost abokatuak kanporatu…
A judge (has) hit this advocate/the five advocates
102. Abeslari hark margolari hau/zortzi margolariak kontratatu…
That singer (has) hired this painter/the eight painters
103. Enpresari batek detektibe hori/detektibe gehienak harrapatu…
A businesswoman (has) trapped that detective/most detectives
104. Igeltsero batek langile hau/zortzi langileak kontratatu…
A bricklayer (has) hired this worker/the eight workers
105. Atezain honek bizilagun bat/hamar bizilagunak ikusi…
This porter (has seen) saw a neighbor/the ten neighbors
106. Katu horrek sendagile hori/sendagile guztiak ikaratu…
That cat (has) frightened that doctor/all the doctors
107. Epaile hark errudun bat/errudun gehienak askatu…
That judge (has) liberated a guilty man/most guilty men
108. Lapur batek aktore bat/hamabi aktoreak ikaratu…
A thief (has) frightened an actor/the twelve actors
109. Artzain batek mendizale hori/zortzi mendizaleak ikusi…
A shepherd (has seen) saw that mountaineer/the eight mountaineers
110. Jokalari batek kazetari hori/hamabi kazetariak gonbidatu…
A player (has) invited that journalist/the twelve journalists
111. Eskultore horrek merkatari hori/hogei merkatariak harritu…
That sculptor (has) surprised that merchant/the twenty merchants
112. Mediku batek etorkin hura/etorkin gehienak zaindu…
A doctor (has) taken care of that immigrant/most immigrants
113. Iturgin honek garbitzaile hau/bost garbitzaileak ezagutu…
This plumber (has) met this cleaner/the five cleaners
114. Errudun batek fiskal hau/fiskal guztiak hil…
A guilty man (has) killed this district attorney/all the district attorneys
115. Urpekari horrek marinel hau/marinel guztiak jipoitu…
That diver (has) given this sailor/all the sailors a thrashing
116. Igerilari horrek ikusle hura/ikusle batzuk txalotu…
That swimmer (has) applauded that spectator/some spectators

117. Jarraitzaile hark txirrindulari hura/hamar txirrindulariak zoriondu…
That fan (has) congratulated that cyclist/the ten cyclists
118. Otso horrek oilo hau/oilo batzuk izutu…
That wolf (has) frightened this chicken/some chickens
119. Langile horrek tabernari hau/zortzi tabernariak mehatxatu…
That worker (has) threatened this barwoman/the eight barwomen
120. Ikasle batek irakasle hau/bost irakasleak goraipatu…
A student (has) criticized this teacher/the five teachers
121. Marinel hark igerilari hau/igerilari batzuk kritikatu…
That sailor (has) criticized this swimmer/some swimmers
122. Txakur batek margolari hau/hogei margolariak zauritu…
A dog (has) injured this painter/the twenty painters
123. Erizain honek gaixo bat/gaixo guztiak zaindu…
This nurse (has taken) took care of a patient/all the patients
124. Ume batek fraide hori/fraide guztiak izutu…
A child (has) scared that friar/all the friars
125. Gizon batek neska hau/neska gehienak laztandu…
A man (has) caressed this girl/most girls
126. Hizlari honek alkate hau/zazpi alkateak aurkeztu…
This speaker (has) presented this mayor/the seven mayors
127. Alkate horrek dantzari hau/zortzi dantzariak gonbidatu…
That mayor (has) invited this dancer/the eight dancers
128. Pailazo horrek ikusle hura/hamabi ikusleak laztandu…
That clown (has) caressed that spectator/the twelve spectators
129. Neska horrek pilotari hau/pilotari batzuk besarkatu…
That girl (has) hugged this pelota player/some pelota players
130. Ertzain hark preso hau/preso batzuk askatu…
That policewoman (has) liberated this prisoner/some prisoners
131. Agure horrek bertsolari bat/hamar bertsolariak ezagutu…
That old man (has) met a troubadour/the ten troubadours
132. Herritar hark fiskal bat/hamar fiskalak txalotu…
That inhabitant (has) applauded a district attorney/the ten attorneys
133. Atzelari hark aurrelari hura/hiru aurrelariak mehatxatu…
That defender (has) threatened that striker/the three strikers
134. Sukaldari batek dendari hura/dendari guztiak jipoitu…
A cook (has) given that shopkeeper/all the shopkeepers a thrashing
135. Gidari hark oinezko hori/oinezko gehienak beldurtu…
That driver (has) frightened that pedestrian/most pedestrians
136. Merkatari honek nekazari hura/nekazari batzuk harritu…
This merchant (has) surprised that farmer/some farmers
137. Gaixo horrek emakume hura/zazpi emakumeak lasaitu…
That patient (has) calmed that woman/the eight women
138. Txistulari horrek entzule hura/hogei entzuleak liluratu…
That flautist (has) charmed that spectator/the twenty spectators
139. Abokatu batek polizia bat/polizia guztiak galdekatu…
An advocate (has) interrogated a policewoman/all the policewomen
140. Bekatari batek moja hau/moja gehienak iraindu…
A sinner (has) offended this nun/most nuns
141. Bahitzaile batek epaile hau/epaile batzuk lotu…
A kidnapper (has) tied up this judge/some judges
142. Ume horrek zuzendari bat/zazpi zuzendariak zirikatu…
That child (has) provoked a director/the seven directors
143. Mendizale honek ehiztari hau/ehiztari gehienak ezagutu…
This mountaineer (has) met this hunter/most hunters
144. Detektibe hark iheslari hau/iheslari batzuk harrapatu…
That detective (has) trapped this fugitive/some fugitives

References

Acuña-Fariña, J. C. (2009). The linguistics and psycholinguistics of agreement: A tutorial overview. *Lingua, 119*, 389–424. https://doi.org/10.1016/j.lingua.2008.09.005.

Baayen, R. H. (2008). Analyzing Linguistic Data: A Practical Introduction to Statistics Using R. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511801686.

Badecker, W., & Kuminiak, F. (2007). Morphology, agreement and working memory retrieval in sentence production: Evidence from gender and case in Slovak. *Journal of Memory and Language, 56*, 65–85. https://doi.org/10.1016/j.jml.2006.08.004.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01.

Bock, K., & Eberhard, K. M. (1993). Meaning, sound and syntax in English number agreement. *Language and Cognitive Processes, 8*, 57–99. https://doi.org/10.1080/01690969308406949.

Bock, K., & Miller, C. A. (1991). Broken agreement. *Cognitive Psychology, 23*, 45–91. https://doi.org/10.1016/0010-0285(91)90003-7.

Chen, L., Shu, H., Liu, Y., Zhao, J., & Li, P. (2007). ERP signatures of subject-verb agreement in L2 learning. *Bilingualism, Language & Cognition, 10*, 161–174. https://doi.org/10.1017/S136672890700291X.

Costa, A., Strijkers, K., Martin, C., & Thierry, G. (2009). The time course of word retrieval revealed by event-related brain potentials during overt speech. *Proceedings of the National Academy of Sciences, 106*, 21442–21446. https://doi.org/10.1073/pnas.0908921106.

Eberhard, K. M. (1997). The marked effect of number on subject-verb agreement. *Journal of Memory and Language, 36*, 147–164. https://doi.org/10.1006/jmla.1996.2484.

Eberhard, K., Cutting, C., & Bock, K. (2005). Making syntax of sense: Number agreement in sentence production. *Psychological Review, 112*, 531–559. https://doi.org/10.1037/0033-295X.112.3.531.

Erdocia, K., Laka, I., Mestres-Missé, A., & Rodríguez-Fornells, A. (2009). Syntactic complexity and ambiguity resolution in a free word order language: Behavioral and electrophysiological evidence from Basque. *Brain and Language, 109*, 1–17. https://doi.org/10.1016/j.bandl.2008.12.003.

Feiz, A., & Cowles, W. (2019). Object attraction effects during subject-verb agreement in Persian. *Quarterly Journal of Experimental Psychology, 72*, 742–752. https://doi.org/10.1177/1747021818769567.

Fleischer, J., Rieken, E., & Widmer, P. (2015). Introduction: The diachrony of agreement. In J. Fleischer, E. Rieken, & P. Widmer (Eds.). *Agreement from a Diachronic Perspective* (pp. 1–26). Berlin: DeGruyter. https://doi.org/10.1515/9783110399967-002.

Franck, J., Vigliocco, G., & Nicol, J. (2002). Subject-verb agreement errors in French and English: The role of syntactic hierarchy. *Language and Cognitive Processes, 17*, 371–404. https://doi.org/10.1080/01690960143000254.

Ganushchak, L. Y., Christoffels, I. K., & Schiller, N. (2011). The use of electro-encephalography in language production research: A review. *Frontiers in Psychology, 2*, 208. https://doi.org/10.3389/fpsyg.2011.00208.

Gillespie, M., & Pearmutter, N. J. (2011). Hiererarchy and scope planning in subject-verb agreement production. *Cognition, 118*, 377–397. https://doi.org/10.1016/j.cognition.2010.10.008.

Hagoort, P., Wassenaar, M., & Brown, C. M. (2003). Syntax-related ERP-effects in Dutch. *Cognitive Brain Research, 16*, 38–50. https://doi.org/10.1016/S0926-6410(02)00208-2.

Hartsuiker, R. J., Antón-Méndez, I., & Van Zee, M. (2001). Object attraction in subject-verb agreement construction. *Journal of Memory and Language, 45*, 546–572. https://doi.org/10.1006/jmla.2000.2787.

Haskell, T. R., & MacDonald, M. C. (2003). Conflicting cues and competition in subject-verb agreement. *Journal of Memory and Language, 48*, 760–778. https://doi.org/10.1016/S0749-596X(03)00010-X.

Haskell, T. R., & MacDonald, M. C. (2005). Constituent structure and linear order in language production: Evidence from subject-verb agreement. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 48*, 891–904. https://doi.org/10.1037/0278-7393.31.5.891.

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software, 82*, 1–26. https://doi.org/10.18637/jss.v082.i13.

Lewis, R. L., & Vasishth, S. (2005). An activation-based model of sentence processing as skilled memory retrieval. *Cognitive Science, 29*, 375–419. https://doi.org/10.1207/s15516709cog0000_25.

Martin, A. E., Nieuwland, M. S., & Carreiras, M. (2012). Event-related brain potentials index cue-based retrieval interference during sentence comprehension. *NeuroImage, 59*, 1859–1869.

Martin-Loeches, M., Muñoz, F., Casado, P., Melcón, A., & Fernández-Frías, C. (2005). Are the anterior negativities to grammatical violations indexing working memory? *Psychophysiology, 42*, 508–519. https://doi.org/10.1111/j.1469-8986.2005.00308.x.

Molinaro, N., Barber, H. A., & Carreiras, M. (2011). Grammatical agreement processing in reading: ERP findings and future directions. *Cortex, 47*, 908–930. https://doi.org/10.1016/j.cortex.2011.02.019.

Pickering, M. J., Branigan, H. P., & McLean, J. F. (2002). Constituent structure is formulated in one stage. *Journal of Memory and Language, 46*, 586–605. https://doi.org/10.1006/jmla.2001.2824.

Pickering, M. J., & Garrod, S. (2013). An integrated theory of language production and comprehension. *Behavioral and Brain Sciences, 36*, 329–392. https://doi.org/10.1017/S0140525X12001495.

R Core Team (2020). *R: a language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org/.

Santesteban, M., Pickering, M. J., & Branigan, H. (2013). The effects of word order on subject–verb and object–verb agreement: Evidence from Basque. *Journal of Memory and Language, 68*, 160–179. https://doi.org/10.1016/j.jml.2012.09.003.

Santesteban, M., Zawiszewski, A., Erdocia, K., & Laka, I. (2017). On the nature of clitics and their sensitivity to number attraction effects. *Frontiers in Psychology, 8*, 1470. https://doi.org/10.3389/fpsyg.2017.01470.

Shen, E. Y., Staub, A., & Sanders, L. D. (2013). Event-related brain potential evidence that local nouns affect subject-verb agreement processing. *Language and Cognitive Processes, 28*, 498–524. https://doi.org/10.1080/01690965.2011.650900.

Staub, A. (2009). On the interpretation of the number attraction effect: Response time evidence. *Journal of Memory and Language, 60*, 308–327. https://doi.org/10.1016/j.jml.2008.11.002.

Staub, A. (2010). Response time distributional evidence for distinct varieties of number attraction. *Cognition, 114*, 447–454. https://doi.org/10.1016/j.cognition.2009.11.003.

Strijkers, K., Baus, C., Runnqvist, E., FitzPatrick, I., & Costa, A. (2013). The temporal dynamics of first versus second language speech production. *Brain & Language, 127*, 6–11. https://doi.org/10.1016/j.bandl.2013.07.008.

Strijkers, K., & Costa, A. (2011). Riding the lexical speedway: A critical review on the time-course of lexical access in speech production. *Frontiers in Psychology, 2*, 356. https://doi.org/10.3389/fpsyg.2011.00356.

Strijkers, K., Costa, A., & Thierry, G. (2010). Tracking lexical access in speech production: Electrophysiological correlates of word frequency and cognate effects. *Cerebral Cortex, 20*, 912–928. https://doi.org/10.1093/cercor/bhp153.

Tanner, D., Nicol, J., & Brehm, L. (2014). The time course of feature interference in agreement comprehension: Multiple mechanisms and asymmetrical attraction. *Journal of Memory and Language, 76*, 195–215. https://doi.org/10.1016/j.jml.2014.07.003.

Vigliocco, G., & Hartsuiker, R. J. (2002). The interplay of meaning, sound, and syntax in language production. *Psychological Bulletin, 128*, 442–472. https://doi.org/10.1037/0033-2909.128.3.442.

Wagers, M. W., Lau, E. F., & Phillips, C. (2009). Agreement attraction in comprehension: Representations and processes. *Journal of Memory and Language, 61*, 206–237. https://doi.org/10.1016/j.jml.2009.04.002.

Zawiszewski, A., & Friederici, A. D. (2009). Processing canonical and non-canonical sentences in Basque: The case of object-verb agreement as revealed by event-related brain potentials. *Brain Research, 1284*, 161–179. https://doi.org/10.1016/j.brainres.2009.05.099.