



## Research report

# Effects of subject-case marking on agreement processing: ERP evidence from Basque

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## ABSTRACT

Previous cross-linguistic research has found that comprehenders are immediately sensitive to various kinds of agreement violations across languages. We focused on Basque, a verb-final ergative language with both subject–verb (S–V) and object–verb (O–V) agreement. We compared the effects of S–V agreement violations on comprehenders' event-related brain potentials (ERPs) in transitive sentences (where O–V agreement is present, and the subject is ergative) and intransitive sentences (where O–V agreement is absent, and the subject is absolutive). We observed a P600 effect in both cases, but only violations with intransitive subjects elicited an early posterior negativity. Such a qualitative difference suggests that distinct neurocognitive mechanisms are involved in processing agreement with transitive subjects (which are marked with ergative case) versus intransitive subjects (which bear absolutive case). Building on theoretical proposals that in languages such as Basque, true agreement occurs with absolutive subjects but not with ergative subjects, we submit that the early posterior negativity may be an electrophysiological signature for true agreement.

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## 1. Introduction

Language is full of dependencies between non-adjacent elements. One type of dependency that has been studied extensively in linguistics as well as in cognitive neuroscience is agreement, namely, the matching of features (e.g., person, gender, number) between two elements in a sentence (e.g., subject–verb, object–verb; adjective–noun; determiner–

noun). Previous research has looked at different languages to examine and compare how the brain processes agreement that (i) involves different features, including number (De Vincenzi et al., 2003; Hagoort, Brown, & Groothusen, 1993; Kutas & Hillyard, 1983), gender (Barber & Carreiras, 2005; Barber, Salillas, & Carreiras, 2004; Hagoort & Brown, 1999), person (Frenck-Mestre, Osterhout, McLaughlin, & Foucart, 2008; Hinojosa, Martín-Loeches, Casado, Muñoz, & Rubia,

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2003) as well as comparisons across features (Alemán Bañón & Rothman, 2016; Alemán Bañón, Fiorentino, & Gabriele, 2012; Barber & Carreiras, 2003, 2005; Hagoort, 2003; Mancini, Molinaro, Rizzi, & Carreiras, 2011; Martín-Loeches, Nigbur, Casado, Hohlfeld, & Sommer, 2006; Nevins, Dillon, Malhotra, & Phillips, 2007; Silva-Pereyra & Carreiras, 2007; Zawiszewski, Santesteban, & Laka, 2016) and (ii) occurs between different constituents (Barber & Carreiras, 2005; Díaz, Sebastián-Gallés, Erdocia, Mueller, & Laka, 2011; Zawiszewski & Friederici, 2009).

Little is known, however, about what happens when the brain has to process multiple instances of grammatical agreement within the same clause. How does the computation of different grammatical agreement relationships interact with each other? For instance, would the cognitive system's computation of subject–verb (S–V) agreement be affected when it has to compute object–verb (O–V) agreement at the same time? Furthermore, little is known about how grammatical case may interact with agreement processing. For example, will the computation of S–V agreement differ depending on the grammatical case of the subject?

Basque, a language spoken in the Basque country in northern Spain and southwestern France, presents a perfect testing ground for this question. Basque is a verb–final ergative language with a rich case-inflectional system (Hualde & Ortiz de Urbina, 2003; Laka, 1996; de Rijk, 2008). As illustrated in (1) and (2), subjects of transitive verbs are marked with the ergative case (-k), while direct objects of transitive verbs and subjects of unaccusative verbs like ‘arrive’ are absolutive and unmarked. Therefore, the subject noun phrase (NP) in a transitive sentence like (1) has ergative case, while that in an intransitive sentence such as (2) have absolutive case.<sup>1</sup>

1. ikaslea-k            mutila            ikusi            zuen  
*student-[Erg.sg.the] boy-[Abs.sg.the] seen 3sg.A.aux.past.3sg.E*  
 “The student saw the boy.”
2. ikaslea            heldu            zen  
*student-[Abs.sg.the] arrived 3sg.A.aux.past*  
 “The student arrived.”
3. Ni-k            emakumea            ikusi            dut  
*I-[Erg] woman-[Abs.sg.the] seen 3sg.A.aux.1sg.E*  
 “I have seen the woman.”

In affirmative sentences, the main verb appears in a nonfinite form (a participle) after all of its arguments and is

<sup>1</sup> These patterns of case-marking hold generally across tenses in Basque, but notably, in progressive constructions, transitive subjects of a class of aspectual verbs are marked as absolutive (Laka, 2006). While we do not examine the way in which these constructions cause a departure from the ordinary pattern of case-marking in Basque within the present study, we return to a discussion of their potential value in future comparisons in the conclusion.

immediately followed by a finite auxiliary.<sup>2</sup> Crucially, as illustrated in (3), Basque has multiple verb agreement, such that the finite auxiliary agrees not only with the subject NP, but also with any direct object and indirect object NP present. Therefore, the number of constituents that undergo agreement with the auxiliary in a sentence critically depends on the verb's argument structure. For intransitive verbs like ‘arrive’ in (2) which only takes a subject and no objects, only S–V agreement has to be computed at the auxiliary. Meanwhile, for transitive verbs like ‘see’ in (1) which take both an ergatively-marked subject and a direct object, both S–V and O–V agreements must be computed at the auxiliary.

Taken together, when it comes to S–V agreement in Basque, transitive and intransitive sentences differ in two interesting ways: (i) S–V agreement has to be computed in conjunction with O–V agreement in transitive sentences but not in intransitive sentences, and (ii) subject NPs have ergative case in transitive sentences but absolutive case in intransitive sentences. Therefore, the present study will capitalize on the presence of multiple verb agreement and the case system in Basque to examine whether and how the processing of S–V agreement may differ between transitive and intransitive sentences. This study adds to the growing body of research that draws on findings from a typologically diverse set of languages to inform the cognitive neuroscience of language (e.g., Bornkessel-Schlesewsky et al., 2011), as Basque is an SOV ergative case-marking language with a rich system of agreement on the auxiliary, all of which place it in stark contrast to languages such as English.

Before describing the details of the present experiment and predictions, we will first introduce the event-related potentials (ERPs) components that have been implicated in agreement processing. We will then review existing ERP findings on agreement processing in Basque.

### 1.1. ERP components implicated in agreement processing

ERPs have been used extensively in the study of agreement processing. Most studies have used a violation paradigm to compare participants' ERP response to a target word that has correct versus incorrect agreement (grammatical: “John runs” vs ungrammatical: “John run”); for a review see Molinaro, Barber, & Carreiras, 2011). The most robust finding across previous studies that examined agreement processing in different languages is that agreement violations commonly elicit an increased posterior positivity starting at around 500 msec after stimulus onset known as the P600 (Alemán Bañón et al., 2012; Coulson, King, & Kutas, 1998; Hagoort & Brown, 2000; Kolk, Chwilla, van Herten, & Oor, 2003; Münte, Szentkuti, Wieringa, Matzke, & Johannes, 1997; Nevins et al., 2007; Osterhout & Mobley, 1995; Silva-Pereyra & Carreiras, 2007). This positivity is sometimes found to be preceded by an increased negativity between 300 and 500 msec after stimulus onset. This negativity tends to have an anterior distribution and is at times found to be left-lateralised [a left-anterior negativity (LAN); Caffarra & Barber, 2015; Caffarra, Siyanova-Chanturia, Pesciarelli, Vespignani, & Cacciari, 2015; De

<sup>2</sup> The finite auxiliary is fronted to the left of the arguments in negated sentences (Pablos, 2011).

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