



Short Communication

Event-related brain potential evidence for animacy processing asymmetries during sentence comprehension

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ABSTRACT

The animacy distinction is deeply rooted in the language faculty. A key example is differential object marking, the phenomenon where animate sentential objects receive specific marking. We used event-related potentials to examine the neural processing consequences of case-marking violations on animate and inanimate direct objects in Spanish. Inanimate objects with incorrect prepositional case marker ‘a’ (‘al suelo’) elicited a P600 effect compared to unmarked objects, consistent with previous literature. However, animate objects without the required prepositional case marker (‘el obispo’) only elicited an N400 effect compared to marked objects. This novel finding, an exclusive N400 modulation by a straightforward grammatical rule violation, does not follow from extant neurocognitive models of sentence processing, and mirrors unexpected “semantic P600” effects for thematically problematic sentences. These results may reflect animacy asymmetry in competition for argument prominence: following the article, thematic interpretation difficulties are elicited only by unexpectedly animate objects.

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1. Introduction

Knowledge about animacy is an essential way in which human cognition carves up the world into natural kinds. It is not surprising then that animacy affects how people communicate about the world. Animacy expresses itself in some form or another in the majority of the world’s languages (e.g., Dahl & Fraurud, 1996). In English, for example, animate entities are usually produced as subjects and in early sentence positions (e.g., Prat-Sala & Branigan, 2000), mirrored by processing costs for sentence-initial inanimate objects during comprehension (e.g., Weckerly & Kutas, 1999). Moreover, some languages realize animacy in their case system such that animate and inanimate noun phrases receive different case marking as sentential object (‘differential object marking’; Bossong, 1991; see also Aissen, 2003; Malchukov, 2008). In the current study, we examine effects of differential object marking on online sentence comprehension using event-related potentials (ERPs).

An essential part of sentence comprehension is distinguishing the sentential arguments and interpreting their respective thematic roles (i.e., establishing ‘who does what to whom’; see Bornkessel-Schlesewsky & Schlewsky, 2009; Dowty, 1991;

Primus, 2011). In many languages, especially those with relatively free word order, thematic interpretation is guided by a case system that marks the grammatical functions of arguments such as subject and object (e.g., Fillmore, 1968). Thematic interpretation in languages without an elaborate case system, however, is more strongly driven by argument prominence (Van Valin, 2005), which correlates with factors such as word order, animacy and definiteness. Animate, definite and first-mentioned entities are more prominent than inanimate, indefinite and later-mentioned entities. According to the distinctness principle (e.g., Bornkessel-Schlesewsky & Schlewsky, 2009; Lamers & De Hoop, 2005; Primus, 2011), thematic role identification is facilitated when all arguments in a described event are as distinct as possible from one another in terms of all available dimensions of prominence. The sentence “John ate an apple” is canonical because it describes a definite, animate subject followed by an indefinite, inanimate object, whereas “The apple disgusted John” is atypical because it contains an animate object that is more agentive than the subject. Importantly, if sentential arguments resemble each other in one or more dimensions of prominence, thematic role identification might be hampered, as may be observed in some form of processing cost.

This hypothesis has received support from ERP studies on the processing of animacy and case information during German sentence comprehension (e.g., Frisch & Schlewsky, 2001; Frisch & Schlewsky, 2005). Frisch and Schlewsky (2001) reported an N400 effect plus subsequent P600 effect for sentences with case

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conflict (two nominative case-marked arguments) when both arguments were animate, but only a P600 effect when the second argument was inanimate. The N400 results were taken to reflect problems with thematic integration that could be avoided or overcome by the use of knowledge that inanimate arguments are less agentive. Under the common interpretation that N400 modulations reflect the ease with which word-associated semantic knowledge is retrieved as a function of the context (Kutas & Hillyard, 1980; Kutas, Van Petten, & Kluender, 2006), these results suggest that syntactically-induced thematic problems carry a semantic processing cost along with a syntactic processing cost. This important novel idea, the N400 being sensitive to thematic interpretation (Frisch & Schlesewsky, 2001), has subsequently received support from various linguistic manipulations in multiple languages (e.g., Choudhary, Schlesewsky, Roehm, & Bornkessel-Schlesewsky, 2009; Frenzel, Schlesewsky, & Bornkessel-Schlesewsky, 2011; Philip, Bornkessel-Schlesewsky, Bisang & Schlesewsky, 2008). In contrast, the P600 results in both comparisons suggest more general processing consequences of two arguments competing for a single position, consistent with accounts of the P600 in terms of syntactic processing difficulty (e.g., Coulson, King, & Kutas, 1998; Hagoort, Brown, and Groothusen 1993, Osterhout, Holcomb, & Swinney, 1994) or perhaps reanalysis (e.g., Friederici, 1995; see also Kaan, Harris, Gibson, & Holcomb, 2000).

The current study follows-up on these issues via differential object marking, a linguistic phenomenon whereby some direct objects receive morphological case marking while others remain unmarked. At least 300 languages of the world have differential object marking (e.g., Bossong, 1991). In Castilian Spanish, the language used here, animacy is among the most important features that controls object marking (e.g., García García, 2007; see also Leonetti, 2004): the differential object marker, the prepositional accusative (or, personal) 'a', is required for definite and specific direct objects when the object is animate but ungrammatical for inanimate objects (e.g., "Natxo escuchó a Agata/a la canción": *Natxo listened to Agata/the song*). Differential object marking has been explained in terms of prominence/markedness (e.g., Aissen, 2003; but see García García, 2007): because animate objects are less prototypical, and therefore more prominent direct objects, they are linguistically marked and receive case-marking, whereas economy dictates that case-marking should be omitted in other situations (see also Primus, 2011). Object marking thus makes thematic interpretation proceed more smoothly in face of atypical, agentive objects.

By means of ERPs, we investigated the processing consequences of correctly marked animate and inanimate direct objects, compared to incorrect ones (see Table 1). We compared ERPs elicited by animate nouns that missed the required object marking compared to those same animate nouns with object marking,¹ and ERPs elicited by inanimate that had ungrammatical object marking compared to those same inanimate nouns that correctly received no marking. The obligatory nature of object marking for definite animate direct objects is well-established in the linguistics literature (e.g., Torrego, 1998) and a standard topic in canonical textbooks on Spanish grammar (e.g., Zagona, 2002).

¹ To our knowledge, one ERP study that examined the equivalent of our animate-object sentences (Casado, Martín-Loeches, Muñoz, & Fernández-Frías, 2005) reported a P600 effect for 'el' compared to 'al'. However, their participants explicitly judged which noun was sentential subject, and 'el' following a sentence-initial animate noun was predictive of an object-verb-subject (OVS) sentence structure. Despite the fact that such OVS sentences are in fact ungrammatical without any further context (see Demestre, 2012), the reported P600 effect was taken to index the reanalysis processes to compute the new phrase structure, as required by the task. Because the current experiment, however, does not involve such a task, and because we created a stimulus set such that 'el' or 'al' was never predictive of phrase structure, the Casado et al. results are not directly relevant to our current study.

Table 1

Example sentences with marked/unmarked (al/el) animate/inanimate objects, and approximate translations.

El Papa besó <u>al/el</u> obispo/suelo en un gesto de bienvenida	The pope kissed the bishop/floor in a welcoming gesture
Los delincuentes asaltaron <u>al/el</u> chófer/vehículo por sorpresa	The thugs assaulted the driver/vehicle by surprise
El ciego golpeó al niño/chupete con el bastón	The blind person hit the kid/postbox with the stick

Note: Critical words are underlined for expository purposes only. Object marking is present on 'al' (contracted from the preposition accusative marker 'a' and the definite masculine article 'el') but not on 'el'.

A first prediction is thus that unmarked-animate and marked-inanimate both elicit P600 effects, reflecting increased syntactic processing cost (e.g., Osterhout et al., 1994), potentially due to case reanalysis (e.g., Friederici, 1995). A second prediction is that unmarked animate objects also elicit an N400 effect, signalling a thematic problem because object and subject are equally agentive, a marked situation normally heralded by case marking. Previous reports always included overtly ambiguous case marking on pre-verbal arguments (i.e., double nominative case marking) or sentences with inanimate subjects (e.g., Frenzel et al., 2011), while we used unambiguous and canonical SVO sentences with sentence-initial animate subjects, wherein it should be straightforward 'who does what to whom', but an incurred thematic processing difficulty might similarly play out in a semantic processing cost.

In principle, presence of case marking on inanimate objects might create a similar case conflict. However, previous work suggests that animacy differences between subject and object facilitate hierarchization (inanimate arguments are less likely agents). This might thus preclude thematic processing difficulty, in which case we expect marked, inanimate objects only to elicit a P600 effect.

2. Methods

2.1. Development and pre-test of materials

We created 120 Spanish sentence quadruplets that crossed object marking (marked/unmarked) with animacy (animate/inanimate) in a 2 by 2 design, using the template <animate subject noun><transitive verb><el/al><animate/inanimate object noun><at least two more words> ('al' is the contraction of 'el' and case marker 'a'). We refrained from using ditransitive verbs (after which 'al' can be dative case) and indefinite direct objects (which do not require marking). Animate/inanimate critical words were matched on several lexical variables, see Table 2, on relatedness to sentence context (indexed as semantic similarity values from latent semantic analysis), and on cloze value (as established in an independent sentence completion test on 16 participants). Additional results are listed from an independent plausibility pre-test on 22 participants, and from an additional grammaticality yes/no judgment test in which 20 participants judged 2 sentences per quadruplet (with conditions counterbalanced across lists).

2.2. Participants

Twenty right-handed students from the University of the Basque Country (10 males; average age = 21.4 years) gave written informed consent. All were native Spanish speakers, had no neurological or psychiatric disorders, nor participated in the pre-tests.

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