Agents strongly preferred: Ambiguity processing in Basque

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Abstract

Is there a universal language processing mechanism to parse the initial element of a sentence? The literature reports a "subject-first" processing strategy (Bever, 1970; Frazier & Fodor, 1978; Bates, Friederici, & Juarez, 1988; Bornkessel & Schlesewsky, 2006a) in which the first ambiguous DP of a sentence is processed as a subject. However, previous literature on sentence-initial processing did not differentiate between subjecthood and agenthood, i.e. between the sole argument of an intransitive verb, and the agent or most agent-like argument of a transitive verb. In this light, the present study seeks to determine what sentence initial processing strategy is applied in ergative languages, in which syntactic subjects can be marked with either absolutive case (subjects of intransitive clauses) or ergative case (subjects of transitive clauses). For that, a self-paced reading experiment is conducted with native speakers of Basque, a head-final, ergative language, in which sentences containing temporary ambiguous subject and object DPs are employed in both SOV and OSV word orders. Results invite the inference that sentence-initial ambiguous DPs are preferably interpreted as being ergative-marked, and thus, as having an agentive role in the event to come. These results contrast with the predictions that follow from minimality models by which a bias towards the syntactically most economical subject, that is, the absolutive subject of unaccusatives, would be expected. Nevertheless, our results are compatible with previous results by Erdocia *et al.* (2009) and Laka & Erdocia (2012), and with cognitive models that consider actor or agent prominence and agent identification of great importance for effective language comprehension cross-linguistically.

1. Introduction

The literature reports a subject-initial processing preference in a number of typologically distinct languages like English (Bever, 1970; Frazier & Fodor, 1978; Bates, Friederici, & Juarez, 1988; Ferreira, 2003), German (Bornkessel & Schlesewsky, 2006b; Matzke *et al*., 2002), Dutch (Lamers, 2012), Turkish (Demiral *et al,*. 2008), or Chinese (Bisang *et al.,* 2013), among others. Most of these languages have a nominative alignment of their arguments, whereas just a few ergative-aligned languages have been examined regarding the application of this strategy (for a recent review see Longenbaugh & Polinsky, 2017). Previous research by Erdocia *et al.* (2009) and Laka & Erdocia (2012) analysing Basque, an ergative-absolutive language (Levin, 1983, De Rijk. 2007), has shown that at least this language does not apply a "subject-first" processing strategy in the same terms as other languages; this difference will be further explained throughout the present chapter.

The division of languages into "nominative" and "ergative" is based on the relationship between the two arguments of a transitive clause and the single argument of an intransitive clause in terms of their overt marking. Following the convention established in Comrie (1978) and Dixon (1979), these three core arguments can be represented as: S, sole argument of an intransitive clause; A, agent or most agent-like argument of a transitive clause; and O, theme or most theme-like argument of a transitive clause. Two arguments are considered to be aligned if they bear the same case or are indexed by the same agreement marker in the verbal paradigm (Clemens *et al.*, 2015). A language has a nominative system if S aligns with A and both of them are nominative case-marked, as opposed to O, which is accusative case-marked. If S aligns with O and both elements bear absolutive case, in opposition to A, which is ergative case-marked, the resulting system is an ergative one.

Basque provides us with an interesting scenario: this ergative language permits us to assess the subject-initial processing strategy by examining the processing contrast of the sole argument of a one-place verb (S, absolutive-marked subject of an intransitive verb) and the agent or most agent-like argument of a two-place verb (A, ergative-marked subject of a transitive verb) separately (Martínez de la Hidalga *et al.* 2019). Research in Basque by Erdocia *et al.* (2009) and Laka & Erdocia (2012) has shown that Basque native speakers process sentences that are ambiguous between a SOV canonical word order and a derived OSV word order as if they were SOV. This means that the initial DP in ambiguous sentences in Basque is interpreted as an ergative case-marked subject, i.e., as the agent of the sentence, and not as an absolutive element. This later form is a viable subject in an ergative language like Basque, and, in fact, an absolutive case-marked element would be the simplest, syntactically most economical subject, since this is the morphological form associated to unaccusative predicates, that is, to truly monoargumental predicates such as (1a) – which contrasts with more complex biargumental predicates such as (1b) –.

(1a) *Txalupa hondora-tu da.*[1] Unnacusative, monoargumental verb, intransitive event
boatdet.ABS sink-PERF is
'The boat sank."

(1b) *Ekaitz-a-k txalupa hondora-tu du.* Unergative, biargumental verb, transitive event
stormdet.ERG boatdet.ABS sink-PERF has
'The storm sank the boat.'

Thus, it appears that subject preference in Basque is biased towards an ergative, or agent, preference rather than being biased to the syntactically most economical subject, which is the absolutive/theme subject of unaccusatives. This distinction between subjecthood and agenthood could not be addressed in the literature about sentence-initial processing preferences since this distinction cannot be investigated in nominative languages.

In the self-paced reading experiment conducted by Erdocia *et al.* (2009), participants could either process the first ambiguous DP of a sentence like (2) as a singular ergative form (2a); or as a plural absolutive (2b).

(2) *emakume-**ak** gizon-**ak** ikusi ditu.*
(2a) woman-ERG.sg man-ABS.pl seen has (SOV)
'The woman has seen the men.'
(2b) woman-ABS.pl man-ERG.sg seen has (OSV)
'The man has seen the woman.'

It appears that sentence-initial processing in Basque is biased towards an agent/ergative (A) preference rather than being biased to the syntactically most economical subject (S), which is the absolutive/theme subject of unaccusatives. Native speakers of Basque chose the former strategy and processed the first DP of ambiguous sentences as an agentive (A) element (see Figure 1 for the results on reading and understanding SOV, OSV and fully ambiguous sentences from Erdocia *et al.*, 2009). However, the agentive-ergative form might have been chosen for economy reasons because it was a singular form, the simplest one in number, while the homophonous absolutive form was a plural DP. It is not clear whether Basque native speakers chose to process the first ambiguous DP of the sentence as an ergative subject due to an agent-first processing preference or due to the simpler nature in number of the ergative-marked element.

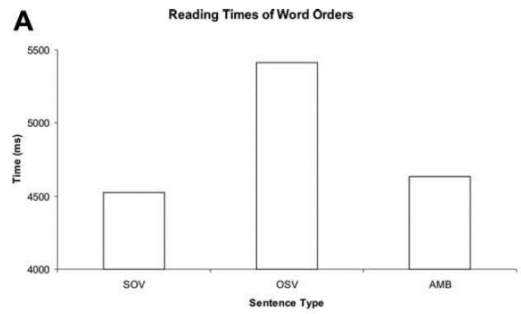

Figure 1: Results from a self-paced reading experiment by Erdocia *et al.* (2009:8). Mean reading times of whole sentences in both experimental conditions (SOV word order; OSV word order; AMB = fully ambiguous sequences). The OSV condition required longer reading times.

In this study, we seek to resolve this confound between singular and agent initial preference determining what sentence initial processing strategy Basque native speakers apply. In order to answer this research question, new materials have to be tested where number is controlled for, and sentences containing temporary ambiguous plural subject and object DPs are employed in both SOV and OSV word orders.

Two hypotheses are taken into consideration. First, according to the SUBJECT-FIRST PREFERENCE HYPOTHESIS, native speakers of Basque will process the first ambiguous DP of a sentence as the most economical possible subject: the subject of an unaccusative sentence. This subject-first processing strategy has been observed in

[1] The following abbreviations are used throughout the paper: ACC—accusative, S—sole argument of an intransitive event, A—agent, O—object, V—verb, ERG—ergative, ABS—absolutive, INE—inessive (in, at), ABL—ablative (from), PART—partitive, de— determiner, sg—singular, pl—plural, perf—perfective.

other languages (English, German, Dutch, Turkish, Chinese…) and is thought to be a universal processing strategy (Frazier & Fodor, 1978; Bates *et al.*, 1988; Bornkessel & Schlesewsky, 2006a, a. o.).

Secondly, according to the AGENT-FIRST PREFERENCE HYPOTHESIS, native speakers of Basque will process the first ambiguous DP of a sentence as an agentive subject, an element with an actor-like role in the event. This hypothesis is supported by the Incremental Argument Interpretation hypothesis (Bornkessel & Schlesewsky, 2006a; Bornkessel-Schlesewsky & Schlesewsky, 2009a, 2009b and subsequent work by these authors) which defends that languages develop a set of prominence scales by which the thematic roles of the participants of an event are identified. This strategy predicts that the comprehension of a linguistic sequence will be easier when the linear order of the elements conforms to the available interpretive hierarchies (Wolff *et al.*, 2008), that is, actors before undergoers. Regarding Basque, previous experiments by Erdocia *et al.* (2009) and Laka & Erdocia (2012) indicate that Basque native speakers may prefer an agentive subject at the beginning of a sentence.

For temporary ambiguous sentences, the subject-first hypothesis predicts that participants will interpret the first ambiguous DP of a sentence as a theme or absolutive subject, and a verb will be expected after this element. Thus, there will be a reanalysis when a second DP is encountered, displaying higher reaction times (RTs) at this non-expected DP. In this hypothesis, parsers would be applying an economy strategy since the ambiguous DP would be interpreted as an absolutive subject, the simplest, syntactically most economical subject that is found in monoargumental predicates[2]. The agent-first hypothesis predicts that SOV sentences will present shorter RTs than OSV sentences in Basque, whose RTs will be higher after the verb, showing that a reanalysis is taking place when the verb disambiguates the object and subject DPs. This would show an actual ergative/agent-first processing strategy, contrary to what has been found in other processing studies with different languages.

Moreover, concerning linguistic typology and linguistic variation, authors such as Bornkessel-Schlesewsky & Schlesewsky (2009a), for example, highlight the need to examine typologically distinct languages and to connect typology with psycholinguistics and neurolinguistics, i.e. to develop neurotypology further. These authors argue that concepts from language typology constitute a promising basis for research in the domain of incremental language comprehension, that it would help constrain the overall structure of the processing architecture, and that this line of research would provide a fruitful basis for the interpretation and theoretical integration of the ever increasing number of empirical findings from different languages and language families. The present research follows this line of thought considering that extending the research on parsing sentence-initial ambiguous DPs to typologically and genetically different languages, such as Basque in this case, would contribute to distinguish which cognitive processes are actually universal preferences and which are due to language-specific properties.

2. Sentence initial processing preferences

2.1. Subject-first preference vs. agent-first preference

As stated in Greenberg´s first universal, in declarative sentences with nominal subject and object, the dominant order is almost always one in which the subject precedes the object (Greenberg, 1963: 43). This tendency has been largely studied from typological, syntactic, semantic and processing perspectives. This chapter focuses on the implications of the processing of sentence-initial constituents, but other viewpoints will also be taken into consideration so as to explain this processing preference (for example, semantic relevance of actors or syntactic economy).

Regarding the processing literature, Bever (1970) already suggested that in language comprehension the hearer employs various perceptual (cognitive) strategies or processing heuristics aside from grammatical knowledge to facilitate (speed up) the mental construction of the meaning representation of sentences. Bever argued that one of the most powerful heuristics is what he referred to as the NVN (NP – V – NP) strategy: "Any Noun-Verb-Noun sequence within a potential internal unit in the surface structure corresponds to "actor-action-object" (Bever, 1970: 298).

[2] The idea that economy of efforts favours minimal constructs is found in pioneering as well as contemporary linguistics and processing literature (Miller, 1962; Chomsky, 1989, 1995; Rizzi, 1990, among others).

Bever claims that this is a primary functional labelling strategy which applies in the absence of specific semantic information. The NVN strategy is suited for head initial languages such as English; a similar but different strategy should be proposed for head final languages. Ferreira (2003) reinterpreted this strategy as a tendency to assume that the first argument in a sentence is a proto-agent and the second is a proto-patient. In these terms, there is no head initial bias, and the same prediction is made for both VO and OV languages. Therefore, Bever´s NVN strategy could be described as a processing preference in which an entity that has many of the features of an agent is inclined to be bound to an initial position, and one that has many of the features of a patient is prone to be bound to the second argument position of any given sentence (Ferreira, 2003).

Similarly, other authors have also provided evidence to support the subject-first processing preference. A study on language acquisition by Slobin (1966) found that children generally verify more quickly pictures corresponding to active sentences (with a more agentive element first, and a patient-like element in second position) than those corresponding to passives (reverted order). Savin & Perchonock (1965) also found that people recall more words from a random word list after the presentation of an active sentence than after a passive sentence. Ferreira (2003) argues that people need more time to identify the thematic roles in passives and object-clefts than in actives and subject-clefts. There is also a tendency to err more with patient-before-agent utterances. Thereby, utterances that require the comprehender to violate the NVN mechanism or the "proto-agents before proto-patients" strategy are more difficult to understand and to process than those that follow this strategy.

Bates *et al.* (1988) carried out a study of syntactic and word order impairment in aphasia with native speakers of English, Italian and German. In all three languages, the basic word order is SVO or SOV; Italian and German permit more variation of basic constituent ordering in opposition to English. The results by these authors show that aphasics preserve the canonical A(agentive subject)VO word order, in all three languages (AVO order was used 81% of the time). They also analysed two-element AO orders disregarding the position or presence of the verb, and they again found a very strong bias toward canonical order (93%), with no significant effects of either language or patient group (aphasics vs. controls); hence, patients and controls seem to behave quite similarly in the ordering of agents and objects. On the light of these results, Bates *et al.* (1988) suggest that these aphasic patients might have an agent-initial preference:

> For example, patients who were native speakers of an SVO language may have a strategy that can be paraphrased as "Start your sentence with the agent of an action whenever possible." This leads to apparently correct structures in many cases, but also leads to errors of role assignment (e.g., when the situation requires something like "The ball hit the boy") (Bates *et al.*, 1988: 350).

Matzke *et al.* (2002) explored the electrophysiological correlates of working memory during sentence comprehension and, for that, they conducted an ERP study in German with 22 subjects, while they read German sentences having subject-first (canonical) or object-first (non-canonical) word orders. Interestingly, they found a negativity differentiating unambiguous object-first and subject-first sentences, interpreted as reflecting the demands of the object-first sentences on working memory, and a parietal positivity for temporary ambiguous sentences that turned out to have a non-canonical word order, which was interpreted as indicating revision and reevaluation processes, suggesting that a subject-first interpretation is initially computed for the ambiguous sentences. These findings therefore provide support for a subject-first interpretation preference both in unambiguous and ambiguous sentences in German.

In another study in German, Bornkessel & Schlesewsky (2006b) also found that the processing of an object at the left edge (sentence-initial position) in German supposes increased processing cost in comparison to a subject in the same position. According to the authors, this local syntactic processing cost that arises when an object precedes a subject can only be overridden when necessitated by an extraordinarily strong information structure requirement, that is, subject-initial sentences were processed easier generally unless corrective focus licensed the object-initial order.

Furthermore, a study by Lamers (2012) evaluated the results of an ease of comprehensibility rating study in Dutch, including sentences with different word orders and different types of verbs. After analysing the results, it was concluded that both verb type and word order influence the ease of comprehensibility, but

there was an overall preference for SO word orders over OS orders. First, SO sentences with clear transitive verbs or subject-experiencer verbs were easiest to comprehend; these were followed by SO embedded clauses with causative psych verbs; SO clauses with unaccusative psych verbs followed; then, OS structures with unaccusative psych verbs; and finally, OS structures with agentive verbs were rated as being most difficult.[3] Hence, Lamers (2012) showed that, despite changing the type of verb, overall, Subject-over-Object orders are easier to understand than OS sentences in Dutch.

Moreover, a preference for subject-initial word orders has also been found in non-European languages with different typological features. The study by Demiral *et al.* (2008), for instance, investigated whether Turkish, which permits an unmarked object analysis of an initial ambiguous argument, shows a subject-preference and, if so, whether this preference is modulated by animacy. Their behavioural findings and the ERP effects at the critical verb position both indicate that participants indeed initially adopted a subject analysis of the first NP, and only when this was disconfirmed by the person marking on the verb, a broadly distributed positivity in the ERP measures and higher reaction times and lower acceptability ratings in the judgement task were observed. Concerning the semantic influence of animacy, their ERP data suggest that the subject-preference is not modulated by animacy; however, the behavioural data suggests that the object reading is more easily reconstructed for inanimate arguments. Moreover, another study by Bisang *et al.* (2013) tested in an ERP experiment the processing preference of Chinese native speakers regarding sentence-initial NPs which were ambiguous between a subject or an object interpretation; and their findings show that Chinese speakers favour a subject-initial interpretation (S or A). Therefore, these studies from Turkish and Chinese point in the direction of a cross-linguistic applicability of the "subject-preference".

With respect to ergative languages, the study by Clemens *et al.* (2015), for instance, examines the processing of relative clauses in Ch'ol and Q'anjob'al, two Mayan languages. In the Ch'ol experiment, the processing of four types of gaps was compared: absolutive subject gaps, gaps ambiguous between ergative subject and absolutive object, temporary ambiguous gaps semantically biased towards ergative subject, and temporary ambiguous gaps semantically biased towards absolutive object. Participants had to listen to the stimuli, and then select the picture that best represented the item that they had just heard. Regarding Ch'ol results, participants were generally faster and more accurate with transitive stimuli than they were with intransitive stimuli, but the authors related this difference related this difference to a mistake in the experimental design, the duration of the duration of the stimuli, in which intransitive sentences were longer. When only transitives are considered, participants were more accurate and had faster response rates with subject-biased stimuli than with object-biased stimuli; furthermore, participants demonstrated a preference for the subject interpretation in the resolution of unbiased ambiguous items, and reaction times are also faster for subject-compatible responses than for object-compatible responses. Thus, subject extractions are less complex than object extractions for speakers of Ch'ol: subjects of intransitive sentences (S) as well as subjects of transitive ones (A). In the Q'anjob'al experiment, in addition to the four gap types analysed for Ch'ol, syntactically unambiguous subject relatives and object relatives were included. As for the Ch'ol experiment, speakers of Q'anjob'al were more accurate with subject gaps (both with subjects of intransitive sentences –S– as well as subjects of transitive ones –A–) than with object gaps in unambiguous and biased relative clauses and, in the ambiguous condition with transitive relative clauses, participants preferred the subject interpretation (A). These results support a subject processing advantage, that is, gaps that correspond to subjects of intransitive (S) and subjects of transitive (A) sentences are processed faster that object gaps in the absence of case cues in these two languages, and the authors suggested that this preference might be present in both ergative and accusative languages (see also Longenbaugh & Polinsky, 2017 for more studies on ergative language processing).

In order to account for all these findings, a new model that seeks to derive this subject-before-object preference has been developed: the extended Argument Dependency Model (eADM; Bornkessel & Schlesewsky, 2006a; Bornkessel-Schlesewsky & Schlesewsky, 2009a, 2009b and subsequent work by these authors). The eADM assumes a general preference for minimising interpretation by means of a simplicity-based processing strategy in which the creation of further non-obligatory dependencies is

[3] Comprehensibility ordering (Lamers 2012: 137):
SO.Ag./Subject-Exp. < SO.Caus. < SO.Unacc. < OS.Unacc. < OS.Caus. < S.Ag./Subject-Exp.

avoided (Bisang *et al.* 2013). This model is presented as a two-stage mechanism: first, the processing system chooses to process the initial ambiguous argument of a sentence as the simplest possible structure or interpretation, that is, as the sole argument of an intransitive event (S). S is the simplest interpretation since it implies no further dependent arguments. Afterwards, if this interpretation cannot be maintained because the sentence is disambiguated into a transitive event, the processing system switches from the S interpretation to an A interpretation. Having an A argument reading (agent or sentient being, etc.) is more simple than an O interpretation, because O (patient, beneficiary, or stimulus, etc.) causally and existentially presupposes an A argument, but not vice-versa (e.g. Primus, 1999). In sum, the eADM posits a subject-initial processing strategy in which the first argument of a sentence is interpreted as S, theme or proto-patient element, but when a second argument or a transitive verb is found, this model postulates that an agent-initial processing strategy will be applied.

Once at this point, some clarification is necessary with regards to the subject and agent strategies. In Bornkessel & Schlesewsky (2006), Bornkessel-Schlesewsky & Schlesewsky (2009a, 2009b) and subsequent work by these authors, the subject-fist processing strategy and the agent-fist processing strategy are considered outcomes of the same mechanism, the later coming in a secondary stage after a reanalysis of the first prediction. This is summarised in their research on initial argument interpretation applied to Mandarin Chinese:

> The preferential interpretation of the initial argument as (what appears to be) a subject can be accounted for cross-linguistically in terms of the extended Argument Dependency Model (…) which assumes a general preference for minimising interpretation by means of a simplicity-based processing strategy. This model is based on a two-fold strategy. Firstly, the processing system chooses the simplest structure/interpretation – the sole argument of an intransitive even {S} – for an initial unmarked argument. Because {S} implies no further dependent arguments, it is the simplest interpretation. (…) Subsequently, if this interpretation does not hold, i.e. when the sentence is disambiguated into a transitive event, the processing system switches from the {S} interpretation to an {A} interpretation, which is comparatively more simple than the [O] interpretation, because {O} (patient, beneficiary, or stimulus, etc.) causally and existentially presupposes an A argument (agent or sentient being, etc.), but not vice-versa (e.g. Primus 1999, 2006). In this way, the subject-preference is actually a by-product of minimising interpretation by avoiding the creation of further dependencies. In this sense, the subject-preference or anti-O effect is a preference of treating {S, A} as similar, but distinct from {O} (Bisang *et al*., 2013: 26).

The eADM predicts a universal subject-first processing strategy. If we extend this prediction to Basque natives´ sentence-initial processing preference, we expect a sentence-initial ambiguous DP to be processed as an absolutive/more patient-like subject; only when encountering a second DP would a reanalysis take place, and an agent-initial strategy would then be enforced.

2.2. The relevance of actorhood and actor identification

Language processing and, more specifically, argument interpretation, has been shown to act incrementally, that is, the human brain processes each new incoming constituent immediately, as soon as the input enters the processing system (e.g. Marslen-Wilson, 1973; Knoeferle *et al.*, 2005; Stabler, 1994). Moreover, parsers form expectations about the upcoming input, and facilitatory effects result for highly predictable words, which are processed faster. These expectations or predictions have to be validated with what is actually encountered later on. When these expectations are not met, comprehenders reanalyse or revise in favour of another analysis compatible with the input. Subsequently, if the perceived input is incompatible with the parser´s preferred interpretation and thus it violates expectations, difficulty ensues. By analysing the points at which parsers have processing difficulties, it is possible to assess the expected argument linearization and to derive the reasons behind those initial predictions.

Besides, in line with the observation on the relevancy of agent-like elements, Bornkessel-Schlesewsky & Schlesewsky (2013: 248) propose the following crosslinguistic generalisation for online language processing: "The processing system attempts to identify the actor role—i.e., the participant primarily responsible for the state of affairs under discussion—as quickly and unambiguously as possible. Corollaries: a) The processing system prefers actor-initial orders. b) The processing system prefers prototypical actors".

Frenzel *et al.* (2015) combine this process of actor identification with the eADM. They present an incremental argument interpretation model accomplished by the syntax– semantics interface in which

online sentence comprehension has two dimensions. First, whenever a "nouny" constituent is encountered, actorhood potential is assessed based on previous experience. Second, a noun's inherent suitability as an actor interacts with other information sources (e.g., word order, case marking), and the computational system interprets those cues and the actorhood potential of the "nouny" constituent so as to identify the argument with the actor role in that particular sentence.

Concerning the first stage, Frenzel *et al.* (2015) show that a noun's actor potential depends on its humanness, its arousal level, its potency and its ability to behave in a goal-directed manner; thus, a good actor is conscious and animate, emotionally arousing (positive or negative), perceived as potent (strong, powerful, and big) and moves in a goal-directed manner. With respect to the second stage, the authors argue that there are some cues that help identify the actor role, such as morphological case marking (nominative case marked elements are preferably interpreted as actors than accusative-marked elements; in languages with an ergative alignment, ergative-marked elements are interpreted as actors, in opposition to absolutive ones), animacy and humanity or definiteness or specificity. Interestingly, one of the cues for actor identification is argument order, with arguments in first position preferentially interpreted as actors, since this initial position is argued to correlate with actorhood crosslinguistically (see Tomlin, 1986). Nevertheless, the degree to which this cues determine the identification of an actor within a particular language depends on their relative weighting within that particular language (cf. MacWhinney & Bates's, 1989, Competition Model), and regarding argument order, this cue might be more reliable and efficient in languages with fixed word order, like English, than in languages with "free" word order, like Basque.

To sum up, we should take into consideration the prominence of actor roles in language comprehension defended by Bornkessel-Schlesewsky & Schlesewsky (2013) and Frenzel *et al.* (2015), and translate these to the debate between the subject-first and agent-first processing strategies. The work by these authors seems to specifically support the agent-first processing strategy, according to which those arguments in first position are preferably interpreted as agentive elements while any other nouny constituent is preferably given a more patient-like role.

This notion of "actor" or "agent-like element" presented before makes reference to the participant primarily responsible for a linguistically expressed event or state of affairs (Frenzel *et al.*, 2015). Hence, this "actorhood umbrella" gives shelter to several thematic roles: agents or causers, experiencers, etc. (cf. Van Valin, 2005). Within generative grammar, actors are generally characterised as external arguments in the position of specifier of vP. (Chomsky, 1995). Frenzel *et al.* (2015) propose that linguistic actorhood is based on a language-independent "actor" category that might be rooted in the human ability to understand goal-directed actions. This idea may account for the cross-linguistic importance of actor identification during language comprehension and for the agent-first processing strategy.

2.3. Minimal Effort

As it has been mentioned before, in order to understand the cognitive bases of a possible subject or agent-first processing strategy, more general mechanisms have to be taken into consideration, such as the "minimal effort" mechanism generally applied by the parser. Contemporary linguistics have developed the idea that economy of efforts favours minimal constructs (Miller, 1962; Chomsky, 1989, 1995; Rizzi, 1990, among others) and motivations for minimal structure and minimal dependencies have been formulated in a number of approaches in the psycholinguistic literature (e.g. Frazier & Fodor, 1978; de Vincenzi, 1991; Gorrell, 1995; Sturt & Crocker, 1996; Gibson, 1998; Schlesewsky & Friederici, 2003). The parser behaves economically, and a principle of *Minimal Attachment* is at play in sentence processing (Frazier & Fodor, 1978), favouring simpler structures, i.e. those with fewer nodes, over more complex ones. By positing an economy principle like Minimal Attachment, we also assume that the comprehender gives priority to the most minimal possible analysis in cases of temporary ambiguity (Grant, 2013). Disconfirmation of the simplest analysis then requires a revision of the linguistic representation. Depending on the circumstances, it may be easy and successful to posit another analysis; otherwise, this may cause extreme processing difficulty or even failure of reanalysis.

In the work by Frazier & Fodor (1978), it is argued that Minimal Attachment will favour the interpretation of an initial NP as the subject of the sentence to come. Concretely, Frazier & Fodor (1978: 322) remark "if an NP node has been established at the beginning of a sentence, Minimal Attachment will require it to be entered as immediate daughter to the top S node, by reference to the rule S → NP - VP. If additional

intervening nodes were postulated instead, they would have to be checked against further rules". Furthermore, they relate this minimality strategy to efficiency in communication:

> In normal conversational contexts sentence parsing has to be performed very rapidly, with little leeway provided by the constant arrival of new words to be processed. It is therefore not at all ad hoc for the parser to pursue whichever structural hypothesis most rapidly becomes available to be pursued, quite apart from the fact that this will also be the easiest one to store and the easiest one to correct if wrong (Frazier & Fodor, 1978: 322).

Bornkessel & Schlesewsky (2006a), in line with Frazier & Fodor, propose that the subject-preference did not arise from any particular properties related to subjecthood per se, such as structural position or number of dependencies, but that it was an epiphenomenon of a general least-effort processing strategy termed *Minimality*. This was thought to be similar in spirit to Fodor and Inoue's *Minimal Everything* (Inoue & Fodor 1995) which defends a general least effort principle when processing language. This Minimality principle assumes that minimal representations are preferred at all levels of processing. More precisely, Bornkessel & Schlesewsky (2006a: 790) define *minimality* as way in which the human language comprehension system assigns minimal structures, in the absence of explicit information to the contrary. This entails that only required dependencies and relations are created.

The preference for subject-first sentences follows from this Minimality principle. When comparing the minimality or economicity of the subject-first processing strategy with the agent-first strategy, the latter seems to be less economical since a more complex structure is implied by this processing strategy than by the former one. However, functional motivations might also explain the application of this agent-first strategy. For example, Bornkessel-Schlesewsky & Schlesewsky (2009a) defend that the application of prominence scales in order to identify the roles of the arguments in a sentence might be useful for real time language processing. These prominence scales weight semantic features such as animacy, definiteness or specificity and person as well as syntactic features such as case marking and linear order. The application of these scales in online processing has a functional motivation because they allow for the establishment of an interpretive relation between the arguments, even if the verb has not yet been encountered. Verb-final word orders, such as the one we find in declarative sentences in Basque, are very frequent in the languages of the world, and concretely, SOV word order is the most frequent canonical order among the analysed languages of the world (Dryer, 2005). For this reason, applying prominence scales in order to identify argument roles seems to be essential so as to have an efficient communication. Defining the role of each argument when it is met serves to guarantee that interpretation is not delayed until the verb (Bornkessel-Schlesewsky & Schlesewsky, 2009a).

In sum, minimal effort in language processing might support both subject and agent-initial strategies; the former being more economical in the number of dependencies and syntactic nodes the parser has to predict, and the later mechanism being more functional due to the necessity of positing the role of each argument before the verb is encountered so as to allow an efficient communication.

3. The present study

3.1. Method

A self-paced reading experiment with a comprehension task using Linger software by Doug Rohde (see http://tedlab.mit.edu:16080/~dr/Linger/) was created to investigate which processing strategy is applied to the initial ambiguous DP of a sentence by Basque native speakers.

3.1.1. Materials

The experimental materials employed in this experiment were 50 SOV sentences such as (3) and 50 OSV sentences like (4) where we used the Basque plural demonstratives *hauek*, *horiek*, *haiek*. The absolutive cases and the ergative cases of these plural demonstratives are homophonous. Thus, we created SOV and OSV sentences which were temporary ambiguous: the S and O elements included morphologically ambiguous DPs. These were disambiguated when reaching the verb due to world knowledge. To this, 100 fillers were added.

Experimental sentences consisted of two ambiguous DPs with plural demonstratives, then the disambiguating verb followed, the auxiliary and two extra words (locatives or temporal markers). Sentence

(3) shows an example of a temporary ambiguous experimental sentence, which gets disambiguated as SOV at the verb due to world knowledge. Sentence (4) is also temporarily ambiguous, but when the verb arrives, it is disambiguated as OSV. The lexical elements used in the experimental sentences were controlled for length and frequency, and the ambiguous DPs were all animate to avoid any animacy biases. Experimental and filler sentences were also randomly mixed for the experiment.

(3) *Azeri* ***hauek*** *untxi* ***horiek*** *lapurtu dituzte ikuilutik gauean.*
foxes these.ABS/ERG[4] rabbit those.ABS/ERG stolen have stable.ABL night.INE
'These foxes have stolen those rabbits from the stable at night.'

(4) *Ikasle* ***haiek*** *irakasle* ***horiek*** *zigortu dituzte jolasordurik gabe.*
student those.ABS/ERG teacher those.ABS/ERG punished have break.PART without
'Those teachers have punished those students with no break.'

In addition to this, comprehension questions such as (5) that corresponded to each experimental sentence were also designed; half of these questions had an SOV order, and the other half had an OSV order. Furthermore, 100 more questions with different word orders were created for the fillers.

(5) *Egia al da untxiak otsoek lapurtu dituztela gauean ikuiluan?*
'Is it true that the wolves have stolen the rabbits from the stable at night?'

Possible biases that would prevent us from analysing the sentence initial processing strategy were avoided. Fillers have been included and sentences have been randomised assuring that participants do not know what the experiment is about or deploy shallow parsing heuristics. The frequency of the lexical elements has been shown to affect reading times when processing a sentence. For this reason, we verified in the *Euskal Hiztegiaren Maiztasun Egitura* (EHME; Acha, Laka, Landa & Salaburu, 2014) that the lexical items used in the experimental sentences in subject position were of similar frequency and length to those in object condition. We ensured that the difference in frequency was not significant (p=.83) and that the length was neither significantly different (p=.58). Moreover, the frequency and length of the lexical elements in S and O positions are matched in this experiment, since two lists were done and similarly distributed among the participants (List1 14 participants, List2 11 participants). In List1, 50 SOV and 50 OSV sentences were presented to which 100 fillers were added; while, in List2, those 50 SOV sentences from the first list had an OSV order, and the 50 OSV sentences from List1 had an SOV order in this second list, and the same 100 fillers were also added to List2.

In addition to this, in order to avoid any animacy biases, we decided that all the lexical elements in subject and object positions should be animate. Furthermore, a larger number of participants and items were used compared to similar, previous experiments so as to avoid a statistical false positive. Finally, in order to avoid a sentence wrap-up effect[5], two extra words (temporal or locative elements) were added after the critical region of the auxiliary.

3.1.2. Participants

Regarding participants, 25 native speakers of Basque took part in this experiment. They filled a questionnaire before doing the experiment so as to check that Basque is their L1 and that they use it with high frequency. Participants were 15 female and 10 male university students with a mean age of 21.44.

3.1.3 Procedure

In this experiment, reaction times (RTs) were measured in a self-paced reading task with a moving-window system. With this technique, we measured the time participants took reading each word of each sentence. Moreover, participants had to answer if the question related to each sentence was true or false. This comprehension task was added so as to make sure that participants read the sentences completely and to verify that they understood them.

[4] Glosses: ERG = ergative, ABS= absolutive, INE= inessive (in, at), ABL= ablative (from), PART= partitive.

[5] Readers tend to spend longer reading sentence- or clause-final words than sentence- or clause-internal words. Check Warren, White, & Reichle (2009) for a review on this effect.

The experimental procedure was the following: participants first saw a row of dashes that covered the words in the sentence. When pressing the spacebar, the first word appeared. With every press of the space bar, a new word appeared and the last word became dashes again. When they finished reading the last word, the dashes went away and participants saw a question about the sentence they had just read. There was no answer feedback, therefore, after the question, the computer automatically went on to the next sentence.

Each participant was presented with 50 temporary ambiguous SOV sentences and 50 temporary ambiguous OSV ones that were never repeated. Mixed with the 8-word-long experimental sentences, they also read 100 unrelated sentences that were 7, 8 or 9 words long in order to distract them from the experimental objective.

3.2. Data analysis

Whole sentence mean reading times and error rates will be first examined and then, reading times per word in each condition will be presented. Participants that had more than 50% incorrect responses in any of the conditions of the comprehension task were excluded; thus, the data from 4 participants out of 25 that had passed the experiment had to be discarded (List1 10 participants, List2 11 participants). Moreover, incorrect responses, reaction times less than 150ms or greater than 3000ms, and reaction times 2.5 times over or under the standard deviation were excluded from the latency analysis. T-test analyses based on participants´ mean correct response latencies and error rates were conducted separately for Whole sentence and Word reading. Also the amount of errors on sentence comprehension in the two word order conditions was analysed.

3.3. Results

Regarding whole sentence reading times, these RTs showed a main effect of word order, $F(1,20)=-4.31$, $p<0.001$, $MSE=65.27$, $\eta 2=0.69$. Basque native speakers read SOV sentences ($M=4543.30$ms, $SE=309.22$) faster than OSV sentences ($M=4825.13$ms, $SE=334.75$); this results thus replicate the findings in Erdocia *et al.* (2009) and subsequent work. The error analysis on sentence comprehension showed a slight difference which did not reach statistical significance, $F(1,20)=-1.90$, $p<0.071$, $MSE=2.10$, $\eta 2= 0.39$. Participants responded incorrectly to more questions in the OSV condition ($M=8.28$, $SE=1.67$) than in the SOV condition ($M=4.28$, $SE=1.14$). Mean whole sentence reading times in ms are shown in Figure 2 (left) and amount of errors per condition (50 questions in each condition) are shown in Figure 2 (right).

Figure 3 shows the mean reading times per word. Interestingly, the word order effect was reflected in the final part of the sentence, concretely on the auxiliary, the first extra word and the second extra word. The mean RT of the first NP in the SOV condition was $M=580.21$ms, ($SE=46.09$) and in the OSV condition it was $M=574{,}10$ms ($SE=43.06$). For the first determiner it was $M=565.29$ms ($SE=58.50$) in the SOV condition, and $M=587.36$ms ($SE=56.86$) in the OSV condition, whereas for the second NP it was $M=577.34$ms ($SE=41.85$) in the SOV condition and $M=585.61$ms ($SE=46.91$) in the OSV condition. The differences between NPs and Ds across conditions resulted in statistically non-significant (all $ps>.2$).

Increasing values for the OSV conditions were observed in the second determiner and in the verb, but still non-significant (all $ps>.5$). Mean RT of the second determiner in the SOV condition was $M=593.87$ms ($SE=50.77$), and in the OSV condition it was $M=597.05$ms ($SE=49.55$). For the verb it was $M=574.485$ms ($SE=39.37$) in the SOV condition, and in the OSV condition it was $M=584.22$ms ($SE=42.58$). All target sentences were temporary ambiguous until the verb, which disambiguated the roles of the DPs due to world knowledge. It is important to note that it is common for parsers to take longer reading times *after* a disambiguation region (and not in the region itself) if they need to reanalyse their expectations. In what follows we will see that this situation fits with the results obtained after the disambiguation region in our sentences.

The difference was already significant in the auxiliary, $F(1, 20)=-3.80$, $p=0.0011$, $MSE=24.85$, $\eta 2=0.64$, reflecting significantly faster reading times in the SOV condition ($M=504.49$ms; $SE=27.28$) than in the OSV condition ($M=599.01$ms; $SE=47.80$). This was so also the case for the first extra word, $F(1, 20)=-3.33$, $p=0.0032$, $MSE=14.30$, $\eta 2=0.59$, readers were faster in the SOV condition ($M=510.54$ms; $SE=28.94$) than in the OSV condition $M=558.28$ms ($SE=33.65$), and this difference was significant. Finally, the mean RT of the second extra word in the SOV condition was $M=637.04$ms ($SE=42.63$), and in the OSV condition

it was *M*=739.47ms (*SE*=55.48); this difference was also significant, *F*(1, 20)=-3.55, *p*=0.002, *MSE*=28.83, *η2*=0.62.

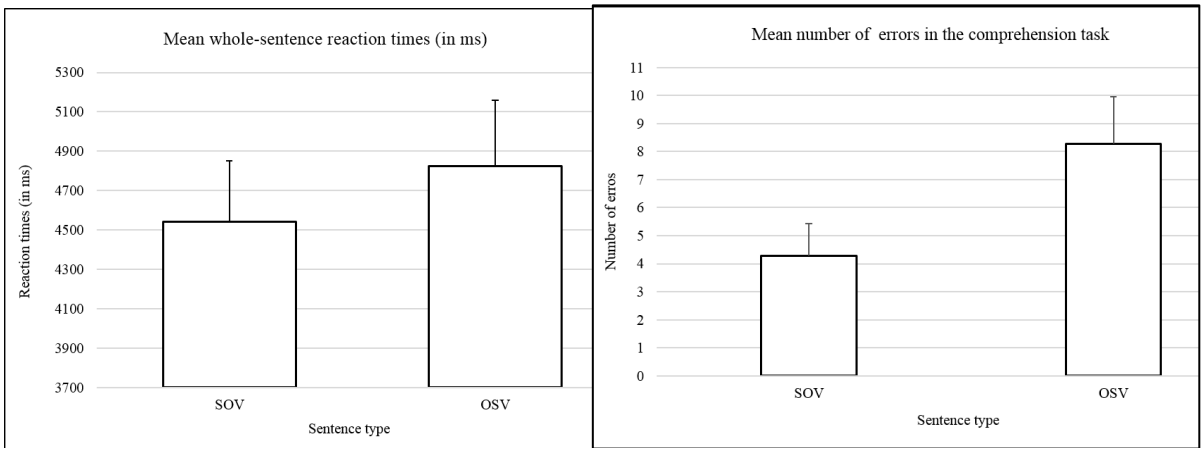

Figure 2: Left: Mean whole-sentence reaction times (in ms) per sentence type (SOV or OSV word orders). Right: Mean number of errors (out of 50) in the comprehension task per sentence type.

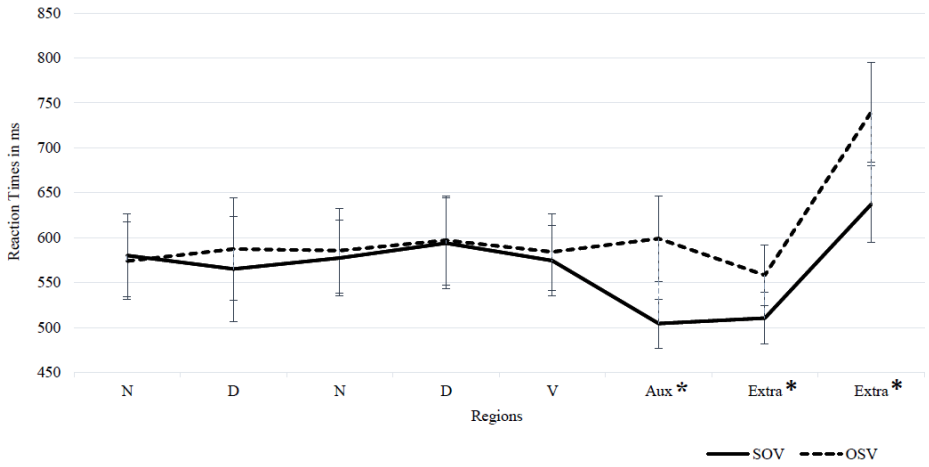

Figure 3: Mean reading times per word in each condition (SOV and OSV). Significant differences are marked with (*).

4. Discussion

All the measures indicate that processing SOV sentences is significantly faster and easier than processing OSV sentences for native speakers of Basque, even though all sentences are equally grammatical. This is convergent with the results by Erdocia *et al.* (2009) and Laka & Erdocia (2012), and also with the predominant view in Theoretical Linguistics regarding word order in Basque, which states SOV as canonical, and all other orders, including OSV, as structurally more complex (De Rijk, 1969; Ortiz de Urbina, 1989). Further, the results also meet one of the predictions for hypothesis 2, the AGENT-FIRST PREFERENCE HYPOTHESIS, by which parsers are expected to prefer to interpret ambiguous DPs in sentence-initial position as agents of the event to come, and thus read temporary ambiguous SOV sentences faster than any other word order.

Comparing reading times per word in the temporary ambiguous sentences disambiguated towards SOV or OSV word orders, there is no significant difference in the crucial regions in which participants encounter the second ambiguous argument of the sentence (that is, the second NP and the second determiner). If participants had a subject-initial processing preference, there should be an extra processing cost when encountering a second non-expected DP (prediction for hypothesis 1); nevertheless, no such processing cost is found in this second ambiguous DP.

A significant difference is found at the critical region after the disambiguating verb, that is, at the auxiliary position of the sentence. At this position, OSV sentences display higher RTs, which indicates that participants have an extra processing cost at this point. Since the verb disambiguates the relation of the

initial ambiguous arguments, this extra processing cost in the auxiliary of OSV sentences is probably due to a reanalysis of the initial predictions made by the parser. Results invite the inference that participants expect the sentence to have an SOV order, in which an agentive subject comes before an object. In temporary ambiguous sentences disambiguated towards an OSV word order, participants´ expectations are violated at the disambiguating verb (observed at the auxiliary point) and a reanalysis of the elements encountered so far has to be performed. This in turn means that the initial ambiguous DP is interpreted as a plural ergative out of the two possible choices, and, therefore, it also means that speakers are not entertaining the possibility that the ambiguous DP is a plural absolutive. Nonetheless, an absolutive form would be a viable subject; in fact, this would be the syntactically most economical subject (the subject of an unaccusative predicate). It thereby appears that subject preference in Basque is biased towards an agent preference, rather than being biased to the syntactically most economical subject. Hypothesis 2 is therefore born out; the present findings confirm that Basque native speakers have an agent-first processing preference by which they favour the parsing of an initial ambiguous DP as an agent of the event under discussion, and the processing of a second ambiguous DP as the object or more patient-like element of the sentence.

The results of our study contrast to some extent with the eADM developed in Bornkessel & Schlesewsky (2006a) and subsequent work by these authors. This model predicted that parsers would process a sentence initial DP as if it were the subject of an unaccusative predicate, expecting a monoargumental sentence, and only after encountering another DP would this expectation be reanalysed and an agent-first strategy would be preferred. Nonetheless, the present findings do not support a two-stage processing preference, but an agentive-subject processing preference from the point in which the first ambiguous DP is encountered.

With respect to minimal effort, our results do not support a minimality approach in the sense of the parser predicting the least possible number of dependencies and syntactic nodes. Therefore, this account that parsers would choose the most economical or minimal possible structure when encountering an ambiguous element or in the absence of explicit information to the contrary does not seem to be of universal application. The minimal effort account might be a generalisation that applies when no other force or processing strategy is applied by the parser. Nonetheless, the agent-first processing preference might be such a productive processing strategy (in the sense that the prediction that this processing preference makes is generally born out) that it overtakes the minimal effort generalisation regarding sentence-initial argument processing. Moreover, the agent-first processing preference is a functional strategy for efficient communication, since positing a specific argument configuration, in this case an actor-before-patient structure, facilitates the comprehension of utterances and the preparation for a possible response in the context of a conversation. This strategy is especially productive and practical in languages with morphological syncretism and head-final configuration such as Basque, in which the role of some arguments in the event under discussion might be ambiguous, and the verb does not clarify this relationship until late in the utterance due to its sentence-final position. Subsequently, the application of an agent-first processing preference that allows positing the role of each argument before the verb is encountered is a strategy that facilitates an incremental and rapid understanding of the linguistic input in real time.

Our results are compatible with the models that consider actor prominence and actor identification of great importance for effective language comprehension cross-linguistically. Frenzel *et al.* (2015), for example, suggest that the special status of the actor role may follow from domain-general properties of human cognition, particularly the independently required need to recognize the initiators of actions and their intentions in the world around us. This notion goes in line with Kemmerer´s (2012) speculation about the saliency of subjects and its relation to cognitive biases. From the point of view of typology, the cross-linguistic prevalence of SOV and SVO word orders might be governed by a general principle called *subject salience*, which states that subjects tend to precede objects (Greenberg, 1963; Tomlin, 1986; Comrie, 1989; Whaley, 1997: 83–5). Kemmerer (2012) argues that the subject salience principle may derive in large part from the fact that in the prototypical transitive action scenario, the agent is at the head of the causal chain that affects the patient.

Overall, the agent-first processing preference found in the present study with Basque native speakers, and maybe the subject-first preference found in the literature so far in a number of other languages, might be the result of the great prominence in our lives of the conceptual primitive "agent". This observation goes in line with Bornkessel-Schlesewsky & Schlesewsky ´s (2013) proposal about the relevance of actor or agent identification

for humans. The relevance of this universal primitive might then manifest as a cognitive bias in several ways; in a preference for ergative arguments in sentence-initial position in those languages that have an ergative alignment, or at least in Basque, and in a nominative preference in nominative aligned languages, for instance.

Summarising, the proposals that have been presented so far regarding the agent-first processing preference and its possible development due to its functional implications or its efficiency in communication and the prominence of agents as cognitive primitives are bold and speculative suggestions, but they seem to offer plausible explanations to the development of an agent-first processing preference for ambiguous sentence-initial arguments.

5. Conclusion

Basque native speakers preferably interpret sentence initial ambiguous arguments as agents. The present findings confirm previous results by Erdocia *et al.* (2009) and Laka & Erdocia (2012) that argued for an agentive/ergative interpretation of a first ambiguous DP in Basque. However, there are several questions left to answer by future research. For instance, is the agent-first preference deployed in other ergative languages as well? Do languages with a nominative alignment also have an agent-first preference that we cannot see at first sight since the same case (nominative) is assigned to agents (A) and subjects of unaccusative predicates (S)? Are both the subject-first preference and the agent-fist preference compatible, or is there crosslinguistic variation regarding which strategy each language applies? These are some of the questions that are left for future research. The present findings challenge the universality of the subject-first processing preference, and thus, the cognitive theories related to this issue might need to account for these findings.

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