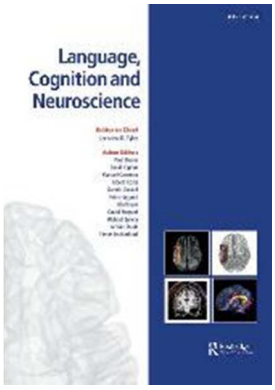

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Journal:	*Language, Cognition and Neuroscience*
Manuscript ID:	Draft
Manuscript Type:	Original Paper
Date Submitted by the Author:	n/a
Complete List of Authors:	Gwilliams, Laura; New York University Abu Dhabi, Monahan, Philip; University of Toronto, Samuel, Arthur; Basque Center on Cognition, Brain and Language,
Keywords:	morphological processing, spoken word recognition, decomposition, derivation

RESEARCH ARTICLE

Sensitivity to Morphological Composition: Evidence from Grammatical and Lexical Identification Tasks

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Word Count: 8978

Figure Count: 3

Table Count: 4

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Abstract

Access to morphological structure during lexical processing has been established across a number of languages; however, it remains unclear which consistuents are held as mental representations in the lexicon. The present study examined the auditory recognition of different noun-types across two experiments. The critical manipulation was morphological complexity and the presence of a verbal derivation or nominalizing suffix in a series of Spanish words. Results showed that Nominalizations such as '*explosion'* were the most difficult to classify as a noun, but the easiest to identify as a word. Words with a regular nominal pseudo-suffix (*i.e., excursion*) appeared to be advantageous in lexical but not in grammatical decision. These findings support the claim that listeners decompose morphologically complex words into their consistuent units during processing. Furthermore, the results suggest that we hold representations of the base morpheme in the lexicon, but may not hold a functional representation of the regular suffix.

Keywords: morphological processing; spoken word recognition; decomposition; derivation; mental lexicon

Introduction

Processing Morphologically Complex Items

The processing of morphologically complex words (e.g., '*argue + ment*') has played a central role in our current understanding of the mental lexicon. A number of theories have been proposed to explain the mental representation of complex words, differing in the degree of decomposition assumed during lexical storage and retrieval. These accounts span a continuum between two primary models of morphological processing: the word-whole or 'continuous' approach (Butterworth, 1983; Janssen, Bi and Caramazza, 2008; Norris and McQueen, 2008) and the decompositional 'parsing' approach (Cutler and Norris, 1988; Marslen-Wilson, Tyler Taft and Forster, 1975; Pinker and Ullman, 2002; Waksler and Older, 1994).

In a continuous model, morphologically complex words are not decomposed into their constituent morphemes prior to retrieval (Butterworth, 1983). Instead, they are stored and processed as whole entries in the lexicon. In the auditory domain, Shortlist B (Norris and McQueen, 2008) is a computational model that assumes that internal word structure is ignored during the prediction of the upcoming speech signal. There are two main justifications for favoring a full-form model. The first is that accounting for morphological structure causes processing to be much more complex. For example, to avoid inappropriately parsing mono-morphemic words (e,g., *corner*) while correctly parsing bimorphemic words (e.g., *heater*), a model would require many exception rules. Second, morphological constituents of derived and compound words are not always directly semantically related to their full forms. Consequently, it would

not be beneficial to access the meaning of these morphemes until the representation of the complex word becomes available, as the correct interpretation of the full form cannot be guaranteed until this point.

There have been a number of counter arguments to the advantages of continuous models. A recurring criticism of this approach, as Marslen-Wilson, Tyler, Waksler and Older (1994), Wurm (1997) and others have highlighted, is the high degree of redundancy that results from representing all words independently in the lexicon. This is particularly apparent in the auditory domain, as strict left-to-right parsing would require independent representations despite semantic transparency among morphologically related forms, e.g., 'covered', 'uncover' and 'discover'; however, this argument assumes that efficiency is dependent upon storage capacity rather than processing complexity, an assumption that some suggest is misguided given the storage capacity of the human brain (Sandra, 1994).

Decomposition models propose that the basic unit of representation is the morpheme and that the lexicon is organized in terms of morphemes rather than whole words. Different decompositional theories vary in their assumptions regarding whether we store *all* morphemic constituents in the lexicon or only a subset of these morphemes. Furthermore, theories differ relative to *which* subset of morphemes is represented in the lexicon.

The Affix-Stripping Model (Taft, 1981,1985; Taft and Forster, 1975) posits that complex words are fully decomposed into constituent morphemes and consequently, segmented into root and affix prior to lexical access. These words are then processed and stored through activation of the base form. Stockall and Marantz (2006) suggest that this is true even for irregular

derivations and inflections, whereby the complex form *taught* is composed of *teach* and [+PAST]. Crucially, this theory suggests that we only represent morphological constituents of a complex word and not the word-whole form.

In contrast to obligatory decomposition, dual-route models suggest that distinct processing systems are employed depending upon the structure of the word. The Dual-Mechanism model (Clahsen, 1999; Pinker, 1999; Pinker and Ullman, 2002) predicts that only regularly formed words are decomposed into constituent morphemes; irregularly inflected and simple words are stored as whole units and are directly retrieved from the lexicon. From this perspective, although *taught* has the meaning of 'teach in the past' there is no attempt to decompose this item into separate units. In contrast, regular complex items are processed using a rule-based mechanism. Words such as *covered* are stored in the constituent form of *cover* and [+PAST], where only the base lexeme has a representation in the lexicon. Neither regular complex words in word-whole form nor affixes have mental representations, reducing the number of stored units.

Other dual-route approaches propose that all morphemic constituents are represented in the lexicon, including affixes, the stem morpheme and the word-whole complex form. The Parallel Dual-Route model (Baayen and Schreuder, 1999) has a number of similarities to the Dual-Mechanism model, but differs in its suggestion that we access the morphemic representation and the full form in parallel. It is based on the assumption that the cognitive costs of storage are less than the cost of rule computation. As such, mass storage is a more efficient technique. An item such as *disappears* would therefore be stored fully

morphemically and word-whole, both as '*dis-appear-s*' and '*disappears*', despite its regular inflection.

As can be seen, there are many competing theories aiming to explain the body of evidence related to lexical processing. A number of previous studies exploring this issue offer evidence supporting morphological representations, but the nature of this organization is still disputed among decompositional theories. The central question is whether the lexicon maintains representations for all morphological constituents or just the root form of complex words

Decomposition Across Languages

Evidence supporting the decomposition of morphologically complex items has been established across a number of different languages, including French (Longtin and Meunier, 2005), English (Rastle, Davis, & New, 2004), Italian (Marangolo, Pira, Galati and Burani, 2006), Basque (Duñabeitia, Perea and Carreiras, 2007), Spanish (Havas, Rodriguez-Fornells and Clahsen, 2012), Finnish (Lehtonen et al., 2007; Leinonen, Brattico, Järvenpääc and Krausea, 2008), Hebrew (Plaut and Gonnerman, 2000) and Dutch (Lemhöfer, Koester and Schreuder, 2011). This generality suggests that morphological parsing is a universal processing strategy and is not specific to a limited set of languages; however, as acknowledged by Hankamer (1989), there is substantially more affixation and composition employed in agglutinating languages, e.g., Finnish and Basque, than in Romance languages. Consequently, users of morphologically rich languages may more frequently employ these morphological decomposition mechanisms due to higher levels of regular inflection. It remains unclear, however, whether this processing strategy would be employed across all of a

multilingual individual's languages or would instead remain specific to the morphologically rich language that requires greater decomposition. The former possibility might be expected based on prior results showing interactions between a bilingual's languages on a number of levels, including phonology, semantics and syntax (see Desmet & Duyck, 2007 for a review), suggesting there is not a clear separation between the processing systems of each language. As relatively little is known about the morphological processing strategies of bilinguals who are proficient in both a morphologically rich and a morphologically poor language, it is unclear whether a bilingual's languages interact on the morphological level. Thus, one goal of the current study is to test whether a parsing bias by a speaker of a morphologically rich language remains in effect while the individual processes a morphologically poor language.

Experiment 1

The primary question addressed by Experiment 1 is whether morphologically complex items are processed word-whole or through primary activation of their constituents. To investigate this question, we measured accuracy and reaction times in response to a series of spoken Spanish words in a grammatical category classification task. Our main comparison was between two types of 'action' nouns: regularly derived nominalizations which could be decomposed into [verb stem] + [nominal suffix] (e.g., *argu + mento* 'argument'), and mono-morphemic 'Event Nouns' that could not be decomposed (e.g., *avalancha* 'avalanche'). This test is potentially powerful because of the different word classes of the decomposed verb stem and the word-whole noun of nominalizations.

A decompositional view of lexical processing predicts greater difficulty for responding 'noun' for the morphologically complex nominalizations, due to the word-class conflict at the base morpheme level (i.e., the verb stem versus the required "noun" response). In contrast, a full-list model predicts no sensitivity to the internal structure of the nominalizations, and so no differences would be expected between the two classes of action nouns.

Different decompositional theories vary in their assumptions of how affix units are stored and processed in complex words. Obligatory and parallel decompositional accounts suggest that the lexicon contains representations of these morphemes, whereas in the Dual-Mechanism model, there is no representation of affix units. Instead, the affix triggers an online grammatical rule to apply to the base morpheme. This theory therefore proposes that there should be no greater sensitivity to these units than would be predicted by their phonological and semantic characteristics alone. To assess sensitivity to affix units we compare nominalizations and nouns with a similar word-final surface structure, containing a 'pseudo' derived suffix and a false stem, [false stem] + [nominal suffix] (e.g., *excursión* 'excursion'). Such items test whether there is sensitivity to the word-final morphological unit, and whether the item is decomposed despite the absence of a free base morpheme (e.g., there is no base verb 'excur', or anything similar, for 'excursion'). These pseudo-suffixed nouns can also be compared to mono-morphemic prototypical nouns with 'object-like' semantics (e.g., *medicina* 'medicine'). Obligatory decomposition models predict faster responses to pseudo-suffixed nouns than to prototypical nouns, while the Dual-Mechanism approach predicts no difference.

To investigate whether experience with languages that differ in their decomposability affects processing, we tested three groups of bilingual native Spanish speakers, differing in their Basque proficiency. Previous studies (Frauenfelder & Schreuder, 1992; Hankamer, 1989) have suggested that knowledge of a morphologically rich language such as Basque may cause a parsing bias during native lexical processing, and the formation of stronger morphological representations; however, there has been little work investigating the effect this this may have on a bilingual's second language. If decomposition is a general language processing strategy, the degree of Basque proficiency may be expected to affect the processing of decompositional words independent of the language being tested. Alternatively, if an increased reliance on decompositional processing is only employed when processing the morphologically rich language, no difference would be expected among the three groups. Therefore, the present study explores the processing of morphologically complex words in the Romance language Spanish, in the light of differing Basque proficiency.

Methods

Participants

Seventy-five right-handed participants with normal hearing took part in this study and were compensated for their time. Participants were either students of, or employed by, the University of the Basque Country. All participants provided written informed consent.

Three participant profiles were specified during the recruitment process. This was based on the individuals' first language and self-rated Basque and

Spanish proficiency. Twenty-five participants were included in each language profile group: dominant Basque (Group B) (mean age = 24.5, *SD* = 5.07, 18 female, 7 male), dominant Spanish (Group S) (mean age = 22.4, *SD* = 3.74, 13 female, 12 male) and low Basque (Group L) (mean age = 23.5, *SD* = 4.68, 18 female, 7 male). Participants in Groups B and S were Spanish-Basque native bilinguals with a self-rating of proficiency between 8-10 in both languages on a 10-point scale. The difference between these groups was therefore determined by which language they considered as dominant. Subjects in the low Basque group provided a self-rating of Basque between 0-3. Spanish was considered to be the only native language of individuals within this group as no individual began learning a second language until later than 5 years (M = 8.2, SD = 4.26). Crucially, all second languages were morphologically poor in comparison to Basque (English (22), French (1), German (1) and Catalan (1)).

In addition to self-rating scores, participants' language proficiency was assessed through the Basque English Spanish Test (BEST) and interviews before the recruitment process. BEST is a modified version of the Boston Naming Task (Kaplan, Goodglass and Weintraub, 1983). Group average scores are displayed in Table 1. The possible scores in the BEST range from 0 – 77, and are based on a picture naming task in each of the three languages. Interview scores range between 0 and 5, and are based on the experimenter's evaluation of the responses provided to a series of five conversational questions.

(Table 1 about here)

Materials

A total of 39 critical items were selected from the Spanish Es-Pal database (Duchon, Perea, Sebastián-Gallés, Martí and Carreiras, 2013) to form the three subsets of nouns. Critical stimulus items and their glosses are presented in Appendix 1. These consisted of: 13 'event-nouns', selected to have an event/action semantic representation but no verbal derivation; 13 deverbal nominalizations selected on the basis of having a clear verbal derivation and nominalizing suffix; and 13 'pseudo-suffixes' selected to have a word-final 'nominal' form, identical to a nominalizing suffix, but without the corresponding verbal derivation. In addition to the 39 critical items, 26 'prototypical nouns' were selected on the basis of being mono-morphemic nouns that referred to objects rather than events.

The presence or absence of verbal derivation was judged by ten native Spanish speakers. They assessed each item in isolation, through an online form. For each word, they were asked to indicate whether it had a verbal counterpart by either selecting 'yes' or 'no'. If the answer was 'yes', they were then asked to report what the associated verb was. Only items reaching at least 90% agreement were included. Any items not meeting this threshold were discarded, and new items were selected and judged until at least 90% agreement was obtained.

Average frequency, length and Uniqueness Point (UP) across all items are presented in Table 2. Length and UP are measured in phoneme number. UP was measured as the position of the first phoneme in the word where it becomes unique from all other onset-aligned words in the language (Marslen-Wilson,

1984). Phonological neighborhood density (ND) was measured as the number of other words that could be formed by changing one phoneme.

(Table 2 about here)

Experiment 1 also included 104 filler items, which consisted of 52 infinitive verbs and 52 inflected verbs. Sets of stimuli were created by matching for length in terms of phoneme number (LP), log frequency (log.), log frequency of the base 'stem' (base log.) and phonological uniqueness points (UP) of the nominalizations. Thirteen sets were created using this structure. Each set included one nominalization (e.g., *mudanza*, *LP* = 7, *log.* = 0.77, *base log.* = 3.26, *UP* = 8), one event noun (e.g., *cirugía*, *LP* = 7, *log*. = 1.01, *UP* = 8), one pseudo-suffix (e.g., *audición*, *LP* = 7, *log.* = 0.69, *UP = 9)* and two prototypical nouns (e.g, *afrenta*, *LP* = 7, *log.* = 0.7, *UP = 8; corbata*, *LP* = 7, *log.* = 0.79, *UP = 8).* Eight verbs were also included in each stimulus set. These included four inflected verbs matched on base-stem length and log frequency of the nominalization (e.g., *mecerías*, *LP* = 7, *base log.* = 3.12, *UP = 8*), and four infinitive verbs matched for word-whole length and log frequency (e.g., *acabaron*, *LP* = 8, *log.* = 0.98, *UP = 8*). The verbal inflection in Spanish was a conjugation indicating either person or tense agreement. All verb items are listed in Appendix 2.

All stimuli were recorded by a female native speaker of Spanish in a sound-treated room at a sampling rate of 44.1 kHz. Each item was read in isolation with sentence-internal intonation. Amplitude intensity was computationally equalized to 70 dB SPL using Praat (Boersma and Weenik, 2001) for all items.

Procedure

Before the task began, noun and verb definitions and examples were provided to ensure that all participants had a full understanding of the task. A noun was defined as "a word for a person, a place, a thing or an idea. It can be modified with adjectives, and specified with 'a' or 'the'"; examples were highlighted in the sentence "El **perro** mordió al **gato** blanco el **domingo"**, *The Black **dog** bit the white **cat** on **Sunday***. A verb was defined as "a word for an action or event. It refers to what is 'happening' in a given situation": "Ella **corrió** y **saltó** por la calle" *She **ran** and **jumped** down the street.* Participants were invited to ask questions for clarification. All interactions were in Spanish.

The word *Verbo* ('verb') was always presented on the left of the visual display, and *Sustantivo* ('noun') on the right side of the display. Stimuli were presented over Beyerdynamic DT-770 headphones at a comfortable listening level. Participants were asked to indicate whether they perceived a verb or noun by pressing the respective left or right key on a response board using their index fingers. They were also instructed to respond as quickly and as accurately as possible. The inter-trial interval was 750 ms and began upon the response to the prior stimulus. The next item was presented regardless of accuracy on the previous trial. If no response was made after 2500 ms the next trial would begin. No feedback was provided.

Three presentation lists were composed, each combining the 65 nouns and 104 verbs. The order of the 169 items was pseudo-randomized in each list, and all three lists presented a critical item after the same number of fillers (i.e., in the 11th, 15th, 17th, 20th position, etc.). Critical items did not appear until the 11th word to allow participants to become familiar with the task.

All participants listened to all three lists at a comfortable volume. A short break was provided between lists. Presentation was counterbalanced in a Latin-square design so that each list was presented equally often as the first, second and third pass. The experiment lasted approximately 30 minutes.

Results and discussion

Table 3 displays the mean reaction times and percentages of errors for the four experimental conditions. Reaction times were measured from word onset. Trials with responses greater than or less than 2.5 standard deviations of the by-subject and by-item means were removed from the analysis. This eliminated 3.3% of the individual responses. No participants or items were eliminated from the final analyses.

(Table 3 about here)

The two primary questions of this study were whether nouns are treated differently depending upon morphological composition, and whether a listener's language profile influences the processing of decomposable items. To address these questions, reaction times and error rates were analyzed across all conditions and groups. Analyses were conducted using a repeated measures 4 x 3 x 3 (F_1 F_2) ANOVA. This included Condition (Event Noun, Nominalization, Pseudo-suffix, Prototypical Noun), Group (B, S, L) and Pass (1^{st}, 2^{nd}, 3^{rd}) as factors.

Mean error rates and response times across all conditions and groups are displayed in Figure 1.

(Figure 1 about here)

Error Rates

Participants' accuracy across conditions was analyzed with a repeated measures 4 x 3 x 3 (F_1 F_2) ANOVA. The analysis revealed a significant main effect of Condition F_1 (3, 216) = 26.48, *MSE* = 0.01 $p < .001$, F_2 (3, 61) = 6.60, *MSE* = 0.02, $p < .001$, indicating that word 'type' was a strong predictor of processing behavior. The pattern shown in Figure 1 suggests that poor performance on the Nominalizations and good performance on the Event Nouns are driving this effect. There was also a significant main effect of Group F_1 (2, 70) = 3.33, *MSE* = 0.04, $p = .048$, F_2 (2, 122) = 34.4, *MSE* = 0.002, $p < .001$, suggesting that language profile may also an important determiner of lexical processing. An interaction was observed between Condition and Group, reaching significance by item F_2 (6, 122) = 4.01, *MSE* = 0.002, $p = .001$, but not by subject F_1 (6, 216) = 1.67, *MSE* = 0.009, $p = .13$. No significant effect of Pass was found F_1 (2, 73) = 1.25, *MSE* = 0.003, $p = .29$, F_2 (1, 64) = 0.3, *MSE* = 0.003, $p = .56$.

Reaction Times

The analysis conducted on the reaction time data followed the same structure as that used for error rates. Results supported the findings of the accuracy data, with the ANOVA revealing a significant main effect of Condition, by-subject F_1 (3, 216) = 33.95, *MSE* = 9837, $p < .001$ though not by-item F_2 (3, 61) = 1.86, *MSE* = 92938, $p = .15$. The main effect of Group was significant by-item F_2 (2, 122) = 12.55, *MSE* = 4420, $p < .001$, but not significant by-subject F_1 (2, 70) =

.29, *MSE* = 323877, *p* = .75. Again, there was no significant main effect of Pass, F_1 (2, 73) = .66, *MSE* = 31255, *p* = .52, F_2 (1, 64) = 1.89, *MSE* = 6335, *p* = .17, indicating that lexical processing did not change when items were heard for a second or third time. A significant interaction was observed between Group and Condition by-item F_2 (6, 122) = 2.55, *MSE* = 4420, *p* = .023 but not by-subject F_1 (6, 216) = 1.52, *MSE* = 9837, *p* = .17.

Noun Composition

To assess whether decomposable nouns were processed differently from items that could not be decomposed, paired t-tests were conducted on the error data using the Bonferroni pairwise correction for multiple comparisons. Nominalizations were responded to significantly less accurately than all other noun types: Prototypical Nouns *t*(74) = -5.02, *p* < .001, Event Nouns *t*(74) = 6.08, *p* < .001 and Pseudo-suffixes *t*(74) = -5.85, *p* < .001. Furthermore, Event Nouns were identified significantly more accurately than Prototypical Nouns *t*(74) = 4.33, *p* < .001 and Pseudo-suffixes *t*(74) = 3.57, *p* < .001. No difference was found between Pseudo-suffixes and Prototypical Nouns *t*(74) = 1.41, *p* = .16.

Pairwise comparisons were also conducted on the reaction time data, yielding similar results to the accuracy analysis. Nominalizations were significantly slower than Prototypical Nouns *t(*74) = -2.73, *p* = .007, Event Nouns (*SD* = 202.58) *t*(74) = -8.52, *p* < .001 and marginally slower than Pseudo-suffixes *t(*74) = 1.96, *p* = .054. Event Nouns (*SD* = 160.86) were significantly faster than all other conditions: Prototypical Nouns (*SD* = 162.51) *t*(74) = -10.95, *p* < .001, Pseudo-suffixes (*SD* = 195.7) *t(*74) = -7.22, *p* < .001. There was no difference

between the Prototypical Nouns and the Pseudo-suffixed nouns in terms of reaction time $t(74) = -1.27$, $p = .21$.

Taken together, these results suggest that decomposable Nominalizations are significantly more difficult to identify as nouns than the mono-morphemic words. Furthermore, as there was no difference between Pseudo-suffix items and Prototypical Nouns in either reaction times or accuracy, the presence of a suffix uniquely corresponding to a noun did not predict ease of word-class identification.

Speed of Event Nouns

A striking finding from these results is the accuracy and speed with which the Event Nouns were identified. This was not initially predicted given that the Event Nouns referred to 'actions' rather than 'objects' and were therefore semantically atypical of their word class. Furthermore, given that the Nominalizations were matched in terms of 'action' semantics, the differing results for these conditions requires further investigation. A possible explanation for this finding arises from previous studies investigating semantic influences on lexical processing. Wurm, Whitman, Seaman, Hill and Ulstad (2007) explored the significance of 'danger' as a dimension predicting speed of auditory perception, and found that responses to 'low useful' concepts (e.g., *card*) were responded to faster on a lexical decision task when coupled with 'high danger' (e.g., *crime*). Interestingly, many of the event nouns included in the current investigation were also included as stimuli in Wurm et al.'s study, and were rated highly on the 'danger' dimension.

The literature indicates that not only are more dangerous concepts easier to process initially, it is also easier to access these concepts later. Whatever the underlying basis may be, the processing advantage has been found in studies of recognition and recall (Kang, McDermott and Cohen, 2008), memory retention of both word lists (Nairne and Pandeirada, 2008) and pictorial stimuli (Otgaar, Smeets and van Bergen, 2010).

To establish whether the semantic nature of the Event Nouns could have driven the speed and accuracy in the responses, subjective danger ratings of the 65 critical nouns were obtained from 20 native Spanish speakers. They were asked to rate each word on a Likert scale from 1 – 7, where 1 referred to something not at all dangerous and 7 referred to something extremely dangerous.

The averages of these ratings are displayed in Table 4. Pairwise t-tests reveal that the Event Nouns were rated as significantly more dangerous than the nouns in all other conditions ($ps < .001$), including a significant difference between the two mono-morphemic conditions – Event Nouns were rated significantly higher than Prototypical Nouns $t(19) = 14.04$, $p < .001$. This is a particularly interesting comparison given that these conditions have comparable morphological structure and differ only in terms of semantic quality.

(Table 4 about here)

The results therefore suggest that the Event Nouns have more dangerous referents than the three other conditions, and this may contribute to the speed with which they were identified (Wurm et al, 2007); however, as we shall see in

Experiment 2, this difference cannot account for the full pattern of results obtained here.

Linguistic Profile

To assess the significance of language profile on lexical processing, Group reaction times and error rates were analyzed. Pairwise comparisons with Bonferroni pairwise correction revealed that the Spanish dominant group (Group S) made significantly more errors than both the Basque dominant group (Group B) $t(64) = -6.86$ $p < .001$ and low Basque group (Group L) $t(64) = -4.49$, $p < .001$. The Basque dominant group was less accurate than the low Basque group $t(64) = 3.63$ $p < .001$. Reaction times for the three groups again patterned with accuracy. The Spanish dominant bilinguals were significantly slower than both the Basque dominant $t(64)$, $= 3.34$, $p = .001$ and low Basque listeners $t(64) = 4.36$, $p < .001$. There was no significant difference between the Basque dominant and low Basque groups $t(64) = 1.53$, $p = .12$.

These results suggest that linguistic profile may be a significant factor in lexical processing. Our expectation had been that because of the highly combinatorial nature of Basque morphology, the Basque-dominant bilinguals would be most sensitive to the morphological differences, a pattern that was not observed. At this point, we can only speculate that extensive experience with Basque made the Spanish-Basque bilinguals less efficient in decomposing Spanish words.

Experiment 1 Conclusions

Overall, the results from the first experiment indicate that morphological composition is an important determiner of lexical processing. The noun-verb task was designed to be sensitive to any disagreement within the nominalizations, between the decomposed stem (verbal) and the required word-whole response (noun). The clear results for the accuracy and reaction times provide evidence for the decomposition of the decomposable items: Responses were slower and less accurate than responses to the mono-morphemic words.

Our interpretation of the results focuses on the conflict between the required nominal response and the hypothesized activated verbal root for the decomposable test items. It is also possible, however, that the difficulty lies in decomposition itself -- the process of decomposition could require additional time and increase errors. To decide between these two possibilities, Experiment 2 uses the same items in a lexical decision task. In lexical decision, the response to any activated verbal root is the same as the word-whole 'final response' because both are 'word' units. Thus, there is no conflict for the nominalizations. If the results of Experiment 1 were due to such a conflict, the cost relative to the matched mono-morphemic words should not occur in Experiment 2. If, however, the cost is due to decomposition per se, we should see the same pattern in the lexical decision task as we did for the noun-verb judgments: Nominalizations should yield slower and less accurate responses than Event Nouns.

Experiment 2

Methods

Participants

Twenty-five volunteers (18 women, mean age = 23.8, *SD* = 4.9) participated in the experiment. All were native Spanish speakers recruited from the same population as Experiment 1. Their language profile matched that of the 'L1 Spanish' group. We focused on this group because it was the one that showed the most robust effects in Experiment 1 and thus offers the strongest comparison between conditions. All participants provided written informed consent and were compensated for their time.

Materials

The same stimuli used in Experiment 1 were used in Experiment 2. As the task was now auditory lexical decision, we also included a set of non-words. Each word was used to construct a non-word by changing one to three phonemes in the word and maintaining the overall syllabic structure. For example, '*purtir*' was a non-word formed from the word '*portar*', and '*anobéis*' was formed from the word '*amabais*'. This procedure yielded 169 word/non-word pairs. Twenty-six of these pairs included a nominal suffix. For example, the pseudo-suffixed non-word '*vatición*' was formed from the pseudo-suffixed word '*vocación*'. This was done both in order to assess the significance of the nominal suffix in the absence of a valid stem, and to make sure that listeners could not simply use the presence of such a suffix to respond 'word' for the nominalization and pseudo-suffix items.

Procedure

Participants received standard lexical decision instructions in writing and were invited to ask clarification questions. The procedure was designed to be as close as possible to Experiment 1. The phrase *Palabra inventada* 'invented word' was always displayed on the left side of the display, and *Palabra real* 'real word' was always displayed on the right side of the display. The rest of the procedure was identical to Experiment 1.

Two presentation lists were created, each combining all of the 338 items. Each list had the same order of 'item type' with words pseudo-randomized within-condition across the two lists. As in Experiment 1, critical words did not appear until the 11th item. All participants received both lists of stimuli, with a short break between the two blocks. Presentation order was counter-balanced so that each list was presented equally often as the first or second pass. There were two passes, rather than the three used in Experiment 1, because of the larger number of items that resulted from including non-words.

Results and discussion

As noted above, the critical issue in Experiment 2 is whether the morphologically complex Nominalizations show the same disadvantage relative to the mono-morphemic (but semantically similar) Event Nouns that we saw in Experiment 1. In addition, the current experiment addresses two other issues. First, a comparison of Event Nouns to Prototypical Nouns provides a converging test of whether the 'dangerous' nature of the Event Nouns was the reason for the high accuracy and fast responses for Event Nouns in Experiment 1. If this account is correct, we should again see an advantage for Event Nouns, despite

the change in task. Second, our design tests whether listeners use the presence of a familiar suffix as a cue to classifying items as words.

Trials that were 2.5 standard deviations greater than or less than the by-subject and by-item means were removed from the analysis. This eliminated 2.1% of the responses. Only correct responses were included in the analysis of RT.

Error Rates and Reaction Times

Mean error rates and response times across all conditions are displayed in Figure 2. As the figure shows, for the four types of stimuli, the reaction times patterned in the same way as the errors. We examined the effect of Condition in by-subject and by-item ANOVAs. For the error rates the main effect of Condition was significant by subjects, F_1 (3, 72) = 20.11, MSE = 0.002, p < .001 but not by items F_2 (3, 61) = 1.29, MSE = 0.022, p = .29. Reaction time analyses were similar, displaying a significant main effect of Condition by subjects, F_1 (3, 72) = 12.56, MSE = 1202, p < .001, and marginally significant by items, F_2 (3, 61) = 2.4, MSE = 4470, p = .077.

(Figure 2 about here)

Morphological Composition

Our central comparison is between mono-morphemic Event Nouns and Nominalizations chosen to match the Event Nouns on both surface properties and semantic properties. In Experiment 1, Nominalizations were responded to more slowly and less accurately than Event Nouns. We attributed this difference

to the conflict between the (decomposed) verbal component of the Nominalizations and the required 'noun' response. In the current experiment, any such decomposition would aid the identification of Nominalizations because the verbal stem is consistent with the required 'word' response, potentially reversing the relative performance for Event Nouns versus Nominalizations. In pairwise t-tests (with Bonferroni pairwise correction), Nominalizations were in fact identified significantly more accurately than Event Nouns $t(24) = 3.39$, $p < .01$, and significantly faster $t(24) = -3.27$, $p < .01$. This reversal across experiments provides strong support for the decomposition interpretation. Overall, Nominalizations produced the best performance, significantly better than the mono-morphemic Prototypical Nouns (Accuracy: $t(24)= 9.9$, $p < .001$; RTs: $t(24) = -7.71$, $p < .001$) and Pseudo-suffixed nouns (Accuracy: $t(24) = 3.45$, $p < .01$; RTs: $t(24) = -2.61$, $p < .05$).

Processing of Event Nouns – the 'danger' factor

As we noted, Experiment 2 provides a second test of whether the 'dangerous' Event Nouns have an advantage over mono-morphemic Prototypical Nouns. The results here converge with those of Experiment 1. Event Nouns were identified both more accurately than Prototypical Nouns $t(24) = 2.89$, $p < .01$, and significantly faster $t(24) = -3.32$, $p < .01$. It therefore appears that the semantic effect of 'danger' facilitates processing, whether the individual is required to make a lexical or grammatical decision about the word, consistent with previous results (Kang, McDermott and Cohen, 2008; Nairne and Pandeirada, 2008; Wurm et al., 2007).

Nominal Suffix

Finally, the results provide a test of the importance given to the presence of a familiar suffix. Two comparisons are relevant to this question. First, for the real word stimuli, Pseudo-suffix and Prototypical Nouns differed in the presence versus absence of such a suffix. Pseudo-suffixed items were identified both more accurately than Prototypical Nouns $t(24) = 6.01$, $p < .001$ and significantly faster $t(24) = -3.18$, $p < .01$.

Second, we can compare non-words containing a nominal suffix (e.g., *nasición*) to those without such suffixes (e.g., *mevorir*). The suffixed non-words were more difficult to dismiss as non-words, as indexed by significantly higher error rates $t(24) = -3.68$, $p < .01$ and slower reaction times, $t(24) = 2.23$, $p < .05$. This suggests that listeners were sensitive to such suffixes, even in the absence of a valid word stem, when asked to judge whether an item is a real word or not.

General Discussion

The current study addresses the question of whether items are processed differently depending upon their morphological composition. The primary comparison of interest was between classifications of 'Event Nouns', which cannot be decomposed (e.g., *avalancha* 'avalanche'), and 'Nominalizations' which can be decomposed into a verb stem and nominal suffix (e.g., *argumento* 'argument'). We also tested 'Pseudo-suffixed' nouns containing a nominal suffix but no corresponding verb stem (e.g., *excursión* 'excursion'). These three conditions provide insight into processing at the word-whole versus the morphological level, and sensitivity to the presence of a nominal suffix. A secondary aim of our study was to determine whether differing levels of Basque,

a language that employs a high degree of morphological composition, affects lexical processing of our bilinguals' other language, Spanish.

Sensitivity to the Stem of Morphologically Complex Items

Different lexical processing models make different assumptions about the status of morphologically complex words in the mental lexicon. Full-listing continuous models predict that there is only a representation of the whole word, whereas decompositional approaches assume that the lexicon is morphologically structured with complex words stored and accessed via their constituent morphemes. Our two experiments investigated sensitivity to the morphological root of complex words, thereby providing tests for the assumptions of these models.

The two experimental paradigms employed were designed to have different effects on the ease of responding to the nominalizations if and only if processing required activation of their root morphemes. Decompositional theories posit that nominalizations such as '*argument*' are composed of a 'verb' at the stem level and a 'noun' at the word-whole level and that their recognition entails activating those components. For syntactic category judgments, there is a conflict between the activated verbal base and the whole-word category, whereas there is no such conflict in lexical decision. Because the activated verbal base is also consistent with a 'word' response, the nominalizations could be expected to have an advantage in lexical decision in contrast to their disadvantage in a syntactic judgment.

As predicted by decompositional theories, our results show Nominalizations to be identified with the greatest difficulty in the grammatical

decision task, and the least difficulty in the lexical decision task. This was in comparison to the mono-morphemic Event Nouns, items specifically selected to match the Nominalizations in their level of 'action' semantics. Degree of difficulty was indexed both by reduced accuracy and increased response times. The pattern of results for the other three mono-morphemic conditions did not differ across the two tasks, suggesting sensitivity to the morphological constituents of the complex nominalization items is driving the divergent ease of identification across the two experiments.

In Experiment 1, the increased difficulty displayed for Nominalizations would occur if the word class of the stem evokes an early bias to respond 'verb', which must then be inhibited once the incoming speech signal is no longer consistent with this response. Previous studies have suggested that inhibiting a favored response requires additional cognitive effort and can result in reduced accuracy and increased processing time (Costa and Santesteban, 2004; Green, 1997).

In Experiment 2, we used a lexical decision task, where all morphologically valid units support the 'word' response, and so the presence of the base morpheme, whatever its word class, supports the processing both of the stem and the word-whole representation. This means that no inhibition is applied to the base morpheme, as both responses are in agreement. Indeed, earlier access to a valid lexical representation provides an advantage relative to the mono-morphemic words whose representations cannot be accessed until the full word has been received. This is consistent with a number of previous studies finding a processing advantage for morphologically complex, over

morphologically simple words (Balling and Baayen, 2008; Clahsen and Neubauer, 2010).

Our findings converge with previous evidence to suggest that we activate the stem during processing of morphologically complex forms. In masked priming studies, for example, significant stem-priming of semantically transparent prime-target pairs (*driver – drive*) has been established in both the visual domain (Lavric, Clapp and Rastle, 2007; Rastle, Davis, Marslen-Wilson and Tyler, 2000; Rastle et al., 2004; Silva and Clahsen, 2008) and auditory domain (Kieler and Joanasse, 2010; Marslen-Wilson et al., 1994). This suggests that we are sensitive to the morphological structure of complex items, and that the observed priming effect is due to the activation of the corresponding stem during lexical retrieval.

Figure 3 below presents a visual depiction of the time-course of available lexical information as a spoken word unfolds. We can see that for the nominalization *argument* the response to the base representation will be either 'verb' or 'word' depending upon the task. The Complex Uniqueness Point (CUP) specifies the phoneme at which the input becomes inconsistent with any other morphologically complex word (Balling and Baayen, 2008, 2012; Wurm, 1997). In Experiment 1, it is at the CUP that inhibition needs to be applied to the base unit, and it is this point that the speech stream switches from greatest consistency with a 'verb' response to being only consistent with a 'noun' response.

(Figure 3 about here)

A related interpretation of the current results is based on the notion of morphological continuation prediction (Ettinger, Linzen and Marantz, 2014; Gagnepain, Henson and Davis, 2012). The idea is that upcoming morphological units are actively predicted depending on the information provided in the incoming speech stream. Listeners are assumed to be sensitive to possible continuations of morphologically complex words after the realization of the stem and to use this probability distribution to aid processing of following units. Crucially, evidence suggests that this prediction is strongest at the boundary between morphemes of complex words, and reflects a morphological process rather than a process involving the prediction of upcoming phonemes alone. For example, a much greater level of prediction was found for the /r/ in *builder* than the /n/ in *bourbon*, despite being matched on continuation frequency (Ettinger et al., 2014).

In Experiment 1, when identifying the grammatical class of a nominalization such as *argument*, once an individual has heard the stem *argue*, it is much more likely that the following morpheme will be a verbal unit rather than a nominal unit. There is higher prediction for the verbal continuations *-ing, -ed, -es* rather than the less frequent nominal continuation *-ment*. Situations in which the predicted morphological unit is not the same as the outcome are associated with slower responses and increased errors, in line with the current findings (Balling and Baayen, 2008, 2012). Due to the less likely occurrence of the nominal suffix, greater cognitive effort is needed to switch from the predicted to the non-predicted outcome. In contrast, for Experiment 2, all morphologically valid continuations of the root support the 'word' response.

Consequently, the high number of possible suffixes after the stem of the nominalizations supports processing regardless of word-class.

Note that both theoretical variations assume a decompositional approach to lexical processing. In contrast, the Full-Listing continuous model would not predict differences between the two types of 'action' nouns, nor the different results across tasks. Thus, the current study provides multiple new results that support the decomposition of complex words.

Morphological Complexity Across a Bilingual's Two Languages

A secondary aim of the current study was to test whether the knowledge and use of a morphologically rich language may lead to stronger morphological representations and more extensive use of decompositional processing strategies. Our findings suggest that decomposition entails primary access to the root of morphologically complex items. A greater use of decomposition in this case would therefore be indexed by greater difficulty categorizing nominalizations as nouns, due to greater sensitivity to the root 'verb'. Although our findings suggest that there were differences among the groups in their responses, greater knowledge of Basque did not lead to increased use of decompositional strategies. Instead, the Basque dominant group performed better than the Spanish dominant group on this task, suggesting that there is an additional factor driving the group differences. One possible explanation stems from the finding that having an unequal proficiency in one language versus the other has been associated with slower lexical access (Bialystok and Craik, 2007). Interpretations of the results for the three bilingual groups are therefore only speculative at this point.

Sensitivity to Word-Final Grammatical Cue

In addition to probing the status of the stem in morphologically complex words, the present study also investigated whether listeners were sensitive to the word-final suffix. As with the comparison of Nominalizations to Event Nouns, we observed an interesting difference as a function of the task that the listeners were given: The presence of an identifiable suffix did not have a significant impact on the grammatical classifications of Experiment 1 but did produce significant differences in the lexical decisions of Experiment 2.

For this issue, the main comparisons drawn were between Pseudo-suffixed words (e.g., *excursión*) and Prototypical Nouns (e.g., *medicina*). In Experiment 2, the Pseudo-suffixes were identified as words with both greater accuracy and reduced response latencies in comparison to the Prototypical Nouns, suggesting easier identification of the words with this pseudo-suffix. The non-words containing these pseudo-suffixes were more difficult to dismiss as valid words, compared to non-words without these suffixes, again suggesting sensitivity to this unit.

Findings from previous studies are consistent with the results of Experiment 2. A visual priming experiment conducted by Rastle et al (2004) found evidence for decomposition of words with an identifiable suffix, even in the absence of a semantic relationship between the stem and word-whole unit (e.g., department-DEPART). No priming effect was found when there was no identifiable suffix (e.g., demonstrate-DEMON), despite the stem overlapping in form to the same extent in both conditions. Lehtonen, Monahan and Poeppel (2011) conducted a similar study employing the same materials and found consistent behavioral and MEG results in a masked-priming experiment.

Consistent results were also found in a cross-modal priming study of regular derivations in pseudo-words, with significant priming effects for items with an interpretable stem + suffix combination (e.g., '*rapid + ifier*') (Meunier and Longtin, 2007). Taken together, these findings suggest that in lexical decision, individuals are sensitive to the information contained within the suffix.

The lack of facilitation shown for Pseudo-suffixes in Experiment 1 is interesting, given that the derivative suffixes were strongly associated with the nominal word class and that we found evidence for listener sensitivity to this information in Experiment 2. The contrasting results suggest that the demands of each task elicit retrieval of different elements of information. It may be that grammatical decision requires retrieval of the 'function' of morphological units to aid classification, whereas lexical decision only requires recognition of the 'form' of that same unit to aid identification. Along these lines, there is evidence to suggest that there are two distinct stages to morphological parsing. The first stage does not take into account any semantic or grammatical information and is only based on surface properties; only later is lexicality considered (Forster and Veres, 1998; Rastle et al., 2000, 2004).

The results of our Pseudo-suffix manipulation are thus most consistent with the view that there is no immediate access to the mental representation of suffixes beyond their physical form. This interpretation matches the assumptions of the Dual-Mechanism model, which proposes that we only store representations of morphological stems and whole-words. Online grammatical rules process affixes without a lexical representation of the affixes as independent units (Clahsen, 1999; Pinker, 1999; Pinker and Ullman, 2002). In order to compute these grammatical rules, the function of the affix must be

available at some point; however, it appears that the functional representation does not become available during the initial stages of lexical access, instead reflecting a subsequent process acting upon the base unit.

Summary

The primary aim of the present study was to determine whether nouns are processed differently depending on their morphological structure. Our main findings suggest that a decomposable word like '*explosion'* is processed differently than a non-decomposable word such as '*avalanche'*, and that this is due to activation of the *stem* within the morphologically complex item. The results of these two experiments therefore support a decompositional theory of word processing. Furthermore, it appears that individuals were sensitive only to the surface form of a derivational suffix and not the functional link to its word class. This finding is most consistent with the Dual-Mechanism theory that proposes we do not hold representations of regular suffixes, only the stem of morphologically complex words. Taken together, the evidence suggests that morphologically complex words are stored and processed primarily through the base stem and that suffixes are not immediately accessed as functional representations in the lexicon.

PJM was supported by a Marie Curie Fellowship, under grant [FP7-People-2010-IIF; Project No. 275751]; AGS was supported by Ministerio de Economia y Competividad, under grant [PSI2010-17781].

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Appendix 1: Noun Items

Nominalization	Eng. Gloss	Log. Freq.	Base Freq.
Argumento	Argument	1.67	4.49
Duración	Duration	1.62	4.11
Creencia	Belief	1.34	4.10
Ganancia	Gain	1.22	3.94
Herencia	Heritage	1.36	3.85
Matanza	Slaughter	1.22	3.80
Donación	Donation	0.98	3.69
Fijación	Fixation	0.99	3.45
Curación	Healing	0.94	3.43
Mudanza	Move	0.77	3.26
Crianza	Breeding	0.72	3.13
Alzamiento	Lift	0.67	3.10
Abdicación	Abdication	0.43	2.75

Pseudo-suffix	Eng. Gloss	Log. Freq.	Base Freq.
Adicción	Addiction	0.78	4.49
Comunión	Communion	0.90	4.11
Excursión	Excursion	0.63	4.10
Vocación	God call	1.21	3.94
Desventura	Misfortune	0.47	3.85
Ruptura	Rupture	1.30	3.80
Lección	Lesson	1.23	3.69
Audición	Audition	0.69	3.45
Falacia	Fallacy	0.55	3.43
Noción	Notion	1.22	3.26
Vigencia	Validity	1.06	3.13
Coalición	Coalition	1.62	3.10
Sección	Section	1.83	2.75

Event Noun	Eng. Gloss	Log. Freq.
Campaña	Campaign	2.02
Accidente	Accident	1.69
Huelga	Strike	1.52
Tormenta	Storm	1.32
Terremoto	Earthquake	1.19
Trayecto	Journey	1.18
Huracán	Hurricane	1.17
Cirugía	Surgery	1.01
Travesía	Crossing	0.91
Avalancha	Avalanche	0.71
Ciclón	Cyclone	0.53
Cataclismo	Cataclysm	0.39
Escaramuza	Skirmish	0.35

Prototypical Noun	Eng. Gloss	Log. Freq.
Organismo	Organism	1.68
Facultad	Faculty	1.69
Salario	Salary	1.28
Catálogo	Catalogue	1.21
Infierno	Hell	1.37
Clínica	Clinic	1.25
Alcaldía	Major's Office	1.04
Estatura	Height	1.00
Diagrama	Diagram	0.89
Afrenta	Insult	0.70
Ensueño	Dream	0.76
Locomotora	Locomotive	0.61
Pasatiempo	Hobbie	0.45
Comisaria	Presinct	1.63
Medicina	Medicine	1.67
Experto	Expert	1.23
Dictador	Dictator	1.24
Mediodía	Noon	1.29
Pantano	Swamp	1.13
Goleador	Scorer	1.02

Elefante	Elephant	0.91
Desayuno	Breakfast	0.90
Corbata	Tie	0.79
Mancebo	Assistant	0.72
Caricatura	Caricuture	0.65
Portezuela	Door	0.40

Appendix 2: Verb Items

Inflected. Verb	Eng. Gloss	Base Freq.	Inflected Verb	Eng. Gloss	Base Freq.
acud[irían	to come	4.43	Cesa[remos	to stop	4.10
roga[bais	to pray	4.09	Medi[rías	to measure	4.23
reg[iría	to govern	3.99	Ama[bais	to love	4.43
suma[rías	to add	4.19	Obra[steis	to do	3.75
así[amos	to grasp	3.80	Fia[rían	be reliable	4.03
besa[réis	to kiss	3.82	Guia[bais	to lead	3.75
borra[rían	to delete	3.70	Bati[rías	to sweep	3.74
chupa[steis	to suck	3.42	Odia[rías	to hate	3.70
nada[réis	to swim	3.60	Roza[bais	to touch	3.54
mece[rías	to rock	3.13	Urdi[rían	to weave	2.87
liga[bais	to bind	3.16	Tose[réis	to cough	2.93
reñi[ríamos	to scold	3.09	Serra[ríamos	to saw	3.04
incuba[rían	to incubate	2.75	Delira[rían	talk nonsense	2.71
Llena[rías	to fill	4.17	Dura[rían	to last	4.23
Viaja[ban	to travel	4.47	Agita[mos	to shake	3.74
Situa[rían	to put	4.41	Juzga[rías	to judge	4.33
Temí[amos	to fear	4.37	Calla[rían	to shut up	3.87
Acentua[ron	to emphasise	3.51	Reanuda[mos	to resume	3.82
Rei[rán	to laugh	4.34	Hiri[eron	to hurt	3.83
Osa[rías	to venture	3.34	Rae[ríais	scrape off	3.14
Ole[rían	to smell	3.57	Ara[rías	to plow	3.66
Jura[ste	to swear to	3.72	Honra[ste	to honor	3.50
Loa[rías	to praise	2.99	Hui[rías	to run away	4.33
Apea[bais	to take down	3.04	Rugi[réis	to roar	3.13
Cifra[bais	to code	3.12	Aloja[rías	to host	3.47
Asa[réis	to roast	3.12	Pia[rías	to chatter	2.90

Infinitive Verb	Eng. Gloss	Freq.	Infinitive Verb	Eng. Gloss	Freq.
aparecen	appear	1.70	mejorar	improve	1.92
continuar	continue	1.71	reconocer	recognise	1.70
dirige	lead	1.55	merece	deserve	1.49
construyó	construct	1.37	preocupa	worry	1.37
advierte	warn	1.21	mantenía	maintain	1.21
sostener	support	1.18	imaginar	imagine	1.23
cortar	cut	1.18	refiero	refer	1.22
acabaron	end	0.98	recupero	recouperate	1.02
difundir	broadcast	0.94	expulsar	eject	0.85
convivir	coexist	0.68	presumir	show off	0.62
aludir	mention	0.49	jugarán	play	0.51
amontonaba	pile up	0.35	recomponer	repair	0.39
desactivar	deactivate	0.40	subestimar	underestimate	0.38
cumplir	carry out	1.86	esperar	wait	1.84
establece	establish	1.74	responder	respond	1.68
llevaron	wear	1.48	sucedió	happen	1.53
discutir	discuss	1.28	subrayar	emphasise	1.30
componen	compose	1.22	competir	compete	1.22
mostraba	show	1.19	distingue	distinguish	1.15
llamaban	call	1.17	suponen	suppose	1.15
conlleva	carry	1.01	valorar	appreciate	1.05
lanzando	throw	0.90	proponía	propose	0.93
derrotaron	defeat	0.66	pretendemos	pretend	0.74
flotar	float	0.45	portar	wear	0.48
compaginar	combine	0.31	sobreviene	happen	0.33
replantear	think over	0.32	tratándo	treat	0.32

	Spanish			Basque			English		
Group	**BEST**	**Interview**	**AoA**	**BEST**	**Interview**	**AoA**	**BEST**	**Interview**	**AoA**
B	76	5.0	2.2	75	5.0	0.3	55	3.6	7.4
S	76	5.0	0.2	62	4.2	1.4	45	3.0	5.8
L	77	4.9	0.2	14	3.6	n/a	49	3.2	7.3
M=	76.38	4.94	0.8	50.04	4.26	0.9	49.43	3.24	6.8

Condition	Log Freq.		Length		UP		Imageability		ND	
	M=	*SD*=	*M*= *SD*=		*M*= *SD*=		*M*=	*SD*=	*M*=	*SD*=
Event Noun	1.08	0.5	7.92	1.32	8.77	1	5.19	0.74	3.31	2.98
Nominalization	1.07	0.37	8.00	1.08	9.08	1.04	3.71	0.92	1.62	1.33
(Base)	*3.62*	*0.49*					*4.20*	*1.16*	*14.77*	*7.12*
Pseudo-suffix	1.04	0.42	7.69	1.18	8.92	1.04	3.71	1.43	2.23	2.17
Prototypical	1.06	0.39	8.08	1.08	9.08	1.04	5.27	0.77	3.81	2.47

Condition	Correct RT	% Errors
Event Noun *e.g., avalancha*	1054	2.5
Nominalization *e.g., fijación*	1133	11.4
Pseudo-suffix *e.g., excurs**ión***	1118	5.6
Prototypical Noun *e.g., medicina*	1107	4.7

Condition	Danger Rating	
	M=	*SD* =
Event Noun *e.g., avalancha*	4.7	0.49
Nominalization *e.g., fijación*	2.4	0.46
Pseudo-suffix *e.g., excurs**ión***	2.2	0.47
Prototypical Noun *e.g., medicina*	2.2	0.45

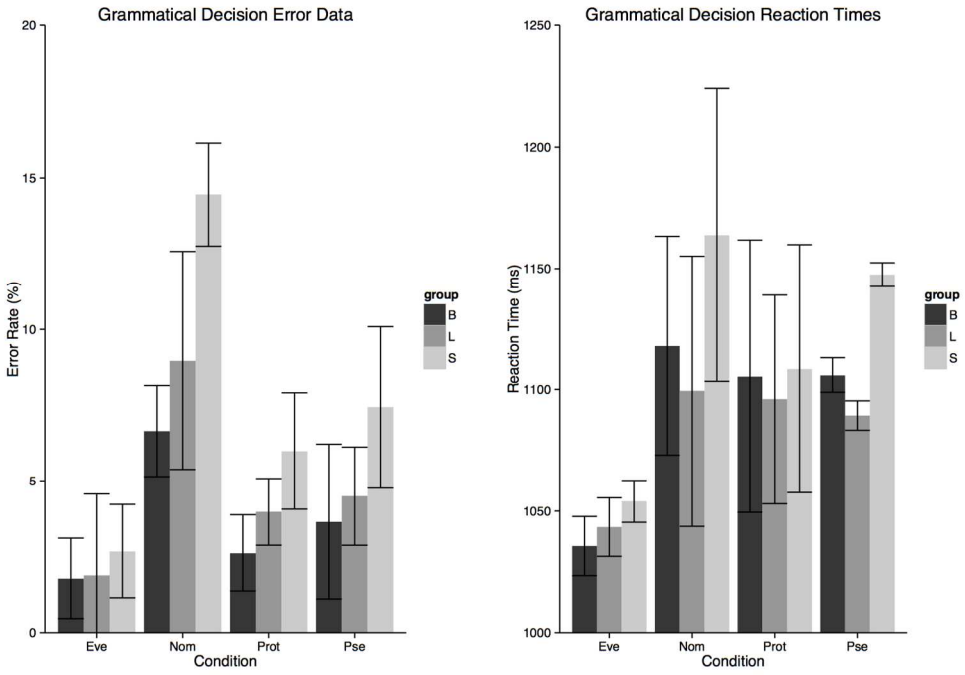

Fig. 1. Mean error rates and reaction times across conditions. Error bars represent a 95% confidence interval. Legend: B = Basque dominant; S= Spanish dominant; L = Low Basque; Eve = event noun; Nom = nominalization; Prot = prototypical noun; Pse = pseudo-suffixed noun.
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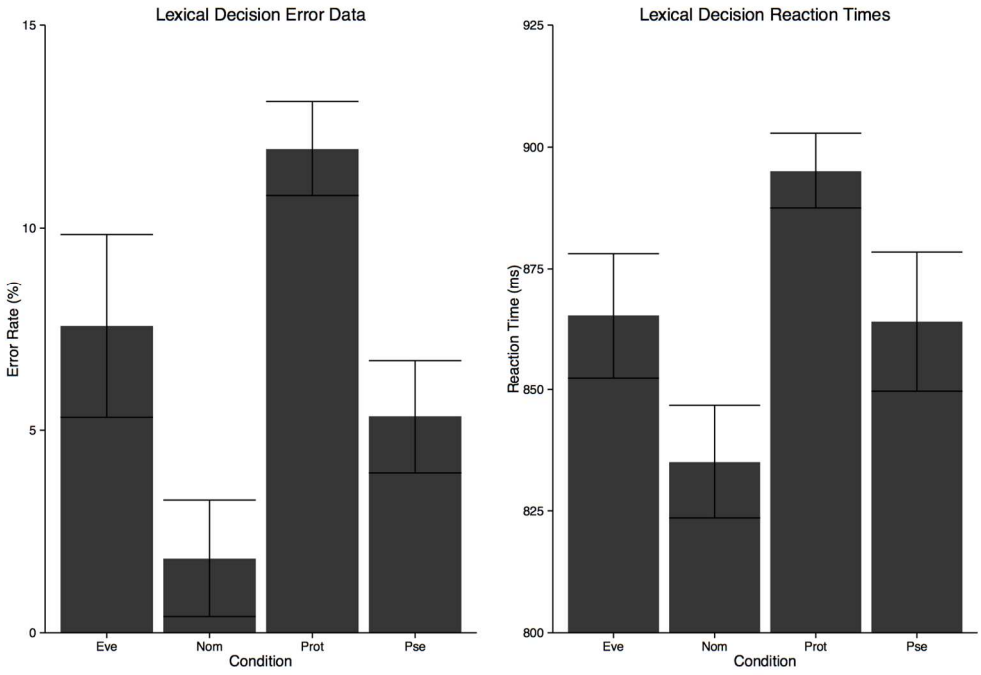

Fig. 2. Mean error rates and response times for each condition of Experiment 2. Error bars represent a 95% confidence interval. Eve = event noun; Nom = nominalization; Prot = prototypical noun; Pse = pseudo-suffixed noun.
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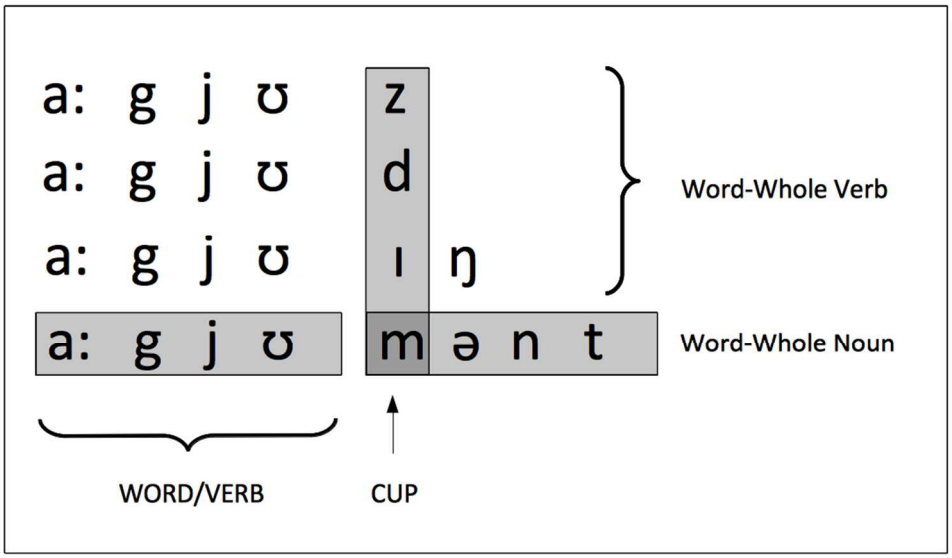

Fig. 3. Depiction of the auditory processing of argument. (British English).