Journal of Experimental Psychology:
Learning, Memory, and Cognition
2015, Vol. 41, No. 6, 1663–1674

0278-7393/15/$12.00 http://dx.doi.org/10.1037/xlm0000130

Sensitivity to Morphological Composition in Spoken Word Recognition: Evidence From Grammatical and Lexical Identification Tasks

Laura E. Gwilliams
Basque Center on Cognition, Brain and Language;
NYUAD Institute

Philip J. Monahan
Basque Center on Cognition, Brain and Language;
University of Toronto

Arthur G. Samuel
Basque Center on Cognition, Brain and Language; Stony Brook University; IKERBASQUE

Access to morphological structure during lexical processing has been established across a number of languages; however, it remains unclear which constituents are held as mental representations in the lexicon. The present study examined the auditory recognition of different noun types across 2 experiments. The critical manipulations were morphological complexity and the presence of a verbal derivation or nominalizing suffix form. Results showed that nominalizations, such as "explosion," were harder to classify as a noun but easier to classify as a word when compared with monomorphemic words with similar actionlike semantics, such as "avalanche." These findings support the claim that listeners decompose morphologically complex words into their constituent units during processing. More specifically, the results suggest that people hold representations of base morphemes in the lexicon.

Keywords: morphological processing, spoken word recognition, decomposition, derivational suffixation

The processing of morphologically complex words (e.g., stem "argue" + suffix "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 whole word, or continuous, approach (Butterworth, 1983; Janssen, Bi, & Caramazza, 2008; Norris & McQueen, 2008) and the decomposition, or parsing, approach (Cutler & Norris, 1988; Marslen-Wilson, Tyler, Waksler, & Older, 1994; Pinker & Ullman, 2002).

In the visual domain, there is considerable evidence consistent with a decompositional theory of word recognition wherein morphologically complex words are segmented into their constituent morphemes prior to retrieval. Visual masked-priming behavioral studies, for example, consistently find that the covert presentation of a complex word, such as "government," or a pseudocomplex word, such as "corner," aids lexical identification of the stem or pseudostem (e.g., "govern," "corn"). This result has been taken as evidence that regularly derived forms are automatically decomposed into constituent morphemes prior to lexical access in English (Rastle, Davis, & New, 2004), Arabic (Boudelaa & Marslen-Wilson, 2001), and Hebrew (Frost, Forster, & Deutsch, 1997; for a review, see Rastle & Davis, 2008). Corroborative findings have also been reported in the neurophysiological literature supporting decomposition of regularly derived forms and pseudoderived forms (Lehtonen, Monahan, & Poeppel, 2011; Lewis, Solomyak, & Marantz, 2011; Solomyak & Marantz, 2010; Whiting, Shtyrov, & Marslen-Wilson, 2015; Zweig & Pylkkänen, 2009) in addition to decomposition of irregulars, such as "taught," into "teach + [past]" (Stockall & Marantz, 2006) and compounds, such as "teacup," into constituent stems (Fiorentino & Poeppel, 2007). Further, there is research to support the significance of stem frequency in predicting response times (RTs) to complex forms, suggesting that access to the whole word entails primary access to the constituent stem morpheme (Taft, 1979,2004; Taft & Ardasinski, 2006).

The role of morphology in auditory word recognition, however, has been much less explored, with contention remaining regarding the importance of morphological structure to the parsing of the speech signal. Continuous models, such as Shortlist B (Norris & McQueen, 2008) and the cohort model (Marslen-Wilson & Welsh, 1978), assume that internal word structure is irrelevant and that onset-aligned whole word competitors are eliminated with each incoming phoneme. Consequently, the target is recognized at the position within the word at which it is unique from all onset-

This article was published Online First May 11, 2015.

Laura E. Gwilliams, Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain; New York University Abu Dhabi, United Arab Emirates; Philip J. Monahan, Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain; Centre for French and Linguistics, University of Toronto Scarborough, Canada; Department of Linguistics, University of Toronto, Canada; Arthur G. Samuel, Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain; Department of Psychology, Stony Brook University, USA; IKERBASQUE Basque Foundation for Science, Bilbao, Spain.

This research was supported by the New York University Abu Dhabi (NYUAD) Research Council from NYUAD Institute Grant G1001, Grant 497058 from the University of Toronto, Marie Curie Award FP7-People-2010-IIF 275751, and Grant PSI2010-17781 from the Spanish Ministry of Economics and Competitiveness.

Correspondence concerning this article should be addressed to Laura E. Gwilliams, Neuroscience of Language Lab, A2-008, NYUAD Campus, Saadiyat Island, Abu Dhabi. E-mail: laura.gwilliams@nyu.edu

aligned words: the *uniqueness point* (UP). This approach allows for a model that does not require a large number of exception rules (e.g., to avoid false decomposition of "corner"); however, the approach entails substantial redundancy, because strict left-to-right parsing requires independent representations despite semantic transparency among morphologically related forms (e.g., "covered," "uncover," and "discover"; see Wurm, 1997).

To test the continuous Shortlist B model, Balling and Baayen (2012) assessed the influence of different UP measures on auditory word recognition. They compared a measure that identifies a target word once the sensory input is inconsistent with all onset-aligned words, including morphological continuations (*complex uniqueness points* [CUPs]), with a measure that does not take morphologically related words into consideration (UPs). For example, in a word such as "acceptable," the UP occurs at /t/, and the CUP occurs at the following vowel. The locations of both the UP and the CUP were significant determiners of response latency in lexical-decision, suggesting that both morphological and word-whole competitors are relevant to auditory word recognition.

Decomposition models propose that auditory processing involves recognition of constituent morphemes rather than whole words, with individual morphemes represented lexically. Although there is evidence to support sensitivity to morphological structure during processing, it is unclear which morphemes are represented in the lexicon. Cross-modal priming studies have found evidence to support stem access during comprehension (Marslen-Wilson et al., 1994), although they have done so only in the presence of a sufficient semantic relationship between the whole word and the root (e.g., "government" and "govern"). More recent investigations (Kielar & Joanisse, 2011) have found that form and meaning codetermine the degree of observed morphological priming.

Evidence for suffix decomposition is also unclear. In an auditory-priming study, Emmorey (1989) found no affix priming for inflectional ("joking"/"typing") or derivational ("tightly"/"cheaply") pairs, suggesting that suffixes do not have lexical representations that can be primed during lexical access. In a cross-modal task, however, Marslen-Wilson, Ford, Older, and Xiaolin (1996) reported evidence for derivational affix priming for words such as "darkness" and "toughness." Further, in a mismatch-negativity (MMN) study, Whiting, Marslen-Wilson, and Shtyrov (2013) found evidence for automatic recognition and decomposition of suffixes, both for "real" (e.g., "baker") and for "pseudo" (e.g., "beaker") suffixed items, in agreement with what had been previously found for visual processing of similar items (e.g., Rastle et al., 2004 [as discussed earlier]). The authors proposed that there was an automatic recognition of suffixes, even for pseudosuffixed items that were not composed of stem and suffix units. Because of methodological constraints, they used a small set of experimental items, making it hard to generalize the results; however, their findings support suffix identification in spoken word recognition and isolable processing structures in the mental lexicon for affixes.

The Current Approach

Here, we present the results of two experiments that used the same critical items. The experiments were run in Spanish with native Spanish speakers (from the Spanish-speaking portion of the Basque Country) as participants. Our main comparison was between two types of action nouns: regularly derived nominalizations that could be decomposed into (verb stem) + (nominal suffix) forms (e.g., *dona* + *-ción* ["donation"]) and monomorphemic event nouns that could not be decomposed (e.g., *avalancha* ["avalanche"]). The two types of items were selected to have similar verblike semantics, but only the first type potentially had a verbal stem in the lexicon. Importantly, because of the morphological characteristics of Spanish, all of the morphologically complex items selected for the current experiments were constructed through the combination of a bound attested stem and suffix, such as *donación*: The listener was therefore not exposed to a free stem (e.g., *donar*) but, rather, an attested stem (e.g., *dona-*).

Psycholinguists have used a wide range of tasks to explore different aspects of lexical access. For example, naming/shadowing has been used to tap early encoding, and semantic categorization (e.g., does a word refer to an animate or an inanimate object?) has been used in studies focusing on access to meaning. Given our interest in morphosyntactic processing, in one experiment, listeners classified spoken words as either a "noun" or a "verb" (i.e., a grammatical-decision task); in the other, listeners classified items as either real Spanish words or not (i.e., an auditory lexical-decision task). If stems are accessed during spoken word recognition, decomposable nominalizations should be more difficult to identify as nouns than monomorphemic event nouns because of the mismatch between the verb stem and the final "noun" response. In contrast, during lexical-decision, the nominalizations should be easier to identify, because access to the stem would bolster the "word" response. Decomposition (i.e., access to the stem) should therefore produce an interaction between the two conditions of interest and the two experimental tasks.

We also included a condition to test the representation of affix units. Because derivational morphology provides direct information regarding word class, if an affix is identified during word recognition, it allows faster identification of a word's grammatical category. To test this, we compared monomorphemic nouns (e.g., *medicina* ["medicine"]) with nouns containing a ("pseudo") derived suffix and a false stem: [false stem] + [nominal suffix] (e.g., *excursión* ["excursion"]). These pseudosuffixed nouns provided a legitimate nominal suffix, but they could not be decomposed in the same way as "explosion" could because of the absence of a legitimate stem (e.g., there is no base verb "excur," or anything similar, for "excursion"). Such items tested whether there is sensitivity to the word-final morphological unit and whether the item is decomposed despite the absence of a free base morpheme. If affix decomposition occurs in pseudosuffixed words, they should produce faster responses in the grammatical-decision task in comparison with monomorphemic "prototypical" nouns.

Experiment 1

Method

Participants. Twenty-five native Spanish participants with normal hearing volunteered and were compensated for their time (12 were female; age: $M = 22.4$ years, $SD = 3.74$). Participants were either students of, or employed by, the University of the Basque Country. All participants provided written informed consent.

Materials. Thirty-nine critical items were selected from the Spanish Es-Pal database (Duchon, Perea, Sebastián-Gallés, Martí, & Carreiras, 2013) to form three subsets of nouns. Critical stimulus items and their glosses are presented in Appendix A. These consisted of 13 event nouns, selected to have event/action semantic representations but no verbal derivations; 13 deverbal nominalizations, selected to have clear verbal derivations and nominalizing suffixes; and 13 pseudosuffixes, selected to have word-final nominal forms identical to nominalizing suffixes but without the corresponding verbal derivations. Item selection was based on the judgments of 10 native Spanish speakers. In addition to the 39 critical items, 26 prototypical nouns were selected. These were monomorphemic nouns that referred to objects rather than events.

Critical stimulus properties are presented in Table 1. Length and UP were measured in number of phonemes. UP is the position of the first phoneme in a word where it becomes unique from all other onset-aligned words (Marslen-Wilson, 1984). Phonological neighborhood density (ND) was measured as the number of words that could be formed by substituting, adding, or deleting one phoneme. Imageability is also reported, because it affects RTs for nouns (Kacinik & Chiarello, 2002).

For the word-class judgment, we included 104 verbs (52 infinitive verbs and 52 inflected verbs). The verbal inflection was a conjugation indicating either person or tense agreement. Sets of stimuli were created by matching for length in terms of phoneme number (LP), log frequency (log.), log. of the base stem, and UP of the nominalizations. Thirteen sets were created using this structure (see Appendix B for all critical stimuli).

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, and amplitude was equalized to 70 dB sound pressure level using Praat (Boersma & Weenink, 2014).

Procedure. Before the experiment, noun and verb definitions and examples were provided to ensure that participants had a full understanding of the task. Participants were invited to ask clarification questions.

The word *Verbo* (“verb”) was always presented on the left side of the visual display, and *Sustantivo* (“noun”) was always presented on the right. Stimuli were presented over Beyerdynamic (Berlin, Germany) DT-770 headphones at a comfortable listening level. Participants categorized each word as a verb or noun by pressing the left or right key on a response board using their index fingers. They were instructed to respond as quickly and as accurately as possible. The intertrial interval was 750 ms and began on response to the prior stimulus. The next item was presented regardless of accuracy on the previous trial. If no response was made after 2,500 ms, the next trial began. No feedback was provided.

Three pseudorandomized presentation lists were composed, each combining the 65 nouns and 104 verbs. Critical items did not appear until the 11th word to allow for task habituation. Participants listened to all three lists, with short breaks between lists. Presentation was counterbalanced so that each list was presented equally as the first, second, and third pass. The experiment lasted approximately 30 min.

Results and Discussion

The mean RTs and percentages of errors for noun and verb conditions are displayed in Figure 1. RTs were measured from word onset. Trials with RTs that were more than 2.5 standard deviations from the by-participant or by-item means were removed from the analysis (2.6% of responses). No participants or items were eliminated from the final analyses. The generally high levels of accuracy indicate that participants did not have difficulty making the noun–verb judgment.

Our primary question was whether action nouns are treated differently depending on morphological composition: Are there differences between the monomorphemic event nouns (e.g., *avalancha*) and their nominalizations (e.g., *donación*)? To address this question, we analyzed RTs and error rates using linear mixed-effects models in the *lme4* package (Bates, Maechler, & Bolker, 2012) in *R* (R Core Team, 2012) using a mixed logit model (Jaeger, 2008). Each model included random by-item and by-participant intercepts, a random slope of condition over participants (following Barr, Levy, Scheepers, & Tily, 2013), and fixed effects for all potentially relevant predictors: condition, imageability, UP, phonological ND, length, and stimuli list.

Mixed-model analysis. As shown in Figure 1, performance for the critical noun conditions patterned in the same way for accuracy and RTs. Because our experimental hypothesis was based on nominal processing, our statistical analyses compared performance across the four types of nouns in our design. Estimates of the linear model for accuracy and RT are provided in Table 2. The analyses revealed a significant effect of condition for accuracy, $\chi^2(3) = 13.1$, $p < .01$, indicating that noun type was a strong predictor of processing behavior. For RTs, condition did not reach significance, $\chi^2(3) = 5.6$, $p = .13$, but as noted, it patterned in the same way as the error data. The results shown in Figure 1 and the estimates of the model reflect poor performance on the nominalizations and good performance on the event nouns.

Table 1
Linguistic Properties From Es-Pal Database: Means and Standard Deviations Across Critical Items

	Log freq.		Length		UP		Imageability		ND	
Condition	*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
Pseudosuffix	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

Note. Imageability was rated on a 1–7 scale ($M = 4.47$). Log freq. = log frreuency; UP = uniqueness point; ND = neighborhood density.

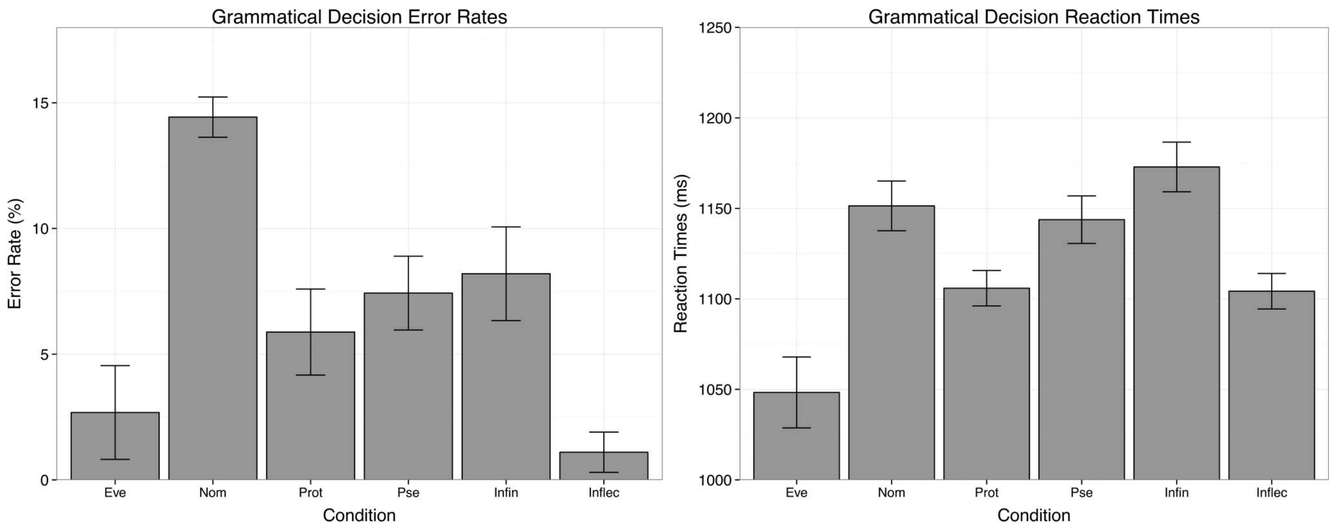

Figure 1. Grammatical-decision error rates and reaction times for noun and verb conditions. Error bars represent standard error from the mean. Eve = event noun; Nom = nominalization; Prot = prototypical noun; Pse = pseudosuffixed noun; Infin = infinitive verb; Inflec = inflected verb.

Noun composition. To assess whether decomposable nouns were processed differently from items that could not be decomposed, we conducted post hoc comparison tests using generalized hypothesis testing with the Tukey adjustment procedure for multiple comparisons in the multcomp R package (Hothorn, Bretz, & Westfall, 2008). This allowed us to compare conditions while taking both by-participant and by-item variability into account. Event nouns were identified significantly more accurately than nominalizations ($z = -3.39$, $p < .01$), and they were responded to faster than nominalizations, although this comparison did not reach significance ($z = -2.15$, $p = .14$). These results suggest that the decomposable words were significantly more difficult to identify as nouns than were the monomorphemic words. Nominalizations were also identified less accurately than prototypical nouns, but not significantly so ($z = -2.18$, $p = .13$), with no RT difference ($z = 0.86$, $p = .82$).

Pseudosuffix. The second question addressed by this experiment was the importance of a suffix to auditory word recognition. To explore this, we compared responses to the pseudosuffix and prototypical nouns. Post hoc tests did not reveal any significant differences (accuracy: $z = -0.16$, $p = .99$; RT: $z = 0.63$, $p = .92$).

Conclusions

Overall, the results of the first experiment indicate that morphological composition is an important determiner of lexical processing. The grammatical-decision task was designed to be sensitive to any disagreement between the decomposed stem (verbal) and the required word-whole response (noun) in a nominalization. The clear results for accuracy and the corresponding (nonsignificant) trends in RTs provide evidence for the decomposition of the decomposable items: Responses were significantly less accurate and numerically slower than responses to the monomorphemic words.

Our interpretation 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; perhaps decomposition re-

Table 2
Parametric Coefficients of the Linear Mixed Model Fitted to the Accuracy and Response Latencies of Experiment 1

	Accuracy				Reaction time			
Variable	Estimate	*SE*	*t*	*p*	Estimate	*SE*	*t*	*p*
(Intercept)	2.550	1.536	1.660	.097	976.612	148.563	6.574	<.001
Event noun	1.135	0.573	1.980	.048	−58.444	33.861	−1.726	.084
Nominalization	−0.938	0.431	−2.176	.030	35.610	41.489	0.858	.391
Pseudosuffix	−0.069	0.439	−0.158	.875	25.819	41.036	0.629	.529
Imageability	0.116	0.105	1.103	.270	−23.562	10.331	−2.281	.023
UP	0.079	0.415	0.190	.849	−15.788	39.582	−0.399	.690
ND	−0.017	0.063	−0.264	.792	2.663	5.843	0.456	.649
Length	−0.064	0.397	−0.161	.872	48.747	38.441	1.268	.205
List	0.053	0.076	0.687	.492	−1.679	5.393	−0.311	.756

Note. Condition estimates are as compared with "prototypical noun." Imageability was rated on a 1–7 scale ($M = 4.47$). Log freq. = log frequency; UP = uniqueness point; ND = neighborhood density.

quires additional time and increases errors. To decide between these two possibilities, Experiment 2 used 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 a result of such conflicts, the impairment relative to the matched monomorphemic words should not occur in Experiment 2. If, however, the cost is a result of decomposition per se, we would expect to see the same pattern in the lexical-decision task as we did for noun–verb judgments: nominalizations yielding slower and less accurate responses than event nouns.

Experiment 2

Method

Participants. Twenty-five volunteers (18 women; age: M = 23.8 years, SD = 4.9) participated in the experiment. All were native Spanish speakers recruited from the same population as in Experiment 1. All participants provided written informed consent and were compensated for their time.

Materials. The stimuli used in Experiment 1 were used in Experiment 2. As the task was now auditory lexical-decision, we also included a set of nonwords. Each word was used to construct a nonword by changing 1 to 3 phonemes while maintaining the overall syllabic structure. For example, *purtir* was a nonword formed from the word *portar* ("to carry"), and *anobéis* was formed from the word *amabais* ("loved"). This procedure yielded 169 word–nonword pairs. Twenty-six of these pairs also included a nominal suffix. For example, the pseudosuffixed nonword *vatición* was formed from the pseudosuffixed word *vocación* ("vocation"). This was done both 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 pseudosuffix items.

Procedure. Participants received standard lexical-decision instructions in writing and were invited to ask clarification questions. 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. The rest of the procedure was as in Experiment 1.

Two presentation lists were created, each of which included all 169 word–nonword pairs. Each list had the same order of item type, with words pseudorandomized 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 counterbalanced so that each list was presented equally often in 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 nonwords.

Results and Discussion

Trials that were 2.5 standard deviations from the by-participant and by-item means were removed from the analysis (2.1% of the responses—just 0.5% less than for the grammatical-decision task). Only correct responses were included in the analysis of RTs. Mean RTs and error rates are displayed in Figure 2.

Mixed-model analysis. RTs for all conditions patterned in the same way as the errors. The models summarized in Table 3 were reached by performing the same mixed-model analysis as in Experiment 1. We found a significant effect of condition for both accuracy, $\chi^2(3) = 15.32$, $p < .01$, and RT, $\chi^2(3) = 9.78$, $p = .02$.

Morphological composition. Our central comparison was again between monomorphemic event nouns and nominalizations chosen to match the event nouns on both surface properties and semantic properties. In the current experiment, stem decomposition would aid the identification of nominalizations, because the verbal stem was consistent with the required "word" response; this would produce the opposite pattern to what we saw with

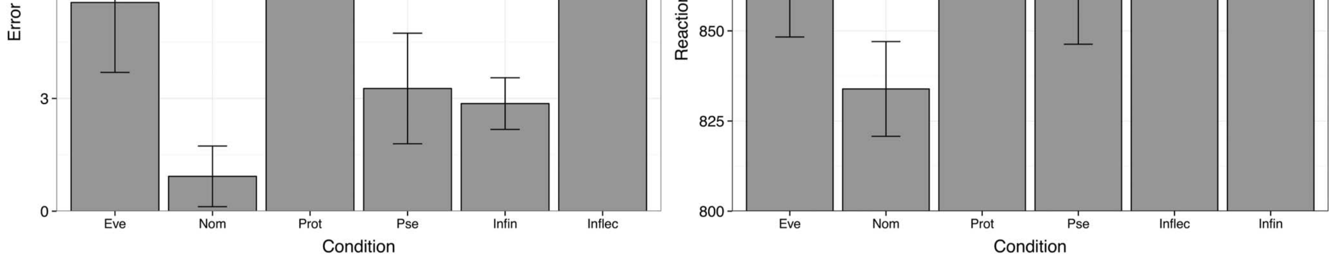

Figure 2. Lexical-decision error rates and reaction times for noun and verb conditions. Error bars represent standard error of the mean. Eve = event noun; Nom = nominalization; Prot = prototypical noun; Pse = pseudosuffixed noun; Infin = infinitive verb; Inflec = inflected verb.

Table 3
Parametric Coefficients of the Linear Mixed Model Fitted to the Accuracy and Response Latencies of Experiment 2

	Accuracy				Reaction time			
	Estimate	*SE*	*t*	*p*	Estimate	*SE*	*t*	*p*
(Intercept)	−1.980	2.845	−0.696	0.487	697.465	95.926	7.271	<.001
Event Noun	0.129	0.631	0.204	0.839	−25.585	22.086	−1.158	0.247
Nominalization	3.192	0.861	3.709	<.001	−77.966	25.151	−3.100	0.002
Pseudosuffix	1.716	0.744	2.307	0.021	−44.676	26.060	−1.714	0.086
Imageability	0.852	0.208	4.094	<.001	−11.054	6.729	−1.643	0.100
UP	0.332	0.741	0.448	0.654	23.866	25.527	0.935	0.350
NP	0.107	0.113	0.950	0.342	−0.019	3.768	−0.005	0.996
Length	−0.215	0.730	−0.294	0.769	4.850	24.756	0.196	0.845
List	0.027	0.051	0.531	0.595	−1.679	5.393	−0.311	0.756

Note. Condition estimates are as compared with "prototypical noun." Imageability was rated on a 1–7 scale ($M = 4.47$). Log freq. = log frequency; UP = uniqueness point; ND = neighborhood density.

grammatical-category judgments. And this reversal was indeed what we found: Nominalizations were identified significantly more accurately than event nouns ($z = 3.36$, $p < .01$); their RT advantage did not reach significance ($z = -1.71$, $p = .22$). Nominalizations were also identified more easily than prototypical nouns (accuracy: $z = 3.71$, $p < .01$; RT: $z = -3.10$, $p < .01$). This reversal across experiments provides strong support for the decomposition interpretation.

Nominal suffix. The results also provide a test of the importance given to the presence of a derivational suffix. Two comparisons are relevant to this question. First, for the real-word stimuli, pseudosuffixed items and prototypical nouns differed in the presence versus absence of such a suffix. Pseudosuffixed items were identified marginally more accurately than prototypical nouns ($z = 2.31$, $p = .09$), although not significantly faster ($z = -1.71$, $p = .31$).

Second, we can compare nonwords containing a nominal suffix (e.g., *nasición*) with those without such suffixes (e.g., *mevorir*). The suffixed nonwords were more difficult to dismiss as real words, as indexed by significantly higher error rates ($z = -10.62$, $p < .001$) and longer RTs ($z = 2.06$, $p < .05$). This suggests that listeners were sensitive to the suffix unit, even in the absence of a valid word stem, when asked to judge whether an item was a real word.

Combined Data Analysis

In the introduction, we noted that if the stem is being decomposed during processing, we would expect nominalizations to be more difficult to identify as nouns but easier to identify as words. To test this prediction, we conducted a mixed-model analysis across the two experiments. We followed the same methods used in the main experimental analyses, testing the additional factor of task and its interaction with condition in the fixed effects. Only the two main conditions of interest (nominalizations vs. event nouns) were included in the condition factor. The results are displayed in Figure 3.

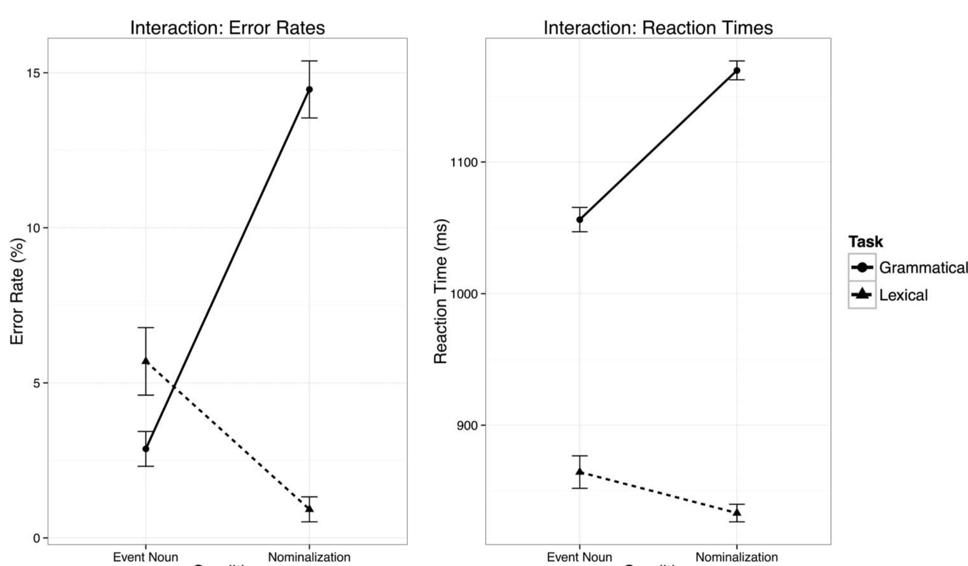

Figure 3. Interaction between task and condition (event nouns and nominalizations) for accuracy and response latencies.

The analysis revealed a significant main effect of task for accuracy, $\chi^2(5) = 6.03$, $p = .014$, and RT, $\chi^2(5) = 13.91$, $p < .001$; there were also highly significant Condition × Task interactions for accuracy, $\chi^2(4) = 41.7$ $p < .001$, and RT, $\chi^2(4) = 33.67$, $p < .001$. These interactions suggest that access to the stem is indexed by poor performance in grammatical-decision and good performance in lexical-decision, consistent with the predictions of decomposition theories of lexical processing.

General Discussion

The current study addressed the question of whether morphological constituents are processed and represented as distinct units during auditory lexical processing. The primary comparison of interest was between classifications of monomorphemic event nouns (e.g., *avalancha* ["avalanche"]) and polymorphemic nominalizations, which are composed of a verb stem and nominal suffix (e.g., *donación* ["donation"]). We also tested pseudosuffixed nouns containing a nominal suffix but no corresponding verb stem (e.g., *excursión* ["excursion"]). These three conditions provide insight into the representation of stem and affix units during spoken word recognition.

Sensitivity to the Stem of Morphologically Complex Items

Our main finding was that morphologically complex nominalizations were more difficult to identify in the grammatical-decision task and easier to identify in the lexical-decision task when compared with semantically matched monomorphemic items. The morphological structure of the Spanish nominalizations we selected consisted of bound stems (e.g., *dona-*) and bound derivational suffixes (e.g., *-ción*); the stems were well-attested morphemes of the language but did not constitute discrete words on their own. Because of this, participants never heard a complete verbal base form (e.g., *donar*) but, rather, a stem that had to be appended with a derivational or inflectional morpheme (e.g., *dona* + *ción*). The interaction we observed across tasks suggested that this stem supported a "verb" response for the whole word but slowed down nominal classification.

One interpretation is that in accessing the representation of the stem morpheme, the processing system activates the possible morphological continuations that may subsequently occur. For example, when identifying the grammatical class of a nominalization, such as "donation," once an individual has recognized the bound stem "dona-," there is greater summative likelihood of a verbal continuation (e.g., "donate" and its verbal inflections) than a nominal continuation (e.g., "donation"). Situations in which the predicted morphological unit is not the same as the outcome are associated with slower responses and increased errors (Balling & Baayen, 2012; Ettinger, Linzen, & Marantz, 2014). Because of the less likely occurrence of a nominal suffix, greater cognitive effort is needed to switch from the predicted (verb) to the nonpredicted (noun) outcome, therefore increasing errors and lengthening RTs for the nominalizations in the grammatical-decision task.

In contrast, in the lexical-decision task of Experiment 2, all morphologically valid units supported the "word" response, meaning that all activated continuations of the root supported the same outcome. Indeed, earlier access to a valid lexical representation, such as an attested stem, would have provided an advantage relative to the monomorphemic words, whose representation(s) could not have been accessed until the full word had unfolded. As there is evidence that bound and free morphemes are processed comparably in the visual domain (Pastizzo & Feldman, 2004), our results are likely to be generalizable to both forms of stem morphemes.

A less interesting possibility is that because there were more verbs (104) than nouns (65) in Experiment 1, there could have been a bias for participants to respond "verb," making it harder to respond "noun" and, thus, disproportionately affecting the classification of nominalizations. Any such bias would be expected to develop over the course of an experiment as listeners were exposed to the noun–verb distribution with increasing difficulty in classifying the nominalizations. Looking at the mean error rates and RTs across each pass of Experiment 1, no such trend was observed: Nominalizations were poorly identified from the beginning, with no increase in difficulty across passes. Moreover, the critical comparison was between nominalizations and event nouns, both of which would presumably suffer from any distribution-based bias against responding "noun."

Our findings converge with those of previous studies supporting activation of stems during processing of morphologically complex forms. Significant stem priming of semantically transparent prime–target pairs (e.g., "driver"–"drive") has been established in both visual masked priming (Rastle, Davis, Marslen-Wilson, & Tyler, 2000; Rastle et al., 2004; Silva & Clahsen, 2008) and cross-modal priming (Kielar and Joanisse, 2010; Marslen-Wilson et al., 1994). This suggests that listeners are sensitive to the morphological structure of complex items and that the observed priming effect was a result of the activation of the corresponding stem during lexical retrieval and not simply a consequence of semantic overlap. Collectively, the evidence indicates that decomposition of constituent units occurred in both the visual and auditory modalities.

Sensitivity to Word-Final Grammatical Cues

In addition to probing the status of the stem in morphologically complex words, we investigated whether listeners were sensitive to a word-final suffix. For this issue, the main comparison was between pseudosuffixed words (e.g., *excursión*) and prototypical nouns (e.g., *medicina*). We observed an interesting difference as a function of the task that listeners were given: The presence of an identifiable suffix did not have a significant impact on grammatical-decisions but did produce significant differences in lexical-decisions.

In Experiment 2, the pseudosuffixes were identified as words more accurately and more quickly than the prototypical nouns, suggesting easier identification of words with such pseudosuffixes. The nonwords containing pseudosuffixes were more difficult to dismiss as valid words than were nonwords without these suffixes, again suggesting that the processing system is sensitive to the presence of derivational morphemes as valid lexical units.

Findings for printed words 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 the word-whole unit (e.g., "depart"–

"department"). No priming effect was found when there was no identifiable suffix (e.g., "demon"–"demonstrate"), despite the stem overlapping in form to the same extent. Lehtonen et al. (2011) conducted a similar study using the same materials and found consistent behavioral and magnetoencephalography results in a masked-priming experiment.

In the domain of spoken word recognition, similar results have also been found in a cross-modal priming study of regular derivations in pseudowords, with significant priming effects for items with an interpretable stem + suffix combination (e.g., *rapid* + *ifier*; Meunier & Longtin, 2007). Further, Whiting et al. (2013) found that both pseudosuffixed (e.g., "beaker") and truly suffixed (e.g., "baker") words elicited comparable neural activation in the left superior temporal cortex as compared with items that did not contain an affix (e.g., "bacon"). The authors suggested that the pseudosuffix was automatically recognized as a distinct unit even when the item was not morphologically complex.

The lack of facilitation shown for pseudosuffixes in Experiment 1 is interesting given that the derivational 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 elicited retrieval of different elements of information: Grammatical-decision requires retrieval of the function of morphological units on the lexical level to aid classification (e.g., the presence of the derivational suffix *-ción* modifies the class of the lexeme to become a noun), whereas lexical-decision only requires recognition of the form of that same unit to aid identification.

One possibility is that a derivational suffix is represented both by form and lexical function, but its syntactic function is only accessed in the presence of a valid stem morpheme. Otherwise, the suffix is identified with shallower processing that does not go beyond physical recognition of a highly frequent phoneme/character string, and the word is processed through the word-whole representation like other morphologically simplex items. This explanation is consistent with the lack of facilitation we observed for pseudosuffixed words and the high accuracy for nominalizations in the grammatical judgment task (~86%) as the suffix was the only indicator of the complex lexeme's word class. Further, in a comparison between the inflected and infinitive verbal conditions of Experiment 1, verbs that contained an inflection (and had no incongruency between stem and final response) were easier to identify than were the infinitive verbs (accuracy: $z = 2.62$, $p = .016$; RT: $z = 2.79$, $p = .015$), suggesting that the presence of a suffix inflection may facilitate the recognition of such items.

This is a viable interpretation given the number of pseudocomplex words that would be inefficient to process compositionally. The present account can also explain the variable results across studies that compare truly complex and pseudocomplex words, because the interaction between pseudostem and pseudosuffix units will depend on the given task. The equivocal results obtained in some studies regarding the status of suffix morphemes may be related to tasks such as lexical-decision and MMN only probing the surface properties of suffixes and not their functional syntactic representations.

Conclusion

The primary aim of the present study was to elucidate whether the morphological composition of a word determines the processing path used for lexical recognition and to shed light on the mental representation of morphologically complex words. Our findings suggest that a decomposable word like "explosion" is processed differently than a nondecomposable word like "avalanche" and that this is because of activation of the stem within the morphologically complex item. The present results therefore support a decomposition theory of word processing. Further, it appears that participants were sensitive only to the surface form of a derivational suffix and not the functional link to its word class. Taken together, the evidence suggests that morphologically complex words are stored and processed primarily through the base stem and that the functional representation of suffixes is crucially dependent on the validity of the stem onto which it attaches.

In the auditory domain specifically, our results support a model of spoken word recognition that identifies morphemes as distinct lexical units during the unfolding of the speech stream. The present evidence is not compatible with continuous models of processing, such as cohort models or Shortlist B, because such models assume that lexical competitors are eliminated phoneme by phoneme regardless of sublexical structure. Instead, we consider our findings to support a model of spoken word recognition that actively predicts upcoming morphological units, and the phonemes that comprise them, during processing.

The evidence from the current experiments, together with the large number of studies conducted in the visual domain (and the few that have been conducted in the auditory domain), supports the hypothesis that morphological constituents are represented as distinct lexical units and are processed as such regardless of language modality. Specifically, our results suggest that the stem morpheme is represented in the mental lexicon, is accessed during spoken word recognition, and serves to inform predictions of subsequent morphemes.

References

Balling, L. W., & Baayen, R. H. (2012). Probability and surprisal in auditory comprehension of morphologically complex words. *Cognition, 125,* 80–106. http://dx.doi.org/10.1016/j.cognition.2012.06.003

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language, 68,* 255–278. http://dx.doi.org/10.1016/j.jml.2012.11.001

Bates, D., Maechler, M., & Bolker, B. (2012). lme4: Linear mixed-effects models using S4 classes.

Boersma, P., & Weenink, D. (2014). Praat: Doing phonetics by computer (Version 5.3.84) [Computer program]. Retrieved from http://www.praat.org/

Boudelaa, S., & Marslen-Wilson, W. D. (2001). Morphological units in the Arabic mental lexicon. *Cognition, 81,* 65–92. http://dx.doi.org/10.1016/S0010-0277(01)00119-6

Butterworth, B. (1983). Lexical representation. In B. Butterworth (Ed.), *Language production* (Vol. 2, pp. 257–294). London: Academic Press.

Cutler, A., & Norris, D. (1988). The role of strong syllables in segmentation for lexical access. *Journal of Experimental Psychology: Human Perception and Performance, 14,* 113–121. http://dx.doi.org/10.1037/0096-1523.14.1.113

Duchon, A., Perea, M., Sebastián-Gallés, N., Martí, A., & Carreiras, M. (2013). EsPal: One-stop shopping for Spanish word properties. *Behavior Research Methods, 45,* 1246–1258. http://dx.doi.org/10.3758/s13428-013-0326-1

Emmorey, K. D. (1989). Auditory morphological priming in the lexicon. *Language and Cognitive Processes, 4,* 73–92.

Ettinger, A., Linzen, T., & Marantz, A. (2014). The role of morphology in phoneme prediction: Evidence from MEG. *Brain and Language, 129,* 14–23. http://dx.doi.org/10.1016/j.bandl.2013.11.004

Fiorentino, R., & Poeppel, D. (2007). Compound words and structure in the lexicon. *Language and Cognitive Processes, 22,* 953–1000. http://dx.doi.org/10.1080/01690960701190215

Frost, R., Forster, K. I., & Deutsch, A. (1997). What can we learn from the morphology of Hebrew? A masked-priming investigation of morphological representation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 829–856. http://dx.doi.org/10.1037/0278-7393.23.4.829

Hothorn, T., Bretz, F., & Westfall, P. (2008). Simultaneous inference in general parametric models. *Biometrical Journal, 50,* 346–363. http://dx.doi.org/10.1002/bimj.200810425

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of Memory and Language, 59,* 434–446. http://dx.doi.org/10.1016/j.jml.2007.11.007

Janssen, N., Bi, Y., & Caramazza, A. (2008). A tale of two frequencies: Determining the speed of lexical access for Mandarin Chinese and English compounds. *Language and Cognitive Processes, 23,* 1191–1223. http://dx.doi.org/10.1080/01690960802250900

Kacinik, N., & Chiarello, C. (2002). Predicting noun and verb latencies: Influential variables and task effects. *Proceedings of the 24th Cognitive Science Society Conference* (pp. 524–529). Mahwah, NJ: Lawrence Erlbaum.

Kielar, A., & Joanisse, M. (2010). Graded effects of regularity in language revealed by N400 indices of morphological priming. *Cognitive Neuroscience, Journal of, 22,* 1373–1398.

Kielar, A., & Joanisse, M. F. (2011). The role of semantic and phonological factors in word recognition: An ERP cross-modal priming study of derivational morphology. *Neuropsychologia, 49,* 161–177. http://dx.doi.org/10.1016/j.neuropsychologia.2010.11.027

Lehtonen, M., Monahan, P. J., & Poeppel, D. (2011). Evidence for early morphological decomposition: Combining masked priming with magnetoencephalography. *Journal of Cognitive Neuroscience, 23,* 3366–3379. http://dx.doi.org/10.1162/jocn_a_00035

Lewis, G., Solomyak, O., & Marantz, A. (2011). The neural basis of obligatory decomposition of suffixed words. *Brain and Language, 118,* 118–127. http://dx.doi.org/10.1016/j.bandl.2011.04.004

Marslen-Wilson, W. D. (1984). Function and process in spoken word recognition: A tutorial overview. In H. Bouma & D. G. Bouwhuis (Eds.), *Attention and performance X: Control of language processes* (pp. 125–150). Hillsdale, NJ: Lawrence Erlbaum.

Marslen-Wilson, W. D., Ford, M., Older, L., & Xiaolin, Z. (1996). The combinatorial lexicon: Priming derivational affixes. *Proceedings of the 18th Annual Conference of the Cognitive Science Society* (p. 223). San Diego, CA: Psychology Press.

Marslen-Wilson, W., Tyler, L. K., Waksler, R., & Older, L. (1994). Morphology and meaning in the English mental lexicon. *Psychological Review, 101,* 3–33. http://dx.doi.org/10.1037/0033-295X.101.1.3

Marslen-Wilson, W. D., & Welsh, A. (1978). Processing interactions and lexical access during word recognition in continuous speech. *Cognitive Psychology, 10,* 29–63. http://dx.doi.org/10.1016/0010-0285(78)90018-X

Meunier, F., & Longtin, C. M. (2007). Morphological decomposition and semantic integration in word processing. *Journal of Memory and Language, 56,* 457–471. http://dx.doi.org/10.1016/j.jml.2006.11.005

Norris, D., & McQueen, J. M. (2008). Shortlist B: A Bayesian model of continuous speech recognition. *Psychological Review, 115,* 357–395. http://dx.doi.org/10.1037/0033-295X.115.2.357

Pastizzo, M. J., & Feldman, L. B. (2004). Morphological processing: A comparison between free and bound stem facilitation. *Brain and Language, 90,* 31–39. http://dx.doi.org/10.1016/S0093-934X(03)00417-6

Pinker, S., & Ullman, M. T. (2002). The past and future of the past tense. *Trends in Cognitive Sciences, 6,* 456–463. http://dx.doi.org/10.1016/S1364-6613(02)01990-3

R Core Team. (2012). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Rastle, K., & Davis, M. H. (2008). Morphological decomposition based on the analysis of orthography. *Language and Cognitive Processes, 23,* 942–971. http://dx.doi.org/10.1080/01690960802069730

Rastle, K., Davis, M. H., Marslen-Wilson, W. D., & Tyler, L. K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes, 15,* 507–537. http://dx.doi.org/10.1080/01690960050119689

Rastle, K., Davis, M. H., & New, B. (2004). The broth in my brother's brothel: Morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin & Review, 11,* 1090–1098. http://dx.doi.org/10.3758/BF03196742

Silva, R., & Clahsen, H. (2008). Morphologically complex words in L1 and L2 processing: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition, 11,* 245. http://dx.doi.org/10.1017/S1366728908003404

Solomyak, O., & Marantz, A. (2010). Evidence for early morphological decomposition in visual word recognition. *Journal of Cognitive Neuroscience, 22,* 2042–2057. http://dx.doi.org/10.1162/jocn.2009.21296

Stockall, L., & Marantz, A. (2006). A single route, full decomposition model of morphological complexity: MEG evidence. *The Mental Lexicon, 1,* 85–123. http://dx.doi.org/10.1075/ml.1.1.07sto

Taft, M. (1979). Recognition of affixed words and the word frequency effect. *Memory & Cognition, 7,* 263–272. http://dx.doi.org/10.3758/BF03197599

Taft, M. (2004). Morphological decomposition and the reverse base frequency effect. *Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 57,* 745–765. http://dx.doi.org/10.1080/02724980343000477

Taft, M., & Ardasinski, S. (2006). Obligatory decomposition in reading prefixed words. *The Mental Lexicon, 1,* 183–199. http://dx.doi.org/10.1075/ml.1.2.02taf

Whiting, C. M., Marslen-Wilson, W. D., & Shtyrov, Y. (2013). Neural dynamics of inflectional and derivational processing in spoken word comprehension: Laterality and automaticity. *Frontiers in Human Neuroscience, 7,* 759. http://dx.doi.org/10.3389/fnhum.2013.00759

Whiting, C., Shtyrov, Y., & Marslen-Wilson, W. (2015). Real-time functional architecture of visual word recognition. *Journal of Cognitive Neuroscience, 27,* 246–265. http://dx.doi.org/10.1162/jocn_a_00699

Wurm, L. H. (1997). Auditory processing of prefixed English words is both continuous and decompositional. *Journal of Memory and Language, 37,* 438–461.

Zweig, E., & Pylkkänen, L. (2009). A visual M170 effect of morphological complexity. *Language and Cognitive Processes, 24,* 412–439. http://dx.doi.org/10.1080/01690960802180420

(*Appendices follow*)

Appendix A

Noun Items

Nominalization	English Translation	Log Frequency	Base Frequency
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	**English Translation**	**Log Frequency**	**Base Frequency**
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	**English Translation**	**Log Frequency**	
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	**English Translation**	**Log Frequency**	
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	

(*Appendices continue*)

Appendix A (*continued*)

Prototypical Noun	English Translation	Log Frequency
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 B

Verb Items

Decomposable Verb	English	Base Frequency	Decomposable Verb	English	Base Frequency
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

Note. The symbol "[" denotes the separation between the base and inflectional suffix.

(*Appendices continue*)

Appendix B (*continued*)

Infinitive Verb	Eng.	Frequency	Infinitive Verb	Eng.	Frequency
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

Received September 16, 2014
Revision received February 25, 2015
Accepted March 2, 2015 ■