Can an on-line response latency task shed light on native and non-native competence in the deverbal compounds of Spanish?

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1. Introduction

Spanish deverbal compounds take the form V + N, as in examples (1) – (3). The V form corresponds to the 3rd person singular of the present indicative. The N form takes a generic –s marker. The ordering of V and N follows canonical Verb Phrase order as in (4).

(1)   Matarratas
        [kill - rats]
        rat-killer
(2)   Cazamoscas
        [catch - flies]
        fly-catcher
(3)   Comelibros
        [eat- books]
        book-eater ('book worm')
(4)   Pedro mata ratas
   Peter kills rats

The head-initial pattern of Spanish deverbals can also be found in languages such as French (e.g., ouvre-boîtes, gratte-ciel). However, deverbals in languages such as English are head-final (e.g., can-opener, sky-scraper); the verb takes an agentive –*er* suffix and the noun takes the singular form.

More formal accounts of Spanish deverbal compounds have been proposed. For instance, Contreras (1985) analyzed them as instances of reduced relative clauses with an empty head as in (5), while Lardiere and Schwartz (1997) portrayed them as a lexical version of verbal phrases, as in (6).

(5) Contreras' account
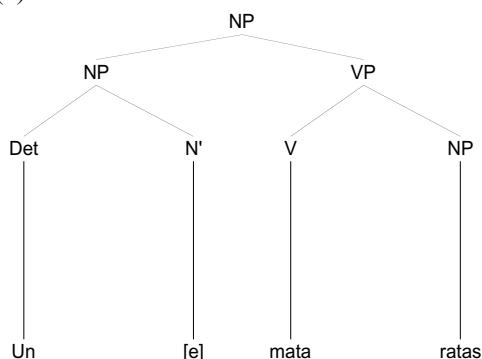
(6) Lardiere and Schwartz's account
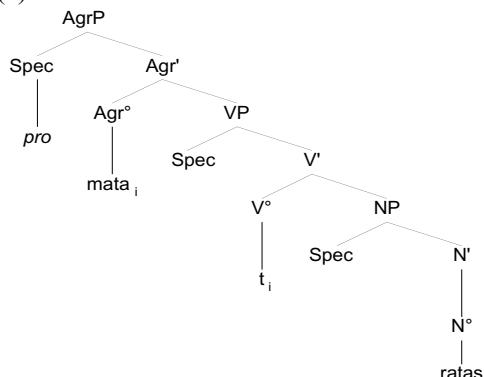
While both accounts permit left-headedness and require that the verb be inflected for person, neither explains the need for the presence of an –s marker on the generic value of the noun. To the extent that (5) and (6) may be taken as a reflection of native speakers' underlying intuitions regarding these compounds, we would expect native Spanish speakers to be sensitive to violations of directionality and verb form, but possibly less so to the –s marker on nouns. As for non-native speakers, and given the fact that these constructions are seldom taught in Spanish language classes, their performance may be determined by reliance on their L1 and/or individual sensitivity to the structure of Spanish.

Previous studies on the acquisition of Spanish deverbal compounds (Salomaa-Robertson, 2000; Pomerleau, 2001; Liceras et al., 2001) have shown that adult L2 learners from different L1 backgrounds have problems with both the morphology and the directionality of these constructions. This is the case even when positive transfer from the L1 should lead to native-like performance in Spanish, as in the case of French speakers. However, the type of elicitation techniques that were used in these studies did not allow for the comparison of subjects in terms of response latency.

In view of this, the main purpose of the present research was to investigate how L1 and L2 speakers process Spanish deverbal compounds with and without morphosyntactic violations. To achieve this goal, young adults were shown individual letter strings that either conformed to the pattern of a deverbal compound or violated a composition rule. In each case, they were asked to decide if the stimulus was or was not a possible Spanish word. The accuracy of their responses and their reaction times (RTs) were measured.[*]

2. L2 acquisition of Spanish deverbal compounds: prior research

The results of a picture task and a sentence completion task carried out on French, English and Finnish learners of Spanish (Salomaa-Robertson, 2000) showed that while beginning and intermediate subjects had problems with directionality, verbal morphology and the s-marker of nouns, advanced learners ceased having problems with directionality but continued to produce non-Spanish morphological markings on the verb, and had even more problems with the s-marker of nouns.

Pomerleau (2001) used a picture task and a grammaticality judgment task to elicit data intended to determine whether French learners of Spanish relied on their L1 or on their L2 (English) to produce and judge Spanish deverbal compounds. The results showed that advanced learners approximated the results of the Spanish native control group in the case of directionality and verb morphology but not in the case of the s-marker of nouns. Pomerleau (2001) attributes the latter result to L1 influence.[1]

However, in a timed grammaticality judgment task administered to French and English learners of Spanish at three different levels of proficiency and to a control group of Spanish speakers, Liceras et al. (2001) found that the latter group accepted nouns without the s-marker in 25% of cases, [2] while one could say that there was no acceptance whatsoever of right headed deverbals and only two cases (out of 72 items) of deverbals with morphology violations were accepted. These results, combined with the fact that linguistic accounts of Spanish deverbal compounds avoid dealing with the obligatory status (or not) of the s-marker of nouns, suggest that this is an aspect of deverbals about which native Spanish speakers do not have clear-cut intuitions.

In all of the above studies, knowledge of Spanish deverbal compounds was tapped via production tasks or grammaticality judgment tasks where the compound appeared contextually, and in none of them were response times measured. Since response times can provide us with important information about processing demands which could influence native and non-native performance, the present study addresses this issue.

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[1] Pomerleau (2001) justifies this on phonological grounds, arguing that the –s marker on French deverbals is not phonologically realized in this language and that native French speakers transfer this knowledge to L2 Spanish.

[2] The Spanish-speaking subjects in Liceras et al. (2001) were all from the northern Castille-León region of Spain and all spoke a dialect of Spanish in which word final /s/ is always phonologically realized; hence, the results for the –s marker on the noun in this study cannot be attributed to phonological/dialectal factors.

Though the literature on the processing of compound words is still limited, extant data permit us to formulate a number of tentative hypotheses. Overall, we can expect a positive correlation between error rate and processing time; violations to this pattern would occur when processing is aborted or derailed. Because the rules for the formation of deverbal compound words are in principle straightforward, we expected a low error rate and relatively fast RTs. Head directionality was taken as the easiest type of violation for native speakers to recognize. Consequently, the error rate was expected to be low and the RTs fast. If deverbal compounds are perceived as having a version of clause structure with a headless NP subject as in (5) or a null third-person *pro* definite subject as in (6), native speakers should reject the Infinitive marker items accurately and quickly. The most difficult type of violation to detect was expected to be the *–s* marker, either because it is perceptually the more subtle cue or because speakers lack clear-cut intuitions about this defining attribute.[3] The processing of deverbal compounds raises an interesting issue regarding the impact of linguistic training. The acquisition of language structure appears to result in part from explicit and implicit learning. The latter process is assumed to occur when the structural features are detected and used without any intentional contribution of explicit knowledge (Pacton, Perruchet, Fayol, and Cleeremans, 2001; Perruchet and Gallego, 1997). Although the structure of Spanish deverbals is, in all likelihood, acquired implicitly, training in fine linguistic analyses can bring implicitly learned patterns to conscious awareness and influence performance, which we chose to examine by comparing the behavior of two groups of native speakers, one of which had received training in linguistic analysis.

If it could be assumed that L2 speakers have been exposed to the same linguistic input as L1 speakers, one would be justified to expect the exact same pattern of results in each case. As this condition is practically never satisfied, we expected at least a global difference between native and non-native speakers of Spanish both on error rates and RTs.

3. Method

3.1. Participants

The participants included 63 native speakers of Spanish enrolled at the University of Valladolid (60) and the University of Seville (3) in Spain, and 20 undergraduate students of Spanish as a second language of the University of Ottawa in Canada, recruited on the basis of their advanced knowledge of Spanish, as indicated by an interview and a self-assessment questionnaire.[4] Of the L1 students, 27 were enrolled in a linguistics program (Spanish Philology), while the other 36 studied in programs unrelated to language studies. Of the L2 students, nine reported English as their mother tongue, nine reported French, and two reported both English and French.

3.2. Materials and Equipment

The linguistic material used in the experiment included a practice list of 15 pairs of items and an experimental list of 99 pairs of items. One member of each pair was a real deverbal compound word in Spanish, while the other was not. The nonword member of the pair violated compounding rules in one of three ways. Each type of violation was equally represented in the practice and experimental lists, which included 99 real compound words and 33 of each type of impossible items. The first type of violation carried an infinitive rather than an inflected verb marker (e.g., *quitarmanchas). The second type was characterized by a head directionality violation (e.g., *manchasquita). The third type carried an empty noun *–s* marker (e.g., *quitamancha). The experimental list had a Latin square design with 99 grammatical items and 99 ungrammatical ones. The pairing of specific grammatical items and the three types of violations was counterbalanced across participants so that all ungrammatical items appeared an equal number of times with the corresponding grammatical one in the experimental list.

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[3] If we follow Van der Lely and Christian (2000), the perceptual subtleness of this Spanish *–s* would lead us to hypothesize that its absence would provide evidence for the existence of either a processing or a representational (grammatical) deficit. However, a similar argument could be made about the word internal *–r* and the right-headed deverbal.

[4] The self-assessment questionnaire used in this research may be obtained upon request to the first or second author.

Each stimulus appeared horizontally at the center of a video monitor in white lower-case letters on a black background. It fitted a rectangular area of 5 x 2 cm on the screen and viewing distance was approximately 70 cm. The timing, sequencing, presentation of stimuli, recording of responses and response latencies were controlled by a PC-compatible microcomputer and the software Micro Experimental Laboratory (MEL), version 2.01 (Schneider, Rogers, Maciejczyk, Zuccolotto, and St. James, 1995).

3.3. Procedure

Participants were tested individually in a quiet and dimly lighted room. They were told they would see letter strings displayed one by one on the screen and asked to decide promptly but carefully if the stimulus could be a real word in Spanish or not. They were instructed to indicate their response by pressing one of two keys on the keyboard (i.e., the letters 'm' or 'x', which were distinguished from each other by the use of red and yellow stickers placed on top of the keys) and to leave their fingers on the keys between trials. The experimental session involved 426 trials, 30 practice trials and two blocks of 198 experimental trials involving the same item list. Each trial consisted of the following sequence of events: a) a fixation point (a + sign) appeared at the center of the video monitor and remained in view for 500 ms, b) a letter string (either a real compound word or a nonword) was displayed and remained visible until the participant made a response, and c) a blank screen was shown for 800 ms before the onset of the next trial. Participants were offered to take a pause between the two presentations of the experimental list. The order of the trials within blocks was random and this random order differed for every participant in the experiment. No feedback for speed or accuracy was provided to the participants.

4. Results

Analyses of variance were carried out on the mean proportions of errors and the mean correct latencies. A response was considered an error and its latency was excluded from the analyses on response latencies if a) it was incorrect or b) its latency was shorter than 150 ms or longer than 2.5 standard deviations above the participant's mean. The data were collapsed over the two blocks of experimental trials. The mean proportions of errors and mean correct latencies are reported below.

Type of stimuli	L1 Speakers					L2 Speakers	
	Sophisticated		Non-Sophisticated			Non-Native	
	ER	RT	ER	RT		ER	RT
Real Compound	.06	1271	.09	1357		.25	1737
Infinitive	.11	1296	.08	1430		.11	1541
Ø N – s Marker	.54	1586	.51	1691		.61	1704
Head Directionality	.04	1472	.05	1526		.12	1884
Average	.19	1406	.18	1501		.27	1717

The data obtained from L1 and L2 speakers were analyzed separately because their respective variance was quite heterogeneous. The analysis on L1 data involved two independent variables: Group of participant (Sophisticated vs. Non-sophisticated speakers) and Type of items. The analysis carried out on L2 data only involved Type of items.

4.1. L1 Speakers

The ANOVAs carried out on error proportions revealed a main effect of Type of items, $F(3,180) = 103.89$, p<.001, but no significant difference between the two groups of participants (p >.73). *Post hoc* analysis indicated that all mean proportions differed significantly among each other, all Fs > 4.92, p < .05, except possible Real Compounds and Infinitives (.08 vs. .09, respectively). The pattern of results shows that the performance of sophisticated speakers did not differ significantly from that of less

sophisticated speakers (.145 vs. .152, respectively). The error rate was below 10% for all types of stimuli except the Ø N –s Marker, to which responses were very close to chance level (i.e., .50). The latter case appeared most equivocal to the participants.

The same analysis carried out on the mean correct latencies revealed again a main effect of Type of items, $F(3,180) = 42.35$, p<.001, but no significant difference between the two groups of participants (p > .25), even though sophisticated speakers responded 95 ms faster than non-sophisticated ones on average. *Post hoc* analyses on Type of items showed that all mean latencies differed significantly among each other, all Fs > 4.32, p < .05, yielding the following ordering: Real Compound (1320 ms) < Infinitive (1373) < Head Directionality (1503 ms) < Ø N –s Marker (1642 ms). The overall pattern of results suggests that the level of difficulty was more similar between Real Compounds and Infinitives than with the other two types of items. Both response accuracy and latency attest that Ø N –s Marker items were most difficult. There is no evidence, however, that the responses to these items were driven by fast guessing.

4.2. L2 Speakers

The ANOVAs detected a significant main effect of Type of items on error proportions, $F(3,57) = 16.88$, p < .001. *Post hoc* comparisons revealed significant differences among all means, all Fs > 4.43, p <.05, except between Infinitive and Ø N –s Marker items. The same analysis on mean correct latencies also confirmed a main effect of Type of items, $F(3,57) = 10.96$, p <.0001. *Post hoc* analyses showed that all types differed among each other, Fs > 5.80, p < .05, except Real Compounds and Ø N – s Marker items.

5. Discussion

The first indication of the difficulty of the compound discrimination task is apparent in the magnitude of the mean reaction times. This on-line task is evidently far more difficult than oral reading or the typical lexical decision. Two characteristics of the stimuli may have contributed significantly to the difficulty of this task. First, many of the real compound words in the experimental list had an extremely low frequency of use in the Spanish language. This evidently did not amplify the error rate but it likely made visual recognition harder. Second, the presence of particularly difficult nonwords in the experimental list is known to slow down all decisions in this type of on-line task (Dorfman and Glanzer, 1988; Ferrand and Grainger, 1996; Gerhand and Barry, 1999).

No significant effect of formal training in linguistic analysis on response accuracy or speed was detected in the present experiment, even though a trend suggesting faster responses from sophisticated speakers was apparent. This observation is consistent with the proposition that the structure of deverbal compounds is learned implicitly and, therefore, the detection of structural cues occurs without intentional analysis. This process appears largely immune from formal training in linguistic analysis, and it seems to be independent of the actual elicitation technique, since our results parallel the ones obtained by Salomaa-Robertson (2000), Pomerleau (2001) and Liceras et al. (2001), as regards the performance of the native controls in these studies.

Despite significant differences in frequency of use, the real deverbal compounds were expected to be detected relatively easily. Indeed, responses were fairly accurate and faster than those observed in the other experimental conditions. The next condition in level of difficulty was the infinitive form. The observed results are consistent with the hypothesis that this form was perceived as having a clause structure with a headless third person NP subject or a null third-person *pro* subject serving as a primary cue in decision making. The head directionality violation was expected to be the easiest to detect. Although the error rate was indeed very low, the response latencies indicate that arriving at a decision involved a significant cost in processing time. By all standards the hardest type of nonwords was the Ø N –s Marker items. The response accuracy was near chance level and the mean response latency was the longest of all. These items were clearly equivocal. Two reasons may be considered for this pattern. One possibility is that the –s marker is not a completely consistent feature in the structure of Spanish deverbal compounds. Other violations of mapping consistency have been found to hinder lexical processing performance. One example involves the inconsistency of grapheme-to-phoneme correspondence in oral reading of English and French (Lupker, Brown, and Colombo, 1997; Desrochers, Gonthier, and Lupker, 2002); another relates to the inconsistency of noun ending-to-

gender class in French gender decision (Desrochers and Paivio, 1990; Holmes and Dejean de la Bâtie, 1998; Taft and Meunier, 1999). Performance on deverbal compounds would then reflect the state of covariation that is present in the language. Another possibility is that the –s marker was known as a feature of compound structure but difficult to process. The nature of the failed process in this case would have to be more general than merely perceptive because it needs to account for similar results in picture-naming, sentence-completion, and grammaticality judgment tasks. A third possibility would involve a conjunction of both: the –s marker as a cue is inconsistent in the structure of the language and, for this reason, is less likely to be encoded into stable representations.

The responses obtained from L2 speakers were generally less accurate and considerably longer (i.e., by more than 200 ms) than those of L1 speakers. Yet they provided a fairly close approximation of the patterns observed with the native speakers. L2 performance with Ø N –s Marker items also was near chance level. Decisions with Head Directionality items were also fairly accurate but required particularly long processing time. The similar pattern of results between L1 and L2 speakers strongly suggest that the processing cost with these items is related not to vocabulary size or grammatical knowledge, but to analyzing order information in lexical processing. Of all three types of violations the Infinitive items were the easiest to process. The most glaring difference between L1 and L2 performance is the relative difficulty of non-native speakers to recognize real deverbal compounds. This pattern is likely attributable to L2 speakers' limited exposure to the language and their relatively restricted vocabulary. Despite differences in detail, these results provide evidence that after only a few years of Spanish instruction L2 speakers display a pattern of behaviour that resembles that of native speakers in a highly specific domain of lexical processing, namely, that of deverbal compounds.

6. Conclusion

The present investigation was intended to examine how L1 and L2 speakers process morphosyntactic cues in the structure of Spanish deverbal compounds. What is unique to this study is the attention paid both to response accuracy and latency. The combination of these dependent variables allowed us to assess the processing cost of different lexical structures that are otherwise decided quite accurately. The results showed that both native and non-native speakers have reasonable facility in discriminating between real compounds and nonwords, except when the violation involves the Ø N –s Marker. Reaction times generally increase with error rates, except when the violation involves Head directionality. No significant difference in performance was detected between sophisticated and non-sophisticated native speakers of Spanish, suggesting that formal training in linguistic analysis has little impact on the processing or actual grammatical knowledge of deverbal compounds.

The on-line task used in the present research was closely modeled after the standard lexical decision task in that it involved a discrimination between real words and nonwords. This task yielded accuracy results that are quite similar to those observed in non-speeded tasks used in prior research such as compound production and grammaticality judgments. This convergence suggests that these tasks are tapping common linguistic knowledge. If indeed this is the case, then they could be used to verify claims about general language processing mechanisms and to distinguish them from task-specific processes. Thus, the answer to the question that we asked ourselves in the title would be affirmative in that this on-line response latency task can shed light on native and non-native competence with respect to Spanish deverbal compounds.

Even though this set of results provided a fairly consistent portrait of the difficulty factors involved in processing Spanish deverbal compounds, several issues deserve closer attention. First, by definition deverbal compounds are constructed from distinct forms that also are in use in the language. One then may wonder how the frequency of use of the compound form and that of its constituents contribute or interact when the letter string is a real compound and when it violates its defining features. Second, because the structure of Spanish deverbal compounds is more similar to the French than the English structure, provided the sample of respondents is sufficient, one might expect native speakers of French to have an advantage over native speakers of English in processing this kind of lexical form. Even though extant data suggest that such influence might be detected only in the early stages of acquisition and for head directionality only, such a pattern of results would provide further evidence of cross-linguistic transfer of knowledge in second-language acquisition. Whether or not response latency provides a more sensitive measure of cross-linguistic transfer remains an open question for now.

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