



# Article Bilingual Processing of Comparative Structures in Spanish

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**Abstract:** Previous studies have focused on the access of content words to investigate the cognitive strategies used in bilingual processing (e.g., Fernández 2003), but less is known about functional words. In this study, I assess (i) whether three groups of bilingual speakers of Spanish (native, heritage, and second language (L2) speakers) access the lexically-encoded information of the quantifier *más* 'more' to activate a comparative structure interpretation, and (ii) what processing strategies are used to resolve a temporary semantic ambiguity that surfaces upon accessing that interpretation. Using a self-paced reading task, three groups of Spanish speakers living in the United States read comparative sentences, which allowed for two possible continuations at the subordinate clause: a subject continuation (e.g., *El cantante obtiene más premios que el pianista en el festival* 'The singer gets more awards than the pianist at the festival') or an object continuation (e.g., *El cantante obtiene más premios que el pianista en el festival* 'D. Results revealed longer reading times for the subject comparison compared to the object comparison structures, and no significant differences between the three groups, suggesting that participants in all groups followed similar processing strategies and preferences in the reading of comparative structures.

Keywords: comparative structures; bilinguals; Spanish; English; comprehension

## 1. Introduction

Koenig et al. (2002, p. 226) define the term lexically-encoded information as "that information which is accessed upon recognition of a word [ ... ] and is relatively specific to the relevant verb." Lexically-encoded information comprises phonological, semantic, or syntactic information, as well as implicit information about the frequency of that word being followed by another word. Previous studies on cognitive processing have been conducted to better understand how the parser accesses and uses that lexical information during online comprehension (e.g., Altmann et al. 1998; Anisimov et al. 2014; Coco and Keller 2015; Demestre and García-Albea 2004; Dussias 2003; Dussias and Scaltz 2008; Dussias and Sagarra 2007; Engelhardt et al. 2017; Fernández 2003; Garnsey et al. 1997; Havik et al. 2009). These studies have suggested that, with enough experience with a language, the linguistic system can extract lexically-encoded information, including the probability of a specific word to be followed by a preferred continuation over several competing possibilities, to anticipate upcoming linguistic information in a sentence (e.g., Altmann 1998). For example, an English speaker who reads the string of words The boy eats macaroni and ... will most likely select the word cheese automatically as the most possible continuation, whereas other less frequent continuations, such as vegetables, will be considered a secondary option. Thus, the expectations to use *cheese* over vegetables is because the structure macaroni and cheese is most likely to appear together than macaroni and vegetables.

The use of lexically-encoded information during processing has been found to be an intrinsic mechanism of the linguistic system in monolinguals (e.g., Altmann 1998). However, with bilinguals' processing in their second language (L2), results were originally mixed, suggesting in many instances

that L2 speakers do not always access all the information encoded in the lexicon, resulting in differences when native and L2 learners were compared. This has led to suggest that L2 speakers are limited in the amount of linguistic information accessible to the comprehension system (e.g., Martin et al. 2013), which in turn, results in the inability to access information in the L2 like a native speaker. Later, research took issue with these differences and found that the ability of L2 speakers to use the same processes as native speakers during comprehension is determined by the speaker's individual differences, such as their level of proficiency or the structure at hand, making it possible for L2 speakers to process information like native speakers when certain conditions were met (see Kaan 2014).

Although much of the work on lexically-encoded information has focused on exploring the verb (e.g., Bernolet and Hartsuiker 2010; Demestre and García-Albea 2004; Dietrich and Balukas 2012; Ferreira and Schotter 2013; Garnsey et al. 1997; Villegas 2014) or nouns (e.g., Dussias 2003; Fernández 2003), fewer studies have investigated whether native and non-native speakers can access and use information encoded on function words during processing (e.g., Dussias et al. 2013; Hopp 2013). This distinction between content and functional words is of special interest for psycholinguistic research because previous evidence from the monolingual literature has suggested that function words have a different representation in the brain than content words (e.g., Brown et al. 1999) and that they differ in the roles that they play in online sentence processing (e.g., Segalowitz and Lane 2000), raising the question of whether these results found in monolingual speakers can also be found in other bilingual groups, such as second language learners and heritage speakers.

In this article, I investigate the comprehension of native and non-native speakers of Spanish to examine whether they access the encoded information of the words *más* ... *que* ('more ... than') to activate a comparative structure in Spanish, and whether they use that information during comprehension to resolve a temporary semantic ambiguity between two possible comparisons. To that end, I use comparative structures in Spanish (e.g., *El cantante obtiene más premios que* ... 'The singer gets more awards than ... '), a novel structure in the processing literature. This structure is of interest for two reasons. First, the encoded information of the functional words *más* ... *que* ('more ... than') is necessary to interpret the sentence as a comparative clause. Second, that interpretation presents a temporary ambiguity between two possible continuations at the subordinate clause where either a comparison with the subject (i.e., *el cantante* 'the singer') or the object (i.e., *premios* 'the awards') are possible, making it a structure ideal to measure the preferred type of continuation of two competing linguistic outcomes.

#### 1.1. Lexically-Encoded Information

The parser is the cognitive system involved in the comprehension of language. This system is fast and able to extract phonological, semantic, morphological, and syntactic information encoded in the lexicon to establish the relationships between lexical items in a sentence. Studies conducted with monolingual speakers have found that the parser is able to extract lexical information and use it to facilitate comprehension. For instance, Altmann and Kamide (1999) investigated how lexically-encoded information could facilitate the assignment of thematic roles during sentence processing. In their study, they presented participants with a static picture containing a child, a toy car, a toy train, a ball, and a cake. Participants were then presented orally with the sentence "The boy will eat the cake", while monitoring their eye movements. Interestingly, the researchers found that participants directed their eyes to the picture of the cake moments before they heard the word *cake*, suggesting that the participants used the semantic information of the verb *eat* to discriminate all the temporarily ambiguous items in the picture that were not edible and direct their attention to the only plausible element (i.e., the cake). Thus, the results suggest that the participants were able to access the semantic information of the word *eat* to conclude that the direct object had to be *cake*, because it was the only eatable item in the visual stimulus.

Verbs have received a special attention in the literature, mostly because they determine the main syntactic relationships between the constituents of a sentence. They contain the semantic information of the action expressed, the syntactic relationships between the verb and its arguments through thematic role assignments, and, in languages like Spanish, morphological information that specifies the tense, aspect, mood of the action as well as the person and number of the agent. More interestingly, studies have found that the information contained in the verb is used to explore the relation between the verb and the preference of certain syntactic continuations over others (e.g., Demestre and García-Albea 2004; Trueswell et al. 1993). For example, Trueswell et al. (1993) investigated subcategorization biases of transitive verbs in English that could be followed either with a Determiner Phrase<sup>1</sup> (DP; e.g., the boy admitted the mistake and went home) or a sentence complement clause (SC; e.g., the boy admitted the *mistake was problematic*). They used verbs that were biased towards the use of DP structures (e.g., The *doctor visited the child* ...) and measured the reading times in sentences with temporarily ambiguous nouns that were possible continuations of verbs that were biased towards the DP (Direct Object-bias verbs). Their results showed that sentences that contained verbs that were strongly biased for the DP continuation were read faster than when the same verbs were followed by the SC continuation. They interpreted the results as the participants being able to use the lexical information of the verb to create preferences for a specific syntactic structure following the verb. Later research has investigated the frequency with which a verb was used, how it affected the preferences for a specific syntactic structure of the direct object following it, and whether those preferences followed the predictions established by previous models of sentence processing (e.g., Garnsey et al. 1997).

In the bilingual literature, the study of syntactic encoded information has also focused heavily on the verb. Studies on verb bias in Spanish have been studies both in production (e.g., Dietrich and Balukas 2012; Dussias et al. 2010) and comprehension (e.g., Dussias and Scaltz 2008). One interesting result extracted from the bilingual literature is the discovery of crosslinguistic differences regarding the information encoded in verbs. That is, verbs that are biased towards the subcategorization of an DP in English, do not necessarily have the same biases in Spanish, revealing the possibility of different processing outcomes depending on the language used (e.g., Dussias et al. 2010).

Other studies have explored whether bilinguals were able to use the encoded information of the verb to decide on the verb morphology used at the first subordinate clause. Villegas (2014), using similar materials to the study conducted with monolinguals by Demestre and García-Albea (2004), investigated whether immersion in the L2 English environment affected the sensitivity to process morphological information efficiently by native and heritage speakers of Spanish. Experimental items were constructed using verbs in Spanish that obligatorily subcategorized for a verb marked with subjunctive mood morphology at a subordinate clause. For example, in a sentence like Pedro aconseja a los chicos que beban agua y que coman mucho ('Peter advises the boys to drink water and eat a lot'), the verb aconseja 'advises' requires that the verb in the subordinate clauses (e.g., beban 'drink' and coman 'eat') be marked with subjunctive mood morphology. Thus, he hypothesized that if participants were able to access the subcategorization information encoded in the main verb, participants would expect the use of subjunctive morphology at the subordinate clause. He compared the sentences to similar ones where the verb of the first subordinate clause was in indicative mood, marking a relative clause (e.g., Pedro aconseja a los chicos que beben agua que coman mucho 'Peter advises the boys who drink water to eat a lot'). The results showed that all groups were able to access the information of the main verb to select the correct morphology of the upcoming verb during comprehension and, more interestingly, that there were no differences between native and heritage speakers of Spanish.

The studies reviewed in this section so far have focused on content words. However, fewer studies have investigated the ability of bilingual speakers to access the encoded information of functional

<sup>&</sup>lt;sup>1</sup> I use Determiner Phrase (DP) instead of Noun Phrase (NP) following Abney (1987) proposal of the DP hypothesis, which states that the Noun Phrase is headed by the functional element D, identified with the determiner.

words during reading comprehension. Such words have been often problematic for the study of comprehension because they are usually skipped during online reading tasks when the stimuli are presented within the sentence all at once. Yet, some studies have suggested that monolingual and bilingual speakers are able to extract information from functional words and that the information can affect comprehension (e.g., Brown et al. 1999; Dussias et al. 2013; Hopp 2013). For instance, studies have investigated whether bilingual speakers used grammatical gender encoded in Spanish articles to anticipate the grammatical gender of the upcoming noun. One example is Dussias et al. (2013) where, following a previous study with monolingual speakers of Spanish (Lew-Williams and Fernald 2007), they investigated whether grammatical gender encoded in articles facilitated the anticipation of nouns in Spanish. They tested monolingual speakers of Spanish, L1 Italian–L2 Spanish, and L1 English–L2 Spanish speakers to investigate whether language systems that have grammatical gender in the L1 (i.e., Italian) make it easier for L2 learners to access and use that information in their L2 Spanish when compared to languages that do not have grammatical gender (i.e., English). Their results showed that L1 Italian speakers only revealed an anticipatory effect when the determiner and the noun in Spanish were feminine, but failed to find the same results with masculine gender markings. For L1 English speakers, their ability to use grammatical gender during processing was modulated by proficiency. That is, L1 English participants with higher proficiency in Spanish used the information of the article to anticipate the noun whereas those with lower proficiency did not.

This article contributes to this line of research and further explores the accessibility to lexically-encoded information in functional words using comparative structures in Spanish. In these structures, the access to the semantic information of the words *más* ... *que* 'more ... than' is necessary for the interpretation of a comparative subordinate clause. Moreover, this interpretation creates a temporary ambiguity during comprehension that can be resolved through case and theta-role assignments within the subordinate clause. To that end, I explore the structure under study next.

## 1.2. Comparative Structures

Comparative structures establish a relation of superiority, inferiority, and equality between two notions through grammar (Gutierrez Ordóñez 1997; Real Academia Española 2009). In this paper, I focus on comparative structures of superiority in Spanish, such as example (1):

1. *El cantante obtiene más premios que el pianista en el festival* 'The singer gets more awards than the pianist at the festival.'

Sentences like (1) are formed by identifiable constituents. First, the comparative notion establishes the semantic relation between the constituents that are being compared (e.g., *el cantante* 'the singer' and *el pianista* 'the pianist'). This semantic relation is determined syntactically by a first constituent of the comparison (i.e., *el cantante*) and the second constituent of the comparison (i.e., *el pianista*). Preceding the second constituent of the comparative quantifier *más* ('more') determines the degree of comparison (i.e., superiority). Finally, the complementizer<sup>2</sup> (i.e., *que* 'than'), together with the second constituent of the comparative complement (i.e., *que el pianista* "than the pianist").

To interpret comparative sentences efficiently, the parser has to consider several things. First, the lexical information of the functional word *más* ('more') has to be accessed obligatorily to activate the comparative structure. If that information were not accessed, the subordinate clause would have to be interpreted as a relative clause. Second, the element following the word *que* must be a DP, which establishes the comparison with the subject or the object of the sentence. Finally, the parser must

<sup>&</sup>lt;sup>2</sup> I follow here Gutierrez Ordóñez (1997) who argues that the comparative structure following *que* in the structure presented in (1) (i.e., *que el pianista en el festival*) is a subordinate clause because this part of the comparative structure is dominated by an elided verb (i.e., *El cantante obtiene más premios que el pianista [obtiene] en el festival*) that provides case to the second element of the comparison.

establish a preference between competing elements that can be possibly compared at the subordinate clause. What is interesting about these structures, as pointed out by Gutierrez Ordóñez(1997), is that both the subject and the object are potential candidates for the semantic comparison:

- 2. *El cantante* obtiene más premios que *el pianista* en el festival '**The singer** gets more awards than **the pianist** at the festival'
- 3. *El cantante obtiene más premios que críticas en el festival* The singer gets more **awards** than **criticism** at the festival

Thus, the comparison may occur with the subject of the main clause as in (2) (i.e., el *cantante/el pianista*) or with the direct object as in (3) (i.e., *premios/críticas*), creating a temporary semantic ambiguity on the type of continuation that can be resolved through theta-role assignment. If we assume that the subordinate clause contains an elided verb that assigns theta roles to its arguments and that the verb is elided at the subordinate clause to avoid repetition (see footnote 1), one may argue that the DP surfacing at the comparison (i.e., *el pianista/críticas*) must mirror how the parser initially interprets the main clause. Thus, if the parser interprets these sentences as a comparison between the subjects, a DP with nominative case and agent theta-role should be expected at the subordinate clause (i.e., *el pianista*). However, if the parser interprets the sentence as a comparison between the objects, the first DP at the subordinate clause would be expected to receive accusative case and theme theta-role (i.e., *críticas*). Consequently, the initial interpretation of the main clause should facilitate the anticipation of case and theta-role assignments at the DP of the subordinate clause.

The structure is relevant when investigating comprehension by bilingual speakers because it can provide further insight into what information is used by the parser that allows for specific subcategorization of the type of continuation in comparative clauses.

### 2. Processing of Comparative Clauses

#### 2.1. Methods

#### 2.1.1. Preliminary Norming Study

Following previous studies investigating the preferred subcategorization of verbs in English (verb bias; e.g., Jaeger and Snider 2007; Trueswell et al. 1993), I normed the preferred type of continuation in comparative structures. To that end, I extracted 1233 tokens from the Corpus del Español database (Davies 2002), which included written and spoken sources from different Spanish speaking countries. Searches included structures formed by any verb followed by the word *más* ('more'), any noun, and the word *que* ('than'). Additional searches kept the initial structure adding one to five words before and after the first constituent of the comparison to include as many tokens as possible. The goal of this norming study was to investigate the frequency of the possible subcategorizations in comparative structures.

First, all tokens were coded to identify which ones contained comparative structures. Results showed that 810 of the tokens were comparative structures. After they were identified, tokens were coded again by the type of second constituent of the comparison following the word *que* ('than'). Tokens were coded based on whether the second constituent set a comparison with the:

4.	a.	Subject	
		En este sentido, <b>el PP</b> está más a la izquierda que <b>el PSOE</b> .	(76 19-OR)
	b.	Direct Object	
		Lógicamente, pues, la novedad del ambiente seminarista le causó más <b>placeres</b> que <b>nostalgias</b> .	(5 19-F)
	c.	Indirect Object	
		Sin embargo, <b>al importante dios tebano Amón</b> se le otorgó más importancia que <b>a otras divinidades.</b>	(17 19-AC)
	d.	Adverb	
		Es decir, y además que <b>en Cochabamba</b> tuvo más votos que <b>en ninguna parte</b> .	(1 19-OR)
	e.	Complement	
			(104.10.4.0

Las tintas de imprenta se parecen más **a la pintura** que **a la tinta para escritura**, (104 19-AC) pues se componen de pigmentos [ . . . ]

Results (Table 1) showed that the most frequent type of comparison is the comparison with a subject (n = 290, percentage = 36.80%), followed by the comparison with a direct object (n = 262, percentage = 32.34%), and an adverb (n = 177, percentage = 21.58%). Less frequent are the comparison with an indirect object (n = 24, percentage = 2.96%) and a complement (n = 57, percentage = 7.03%). To observe these differences statistically, a chi-square test of goodness-of-fit was performed to determine whether the five types of continuation were equally preferred. Results showed that preference for the five types of continuation were not equally distributed in the corpus,  $X^2$  (4) = 350.8, p < 0.001. To further observe the differences among the five types of continuation, standardized residuals were calculated. In this calculation, positive numbers mean that the frequency of the type of continuation was higher than expected and negative numbers mean that it was lower than expected in a normal distribution. Results showed that there was a higher frequency to form comparison with the subject (+10.06), the object (+7.86), and the adverb (+1.18) than expected. However, comparison with the indirect object (-10.84) and the complement (-8.25) were below expectations. Overall, results suggest that the comparisons with the subject and the direct object were the two most frequent types of continuation when compared to any other constituents of the sentence.

Type of Continuation	п	Percentage	Expected <i>n</i>	Standardized Residuals
Subject	290	35.8%	162	+10.06
Direct Object	262	32.3%	162	+7.86
Indirect Object	24	3%	162	-10.84
Adverb	177	21.9%	162	+1.18
Complement	57	7%	162	-8.25
TOTAL	810	100%		

Table 1. Results of the preferred type of continuation in corpus data.

The results of this norming study revealed two important findings. First, they showed that there were two prevalent continuations in these structures. Comparisons to the subject and the direct object were more frequent than any other type of continuation. Second, the frequency of both the subject and the direct object continuation was similar (i.e., subject percentage = 35.8%; direct object percentage = 32.3%), showing that expectations should not be driven at first by the frequency of the type of subcategorization. These two findings are relevant because they allow creating accurate

experimental items to investigate the processing of these structures. Since subject and direct object comparisons were the most frequent comparative structures, they can be selected to create a temporary semantic ambiguity between a subject comparison reading and a direct object comparison reading. In addition, these two possible continuations are similarly distributed in the corpus, which suggests there should be no preference of one continuation over the other. However, if there are underlying cognitive processes driving a preference, these differences should be captured during online processing, similar to previous studies that have found differences between the production and the comprehension of the same structures, within the same bilingual participants and arguments that the cognitive processes in comprehension and prediction may differ (e.g., Villegas 2014).

#### 2.1.2. Participants

Three groups of bilingual speakers living in Florida (United States) at the time of the experiment were recruited (Approval of Human Research, University of Central Florida Institutional Review Board No: SBE-14-10568). The first group (native group) consisted of 20 L1 Spanish-L2 English speakers who learned their L1 in a Spanish speaking country since birth and their L2 in the United States during adulthood. The second group (heritage group) consisted of 20 LA Spanish-LB English<sup>3</sup> speakers who were born in the United States or migrated before the age of five, whose parents were originally from a Spanish speaking country, learned Spanish at home as their L1, and considered themselves more dominant in L2 English as adults by their social interactions with the language spoken in their communities. Finally, the third group (learner group) consisted of 22 L1 English–L2 Spanish speakers taking Spanish courses at the university level.

To tap into the information of the participants, participants completed two separate tasks. The first task was a Language History Questionnaire (LHQ), which was a version of the LEAP-Q task designed by Marian et al. (2007). The LHQ reported the demographic information, the linguistic experiences, self-rated linguistic dominance, and self-rated proficiency evaluation of the participants. In addition to the LHQ, participants were administered a short version of the Diploma del Español como Lengua Extranjera (DELE), which certifies the degree of competence and mastery of the Spanish language and is granted by the Ministry of Education, Culture, and Sport of Spain. This was a fifty-item grammar-based questionnaire previously used in research to evaluate the participants' proficiency in Spanish (e.g., Montrul 2004).

A set of one-way analyses of variance (ANOVA, Table 2), with Score as dependent variable and Group (native, heritage, learner) as a between-subject factor, were conducted to investigate group differences with regard to the participants' age, proficiency in Spanish (speaking, reading, listening), their exposure to Spanish (overall, reading, speaking), and the DELE scores. Results (Table 2) revealed significant differences among the groups in all measures. Scheffé post hoc comparisons were conducted for each of the measures to investigate which group prompted the differences.

<sup>&</sup>lt;sup>3</sup> It is common in the heritage literature to avoid the use of L1 and L2 to define heritage speakers and to use LA (i.e., language A) and LB (i.e., language B) instead when the acquisition of both languages happens simultaneously (Montrul 2013).

		<b>GROUP MEANS</b>		ANG	OVA
	Native	Heritage	Learners	F	р
n	20	20	22		
Age	26.40 [range: 18–26]	21.45 [range: 18–40]	23.32 [range: 19–39]	5.23	0.009
Proficiency Spanish (x/10)					
Speaking	9.26	8	7.05	13.91	0.000
Reading	9.11	7.75	7.77	8.4	0.001
Listening	9.47	9.40	7.77	33.82	0.000
Exposure Spanish (%)					
Overall	47.37	31.45	24.48	9.11	0.000
Reading	50.79	70.70	61.90	6.24	0.004
Speaking	41.16	24.30	41.62	3.79	0.028
DELE (x/50)	37.90	29.00	26.45	22.38	0.000

Table 2. Participant information.

DELE: Diploma del Español como Lengua Extranjera ('degree of competence and mastery of the Spanish language').

Regarding age, results revealed that members of the heritage group (Mean (M) = 21.45, Standard Deviation (SD) = 2.41) were significantly younger than the native group (M = 26.40, SD = 6.60, p = 0.009). No other group differences were found.

In regard to the participants' proficiency in Spanish, results showed that native speakers rated themselves significantly higher in their speaking (M = 9.26, SD = 0.933) and reading skills (M = 9.11, SD = 0.809) when compared to the participants in the heritage (speaking: M = 8.00, SD = 1.71. p = 0.018; reading: M = 7.75, SD = 1.58. p = 0.003) and the learner groups (speaking: M = 7.05, SD = 1.25, p < 0.001; reading: M = 7.77, SD = 1.02, p = 0.003). Moreover, results revealed that the learner group (M = 7.77; SD = 0.813) rated their listening proficiency significantly lower than the native (M = 9.47, SD = 0.697, p < 0.001) and the heritage groups (M = 9.40; SD = 0.754; p < 0.001).

Next, examining the participants' exposure to Spanish, overall results showed that the native group (M = 47.37, SD = 19.10) rated themselves being overall significantly more exposed to Spanish than the heritage (M = 31.45, SD = 16.17, p = 0.021) and the learner groups (M = 24.48, SD = 16.50. p < 0.001). However, specific ratings for reading and speaking exposure to Spanish revealed differences between the groups. For reading, heritage speakers (M = 70.70, SD = 14.96) rated themselves as reading significantly more in Spanish than the native group (M = 50.79, SD = 18.12, p = 0.004). No other group differences were reported. For speaking, results revealed that the heritage group (M = 24.30, SD = 17.49) rated themselves as being exposed to spoken Spanish almost significantly more often than the native (M = 41.16, SD = 28.83, p = 0.76) and the learner (M = 41.62. SD = 20.64, p = 0.53) groups.

Finally, results showed significant group differences for the DELE scores. Results revealed that the native speakers (M = 37.90, SD = 5.78) scored significantly higher than the heritage (M = 29.00, SD = 6.43, p < 0.001) and the learner (M = 26.45, SD = 5.05, p < 0.001) groups. No other group differences were reported.

Overall, participants' data suggest that the native group was generally different from the heritage and the learner groups. In addition, the data also suggest that the heritage and the learner groups were generally not different to each other.

#### 2.1.3. Materials and Procedures

Upon consenting to participate in the experiment, participants were first administered the LHQ and were given as much time as they needed to complete it. After the LHQ, participants then completed a Self-Paced Reading Task (SPRT) designed to investigate the online processing of sentences that were ambiguous between a subject comparative reading and an object comparative reading. The SPRT was selected to ensure that participants read all the words of the sentence and they accessed the word *más* "more" during the task. Twenty-four pairs of sentences were created, representing the following two conditions:

5. a. Subject Comparative Condition

	<i>El</i> The	<i>cantante</i> singer	obtiene gets	<i>más</i> more	<i>premios</i> awards	<i>que</i> than	<i>el pianista</i> the pianist	en at	<i>el</i> the	<i>festival</i> festival
b.	Object C	omparati	ve Condi	tion						
	El	cantante	obtiene	más	premios	que	críticas	en	el	festival
	The	singer	gets	more	awards	than	criticism	at	the	festival

The difference between the two conditions resides on the first DP following the complementizer *que* ('than'). Thus, assuming that participants access the information encoded in the word *más* 'more', which allows them to identify the structure as a comparative, upon reading the sentence up to the word *que* 'than', participants must encounter a temporary semantic ambiguity based on the case and the theta-role that the DPs receive from the verb. If participants interpret the sentences as a comparison between the subjects (e.g., *el cantante* 'the singer' and *el pianista* 'the pianist' in (5a)), results should show longer reading times in the Object Comparative Condition when compared with the Subject Comparative Condition, because readers should expect a DP with the same case and theta-role at the subordinate clause as the DP selected for comparison at the main clause. However, if participants interpret the sentences as a comparison between the direct objects (e.g., *premios* 'awards' and *críticas* 'criticism' in (5b)), reading times in the Subject Comparative Condition should be longer when compared to the Object Comparative Condition. No differences between the two conditions will be interpreted as the inability to decide on the type of continuation either because (i) participants followed the frequencies found in the corpus study or (ii) they failed to access the information of the functional word *más* 'more' to interpret the structure as a comparative clause.

To control for the effects of frequency at the critical area, a Welch's *t*-test was conducted, comparing the frequency of the DPs between the two conditions<sup>4</sup> and results revealed no significant differences between the two (t(27.83) = 1.93; p = 0.063). A similar post-hoc analysis was also conducted to measure the effects of length in characters at the critical area. Results from this test revealed a significant difference between the length of the DPs in the two conditions (t(4.05) = 4.48, p < 0.001)<sup>5</sup>.

Participants read 80 sentences during the experiment consisting of 8 practice sentences, 24 experimental sentences, and 48 filler sentences. Practice sentences were designed for the participants to get used to the task, and they were the same for all participants. Experimental sentences were 24 pairs of sentences that were semantically ambiguous between a subject comparison and an object comparison reading. The experimental sentences were divided into two files following a Latin Square design so that participants were not exposed to the same pair of sentences during the experimental session. Finally, all participants read the same 48 filler sentences, which aimed at distracting the participants from identifying the experimental sentences. Out of all the filler sentences, half were random sentences with no set structure that grouped them (e.g., *El ronquido del estudiante fastidiaba a*)

<sup>&</sup>lt;sup>4</sup> Data frequencies were obtained at the Corpus del Español (Davies 2002) database, the same source of information for the Preliminary Corpus Study, to maintain consistency of the data source.

<sup>&</sup>lt;sup>5</sup> It is important to point out that the differences in length at the critical area can have a direct effect on the results and their interpretation. I address this in the Analysis and Discussion section below.

*sus compañeros de clase* 'The snoring of the student bothered his classmates'). The other half were filler sentences similar to those used in studies investigating high and low attachment of relative clauses (e.g., *Hugo escribió a la traductora del dramaturgo que era rusa y anciana* 'Hugo wrote to the translator of the playwright who was Russian and old'). All experimental and filler sentences were randomly mixed so that participants could not recognize the structure under study. In addition, they were all followed by a "yes/no" comprehension question about the information they had just read in the sentence designed to keep participants involved in the task.

Following the SPRT, participants completed the DELE test, which assessed the participants' knowledge of Spanish grammar, and it was used as a reference for their overall proficiency in Spanish. Correct answers were scored with a 1 value and incorrect answers were scored with a 0 value. Overall, the whole session lasted about an hour.

#### 2.2. Hypotheses

The hypotheses for the comprehension study are based on the results from the Preliminary Norming Study, which revealed no difference in the frequency of Subject and Object comparative structures in a corpus of Spanish. Therefore, it was hypothesized that, if participants relied mainly on the frequency of these structures during comprehension, participants were expected to show no differences in processing times at the critical area (i.e., the DP following *que* 'than'). However, if participants prefer one type of continuation over the other, significant differences between the two conditions are expected. If participants initially interpret the structure as a comparison between the subject at the main clause and at the subordinate clause, results should reveal longer reading times in the Object Comparative Condition than in the Subject Comparative Condition because participants will expect a DP containing nominative case and agent theta-role. However, if participants initially interpret the structure as a comparison between the objects, results should show longer reading times in the Subject Comparative Condition than in the Object Comparative Condition because participants will expect a DP with accusative case and patient theta-role.

#### 2.3. Analyses and Results

Prior to the analysis, one sentence was eliminated after data collection took place because it revealed a spelling error that could potentially affect the results at the critical area. The analyses that follow were based on 23 experimental sentences. Mean reading times were calculated for each word in the two experimental conditions. Since the number of words in the critical area were different between the two conditions, the two words following the word *que* ('than') in the Subject Comparative Condition were concatenated, and their times added to create a unique area. This analysis would allow for more accurate results at the critical area.

A repeated measures analysis of variance (ANOVA) was conducted with Type of Continuation (Subject, Object) as a within-subject factor and Group (native, heritage, learners) as a between-subjects factor for each of the areas in the experimental sentences (Table 3). Analysis were conducted treating both participants (*F1*) and items (*F2*) as a random factor. Results revealed no significant effect of Type of Condition and no interaction between the Type of Condition and Group in any of the areas preceding the critical area for both participants and items. At the critical area, results revealed a significant effect of the Type of Continuation for participants (*F1* (1, 59) = 297.16, *p* < 0.001) and for items (*F2* (1, 66) = 265.88; *p* < 0.001). For the area following the critical area, results showed a significant effect of the Type of Continuation for participants (*F1* (1, 59) = 7.19, *p* = 0.009) but not for items (*F2* (1, 66) = 2.27; *p* = 0.137). There were no significant interactions between the Type of Continuation and Group at the critical and the following areas.

		SUBJECTS			ITEMS			
		Mean Reading Times (ms)			Mean Reading Times (ms)			
AREA	WORD	Subject	Object	p *	Subject	Object	p *	
1	El	459.22	468.57	0.344	462.96	465.56	0.781	
2	cantante	619.21	630.92	0.408	624.08	631.26	0.620	
3	obtiene	604.96	606.39	0.932	605.32	617.10	0.506	
4	más	469.57	484.59	0.101	473.33	485.89	0.269	
5	premios	539.52	558.71	0.139	540.18	562.95	0.058	
6	que	441.20	443.65	0.776	446.03	442.97	0.765	
7	el pianista / críticas	993.65	639.71	0.000	999.68	628.71	0.000	
8	en	443.75	472.62	0.009	448.89	468.54	0.137	
9	el	418.63	433.89	0.241	426.23	433.43	0.538	
10	festival.	668.07	645.24	0.207	657.41	638.77	0.350	

Table 3. Reading times of Type of Continuation with raw data in milliseconds.

However, it is possible that the results obtained in this first analysis could have been influenced by the differences in length of characters between the lexical items at the critical area in both conditions. Whereas the Object Comparative Condition included a DP with only one word (e.g., *críticas*), the Subject Comparative Condition included a DP with a determiner followed by a noun (e.g., *el pianista*). Thus, it was logical to expect that the critical area at the Subject Comparative Condition would take longer to read than the critical area at the Direct Object Comparative Condition just because the region was longer in number of characters in the first condition compared to the second condition.<sup>6</sup> To resolve this, residual reading times were then calculated following Keating and Jegerski (2015) to eliminate the effect that length at the critical area may have had in the results. A regression equation with word length (including the space in the Subject Comparative Condition) as the predictor variable was calculated using the participants' raw reading times for each participant, all areas, and all items (filler sentences included). Reading times obtained in the experiment, which produces positive and negative results. Negative numbers indicate that reading times were faster than expected, whereas positive ones indicate that they were slower than expected. The data were then submitted for statistical analysis.

A new repeated measures analysis of variance (ANOVA) using residual reading times as data was conducted with Type of Continuation (Subject, Object) as a within-subject factor and Group (native, heritage, learner) as a between-subjects factor for each of the areas of the experimental sentences. The results showed no significant difference between Type of Continuation nor an interaction between Group and Type of Continuation at any of the areas of the experimental sentences except for the critical area (see Table 4 for results). At the critical area (e.g., *el pianista/críticas*), results revealed a significant effect of Type of Continuation for participants (*F1* (1, 59) = 5.43, *p* = 0.023) and for items (*F2* (1, 66) = 8.29; *p* = 005) and no interaction between Type of Continuation and Group. Thus, results suggest that the results in the study were not directly affected by the length of the DP at the critical area.

<sup>\*</sup>  $\alpha = 0.05$ .

<sup>&</sup>lt;sup>6</sup> A reviewer has suggested that, although controlling for the number of characters at the critical area was important, it does not take away the fact that the two areas of interest differ in the number of words and that can be another factor driving the results beyond length. I conducted the residual reading time analysis that follows to quantify the possible effect of differences in length at the DP, but I was not able to analyze the effects of number of words taking into consideration the nature of the materials. We are currently investigating this difference and whether the results can be replicated with the same number of words in both conditions.

			SUBJECTS		ITEMS			
		Mean Reading Times (ms)			Mean Reading Times (ms)			
AREA	WORD	Subject	Object	p **	Subject	Object	<i>p</i> **	
1	El	-22.18	-13.07	0.379	-17.89	-16.91	0.913	
2	cantante	-41.57	-36.37	0.710	-40.95	-30.55	0.440	
3	obtiene	-6.14	-5.46	0.958	-5.71	5.74	0.451	
4	más	-2.97	12.64	0.096	40	12.92	0.212	
5	premios	-54.33	-36.83	0.135	-54.56	-32.46	0.053	
6	que	-16.89	-15.13	0.789	-14.17	-16.18	0.834	
7	el pianista/críticas	7.99	-26.63	0.023	21.67	-31.61	0.005	
8	en	13.61	.30	0.254	6.71	-8.68	0.245	
9	el	-13.59	-7.24	0.452	-9.74	-8.12	0.889	
10	festival.	34.82	54.42	0.338	28.26	26.56	0.927	

Table 4. Residual reading times of Type of Continuation in milliseconds \*.

\* Positive numbers indicate reading times that were slower than expected. Negative results indicate reading times that were faster than expected. \*\*  $\alpha = 0.05$ .

## 3. Discussion and Conclusions

In this paper, I investigated whether three groups of speakers of Spanish access lexically-encoded information from functional words that activate the interpretation of a comparative structure (i.e., *más* ... *que* 'more ... than') and whether, upon accessing that interpretation, participants showed a preference between two competing interpretations (i.e., a subject or an object comparison) based on the case and the theta-role of the first DP at the subordinate clause. To prepare the materials, a norming study was first conducted to investigate the preferred type of comparison, which revealed a preference for subject (4a) and direct object (4b) over indirect object (4c), adverb (4d) and complement (4e) continuations. The results from the comprehension study showed that native speakers, heritage speakers, and L2 learners living in the United States were able to access the linguistic information encoded in the words *más* ... *que* 'more ... than', during comprehension, to identify the structure as a comparative. Further analyses showed a preference for the comparison with the direct object over the subject and no differences between the participant groups. These results suggest that, during comprehension, speakers of Spanish living in the United States show a preference to build the comparison with the object than the subject of the main clause. Overall, these results show important implications in terms of the participants and the processing strategies used in comparative structures.

First, results showed that native and non-native speakers of Spanish were able to extract the information of functional words to interpret the structure as a comparative. Without accessing the information of the word *más* 'more', participants were expected to interpret those sentences as a relative clause. If so, it was hypothesized that the results would show no differences between the conditions. The fact that the results show faster reading times at the Object Comparative Condition over the Subject Comparative Condition suggests that all participants interpreted the sentences as comparative clauses and that both native and non-native speakers of Spanish can use information encoded in functional words that is required to successfully establish a comparison between different components in the structure. This is a relevant finding in this paper because participants revealed similarities in comprehension even when the individual differences show a statistical difference between the proficiency of the three groups. As it was mentioned in the introduction, Dussias et al. (2013) have suggested that processing linguistic information in the L2 may be determined by the grammatical similarities between the languages, and that different outcomes could be expected from different bilingual populations depending on the proficiency of the experimental sentences similarly, regardless

of the proficiency differences in Spanish. Recall that results on individual differences between the groups (Table 1) showed differences in proficiency, both self-rated and in the DELE, eliminating proficiency as a possible factor affecting these results. However, it is important to notice that, in Dussias et al. (2013), participants had to process information in the L2 (i.e., grammatical gender) that was not part of their L1 English, whereas this study uses a structure that is similar in both languages.

Second, the results reported in this study bring into question whether the processes identified to take part in the comprehension of syntactic ambiguities can also be extrapolated to other ambiguities in the linguistic domain. This is an important question because it provides more information on whether processing strategies are universal or whether they really depend on the structures and the information being processed. In studies investigating syntactic ambiguities, researchers have used relative clause structures (such as El policía arrestó a la hermana del criado que estaba enferma desde hacía tiempo 'The police arrested the sister<sub>female</sub> of the servant<sub>male</sub> who had been ill<sub>female</sub> for a while'; Dussias and Sagarra 2007). The syntactic ambiguity in this structure resides in making the decision about who the relative pronoun (i.e., que 'who') referred to (i.e., la hermana 'the sister' or el criado 'the servant'). They manipulated the adjective of the relative clause (i.e., enferma 'ill'), which matched with the grammatical gender of the main clause, to measure the participants' preference through reading times. The researchers hypothesized that, if participants accessed the information of the two competing DPs at the main clause (i.e., la hermana 'the sister' or el criado 'the servant') and were sensitive to grammatical gender, processing the grammatical gender at the adjective in the relative clause would reveal their preferences to attach the relative clause to the higher DP (la hermana 'the sister') or the lower DP (i.e., el criado 'the servant'). Relevant to the results of this paper is that Dussias and Sagarra (2007) found that native speakers of Spanish living in the United States showed a preference to attach the relative clause to the lowest DP, whereas native speakers of Spanish living in Spain showed a preference to attach to the high DP. Similarly, the structure used in this study, which introduces a temporary semantic ambiguity, follows similar processes to those in the studies on syntactic ambiguities, although it uses semantic information encoded in the critical area instead of morphosyntactic information. Here, participants had to access the information of the DP at the subject (i.e., *el cantante* 'the singer') and the DP at the object (i.e., *premios* 'awards') of the main clause before accessing the DP at the subordinate clause. As in relative clause attachment structures, the case and theta-role of the first DP of the subordinate clause was expected to reveal the participants' preference to build a semantic comparison with the subject or the object of the main clause. The results of this study showed that native speakers of Spanish living in the United States showed similar results as in the study of relative clause attachment. That is, in structures with two DPs competing, either syntactically or semantically, speakers of Spanish living in the United States showed similar preferences to use the latest processed DP at the main clause to process these structures. If this holds true, it may be possible that the processing strategies used in the resolution of syntactic ambiguities are also active during the resolution of semantic ambiguities.

Nonetheless, conclusions from this study should be drawn carefully for two reasons. First, as indicated in footnote 4, there is a methodological issue that was pointed by the reviewers in relation to the length in characters and words at the critical area. In the analyses of the results, I applied an analysis using residual reading times that is often used in psycholinguistic research to control for length at the critical area. This analysis showed faster than expected reading times at the Object Comparative Condition, supporting the results of the original analysis. However, as indicated by the reviewer, this does not take away the fact that the critical area in the two conditions differed in the number of words. This difference in the number of words may have had an effect on the results that may have not been completely resolve through the analyses of residual times. To investigate this, we are currently conducting two separate variations in our lab using comparative structures to further investigate this issue. The first experiment has changed the contents of the DP into a proper noun consisting on a single word, so that the critical area has the same number of words across conditions. The second experiment explores the processing of bilinguals using the same structure in Russian,

because this language does not require a determiner in the Subject DP and the case is marked overtly through morphology. Results from these studies will help to shed light on the results from this study.

In addition, the results reported here lack a group of bilingual speakers that were not immersed in a linguistic environment dominant in English. In this study, native speakers where living in the United States at the time of the experiment. This group would be important to understand how native speakers of Spanish process this structure under minimal influence of English. These groups were not originally included in this study because of limitations on funding at the time of the investigation. Instead, to cover this gap, I reported the results from a norming study that investigates the overall production of these structures in Spanish. This analysis was conducted based on previous arguments arguing that corpus data can also inform us about the production of native speakers (Biber 2000). Yet, I recognize that the analysis of the data provided, although informative, is not conclusive, and that the direct production of these structures by the participants would have provided more information on the structure. This is currently being investigated in a study on the production and comprehension of speakers of Spanish, similar to the study reported here, that includes a group of native speakers of Spanish with no immersion in the L2 English environment using eye-tracking methodology.

In conclusion, the results of this study suggest that all three groups of speakers, regardless of their proficiency level, display similar results and were able to extract information from functional words in Spanish to process comparative clauses. Moreover, the processing strategies used to parse these structures may be guided by strategies captured in other processing studies investigating syntactic ambiguities, something that future studies should corroborate further.

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