Ambiguous Sentence Processing in Translation

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The goal of our research was to explore the possible online co-activation of both the target language (TL) syntactic structure representation and TL attachment strategies in translation, and to look over a possible interaction between both syntactic properties. To this purpose, Spanish (L1) – English (L2) bilinguals were instructed to read complex noun phrases with an ambiguous relative clause in Spanish to either repeat them in Spanish or translate them into English. The final word of the sentences and the syntactic congruency between the source language (SL) and TL syntactic structure were manipulated. The results revealed co-activation of both TL syntactic properties: participants interpreted sentences more accordingly to the TL preferred strategy (low attachment) in the reading for translation task, read congruent sentences faster, and used the TL preferred interpretation strategy in the congruent condition of the sentences more. These results indicated TL activation at different syntactic levels during comprehension of the SL in translation.

Sentence comprehension involves different aspects such as the activation of sentence structure representations and syntactic processing strategies. Among the syntactic processing strategies, we can find opposed attachment preferences regarding sentences with an ambiguous relative

clause (RC) preceded by a complex noun phrase (NP). For example, it has been found that in a sentence like *Someone shot the servant of the actress who was on the balcony*, where the RC (*who was on the balcony*) can be attached to either the first noun (NP$_1$/*servant*) or the second noun (NP$_2$/*actress*), the answer to the question *Who was on the balcony?* depends on several factors like language (Spanish, English, etc.), time of exposure to a given language, prosodic breaks, the number of languages spoken by the individual, and age of the speaker´s second language (L2) acquisition. In addition, RC attachment is modulated by the linguistic characteristics of the material and the emotionality of the words embedded in the sentence (Díaz-Lago et al., 2014). In the next section, we review studies on crosslinguistic differences in the way monolinguals and bilinguals understand sentences with an ambiguous RC.

Crosslinguistic differences in relative clause ambiguity resolution

Many previous studies have shown that native Spanish speakers with no knowledge of English rely on a high (NP$_1$) attachment strategy for ambiguity resolution (i.e., *the servant was on the balcony*; Arancibia et al., 2015; Carreiras & Clifton, 1999; Carreiras et al., 2004; Dussias, 2003; Dussias & Sagarra, 2007; Jegerski et al., 2016), while English monolinguals rely on a low (NP$_2$) attachment strategy (i.e., *the actress was on the balcony*; Carreiras & Clifton, 1999; Cuetos & Mitchell, 1988; Mitchell & Cuetos, 1991; Dussias, 2001, 2003; Fernández, 2003; Frazier & Clifton, 1996). RC attachment to the NP$_2$ in native English speakers agrees with the *late closure principle* proposed in the Garden-Path Model (Frazier, 1987; Frazier & Rayner, 1982), which predicts that new lexical items are attached to the constituent or phrase currently being processed. However, this is not a universal principle because, as we have explained previously, speakers of other languages (e.g., Spanish) show a preference for high attachment in ambiguous RC sentences.

Several accounts have been put forth in an attempt to explain the crosslinguistic differences in RC ambiguity resolution. For instance, the *Implicit Prosody Hypothesis* (Fodor, 2002) claims that such preferences result from the crosslinguistic differences in the prosody of sentences. To be more specific, it assumes that prosodic breaks modulate syntactic interpretation. Thus, it has been shown that a prosodic break before the RC is associated with high attachment in NP$_1$ + NP$_2$ + RC structures (De la Cruz-Pavia & Elordieta, 2015; Jun, 2003; Jun & Kim, 2004; Jum & Koike, 2008; Lovrić et al., 2000, 2001; Maynell, 1999), while a break after NP$_1$ favours low attachment (Fernández & Sekerina, 2015; Yao & Scheepers, 2018). That is, prosodic breaks function as cues, creating boundaries between some of the

sentence constituents (Wagner & Watson, 2010) and grouping others (Clifton et al., 2002; Watson & Gibson, 2005). If a prosodic boundary is created after NP_1, then NP_2 and RC will form a single prosodic constituent, and the RC will be associated to NP_2. On the other hand, a break after NP_2 will bind the NP_1 and the NP_2, while the RC will constitute a separate prosodic unit associated to NP_1. Along this line, some studies have found that native Spanish speakers (Fromont et al., 2017; Teira & Igoa, 2007) and native English speakers (Fernández, 2007; Fernández & Sekerina, 2015) favoured a low attachment strategy when no prosodic break was present in auditory sentences. This was reinforced by the presence of a prosodic break after NP_1, whereas a prosodic break after NP_2 elicited a modulation towards a high attachment strategy. Furthermore, the probability of creating a prosodic break after either NP_1 or NP_2 seems to correlate to the length of the RC (Jun & Kim, 2004; Jun & Koike, 2008). To test this hypothesis, De la Cruz-Pavia and Elordieta (2015) conducted a study where they investigated the production of prosodic phrasing in Spanish and the potential influence of RC length in monolingual speakers of Spanish, Spanish (L1) – Basque (L2) bilinguals, and Basque (L1) - Spanish (L2) bilinguals. Basque has been reported as a low attachment preference language (Gutierrez et al., 2004) in contrast with Spanish which has shown preference for high attachment, as we mentioned before. The sentences consisted of a complex NP (NP_1 + NP_2) and a syntactically ambiguous RC which was divided into three groups, according to the number of syllables (short, medium, and long). The results revealed significant differences in the percentages of prosodic boundaries after NP_2 between native Spanish speakers (monolingual and Spanish – Basque groups) and non-native Spanish speakers (Basque – Spanish group). While the latter group presented a 75.81% of breaks after NP_2, the monolingual speakers of Spanish and Spanish (L1) – Basque (L2) bilingual groups produced 82.15% and 82.77%, respectively. Furthermore, a correlation between the prosodic breaks and the length of the RC was also found. There was a significant difference in the production of prosodic boundaries after NP_2 between the short RC block (56%) and the middle (90.3%) and long blocks (94.0%), but no difference between the last two. Regarding the performance by group, the native speaker group produced more breaks after NP_2 in the middle and long blocks than the non-native one. Therefore, although a prosodic segmentation after NP_2 is the default preference in Spanish, the RC length influenced it with a higher frequency of prosodic breaks after NP_1 in short RCs, while long RCs seemed to lead towards a prosodic break after NP_2.

Accounts based on immersion experience have also been proposed to explain the crosslinguistic differences in attachment preference, besides the explanations based on phonetic cues. For example, the *Tuning Hypothesis*

(Mitchell & Cuetos, 1991) claims that in case of sentence ambiguity, individuals will opt for the kind of interpretation they have encountered more often in their previous linguistic experience. In other words, in the case of an ambiguous RC in a complex NP, parsers will favour either high attachment or low attachment depending on the language they have been exposed to more. If they have been exposed to a language to a greater extent where high attachment strategy is used more frequently (e.g., Spanish), they will favour this interpretation to solve the ambiguity. Nevertheless, if they have had a greater exposure to a language which favours low attachment (e.g., English), then parsers will resort to a low attachment strategy to solve the ambiguity. Supporting evidence towards this claim for English and Spanish comes from a corpus analysis by Mitchell et al. (1992) who reported that in sentences with an ambiguous relative clause preceded by two antecedents (NP_1 and NP_2), 60% of the relative clauses had a high attachment (to NP_1) in Spanish, while only 38% of them had a high attachment in English.

Further evidence coming from studies with high proficiency late Spanish-English bilinguals also suggests that RC attachment preference can be related to language exposure; and hence, to the Tuning Hypothesis. In a self-paced reading study, Dussias (2003) explored the use of RC attachment strategies among Spanish (L1) – English (L2) bilinguals who had been living in the United States for 7.5 years on average and English (L1) – Spanish (L2) bilinguals who had lived in a Spanish-speaking country for an average of 2 years. The results of the offline questionnaires revealed a low attachment preference in both languages for both groups, whereas in the online results, only the Spanish (L1) – English (L2) group showed a preference for the low attachment strategy. A similar result was obtained with a Spanish (L1) – English (L2) bilingual group with less language exposure to L2 (3.7 years) in Dussias (2004) where the bilinguals exhibited a low attachment preference in their L1. Nevertheless, in an eye tracking study where two late Spanish (L1) – English (L2) bilingual groups who differed in L2 language exposure were compared (7.1 years of residence in the United States vs. 8.5 months of residence in an English-speaking country and residing in Spain at the time of the experiment), Dussias and Sagarra (2007) found asymmetrical results in the attachment preferences of the L1 of the groups. The longest exposed group showed a preference for low attachment, as opposed to the least exposed group that preferred a high attachment strategy. Hence, the studies above mentioned provide enough evidence to consider the amount time of past language exposure as a plausible factor to account for the different RC attachment preferences between languages. There is, however, another possible explanation put forth by Jegerski (2018) to explain the pattern of results reported by Dussias (2007): given the extended exposure to English,

it may be possible that the preference for low attachment exhibited by the late bilinguals was not due to L2 transfer but a consequence of crosslinguistic competition instead. In that case, the participants would have resorted to a less cognitive demanding strategy like the low attachment, which entails only a general processing strategy like the *late closure* (Frazier, 1987), and it seems to be less complex than the high attachment strategy.

Studies with early bilinguals, on the other hand, have shown a different picture. Jegerski, VanPatten, and Keating (2016) explored the attachment preferences of a group of early Spanish (L1) – English (L2) bilinguals (Spanish heritage speakers) and a group of late Spanish (L1) – English (L2) bilinguals who were both residing in the United States. The participants had to answer a questionnaire with ambiguous RCs. The authors found that the attachment preferences for the late bilinguals were nearly the same in both languages (high attachment 57.1% and 50.5% in Spanish and English, respectively), which was consistent with previous studies (Dussias, 2003, 2004) and suggested that late bilinguals might use a single strategy to parse in both languages; most likely, the one preferred in the language they are immersed in. On the other hand, the heritage group showed contrasting results between the two languages (high attachment 68.7% and 47.8% in Spanish and English, respectively). In another study, Jegerski, Keating et al. (2016) examined whether extensive exposure to English had no influence on the online RC attachment preference of heritage speakers of Spanish, like in the offline results presented by Jegerski, VanPatten et al. (2016). They compared the attachment preferences of a Spanish monolingual group and a group of Spanish heritage speakers when reading sentences with RCs that were pragmatically biased to either low or high attachment while online and offline measures were considered. For the online measure, the authors divided the sentences in two critical regions. The first region comprised of a complex NP (NP$_1$ + NP$_2$), and the second region, a RC. For the offline measure, the participants were asked to answer a question regarding their interpretation of the RC after each sentence. The results of both online and offline measures pointed towards a high attachment preference for both groups when the sentences were biased towards high attachment.

Finally, Jegerski (2018) carried out a self-paced reading study with early Spanish – English bilinguals (Spanish heritage speakers), late Spanish (L1) – English (L2) bilinguals and Spanish monolinguals. According to the author, both bilingual groups went over the critical period of time related to between-language competition on RC attachment, based on Dussias (2004) and Dussias and Sagarra (2007) (0.7 - 3.7 years). The participants were instructed to read complex NP sentences with RCs that forced either low or high attachment by means of gender agreement, and then, to answer a

comprehension question regarding the meaning of the sentence. In addition, RC length was also manipulated, with short clauses ranging from 5 to 7 syllables and long clauses, from 12 to 14 syllables. The offline results exhibited high attachment tendency for the three groups. The online results were less clear, nonetheless, because none of the groups showed a clear attachment preference. Altogether, the results of this study suggest that extended exposure to L2 in early bilinguals might have helped them to manage crosslinguistic competition more efficiently rather than creating greater between-language competition. As for the results of the late bilingual group, the author suggested that the high attachment preference showed by this group does not contradict an exposure-based hypothesis to account for the results found in other studies, where late bilinguals showed a preference for low attachment (Dussias, 2003, 2004; Dussias & Sagarra, 2007) or no preference at all (Jegerski, VanPatten et al., 2016), because they may have been less exposed to their L2 (English) and had a lower L2 proficiency, according to the participant's personal information.

Accounts based on syntactic factors have also been proposed to explain crosslinguistic asymmetries in RC attachment. For example, the *PR-first Hypothesis* (Grillo & Costa, 2014) suggests that individuals prefer pseudo-relative (PR) constructions over RCs because they are structurally simpler and easier to interpret than RCs. PRs are found in high attachment languages (e.g., Spanish) and are identical to RCs string-wise, although semantically and structurally different from them. For instance, PRs take perceptive verbs in general. They are either complements or adjuncts of verb-phrases (VPs) and introduce an event as the theme of the verb, while RCs modify NPs and denote properties of the NPs. Their similarity allows the same construction to be parsed as a RC and a PR simultaneously. When a complex NP (NP_1 + NP_2) is parsed as a RC, both NPs are accessible and the RC, which denotes a property, must be attached to one of them. For example, *Vi al hijo$_{NP1}$ del hombre$_{NP2}$ que corría$_{NP1\ or\ NP2}$* [$_{RC\ parsing}$] / I saw the son of the man that ran [$_{RC\ parsing}$]. Nevertheless, PRs are similar to small clauses (SCs) in English and take the complex NP as their subject. Therefore, when the same structure is parsed as a PR, the only accessible subject embedded in the predicate is the NP_1 (high attachment). For example, *Vi al hijo$_{NP1}$ del hombre$_{NP2}$ que corría$_{NP1}$* [$_{PR\ parsing}$] / I saw the son of the man running [$_{PR\ parsing}$]. According to the PR-first Hypothesis, when everything else is equal, individuals will prefer PRs over RCs when they are available because they are simpler to interpret than RCs.

Evidence supporting the *PR-first Hypothesis* has been reported in studies with high attachment languages like Spanish (Grillo et al., 2012b; Aguilar & Grillo, 2016) and Portuguese (Grillo et al., 2012a, 2012b; Grillo et

al., 2013; Fernandes, 2012; Tomaz et al., 2014). Grillo and Costa (2014) presented evidence of high attachment in Italian. Native Italian speakers participated in an offline questionnaire on attachment preferences. The authors reported a significant high attachment preference (78.6%) for event-taking verbs (perceptual verbs) which are PR compatible compared to entity-taking verbs (stative verbs) (24.2%) which are not PR compatible. The authors concluded that the availability of a PR interpretation modulates RC attachment ambiguity resolution. More recently, Pozniak et al. (2019) conducted an eye-tracking study in English and French, the latter considered a high attachment language. Their results only reflected a greater processing difficulty when disambiguation was forced towards a RC parsing in sentences with an embedded perceptual verb in French; thus, providing online evidence that supports PR preference. In short, the PR-first hypothesis suggests that speakers of languages in which PR constructions are possible (e.g., Spanish but not English) will prefer the high attachment to interpret sentences with ambiguous RC clauses.

Finally, the *emotionality of the words* has been considered a determining factor in the understanding of ambiguous sentences with RCs (Díaz-Lago et al., 2014; Fraga et al., 2012; García-Orza et al., 2017). Emotion has three basic dimensions, valence, arousal and dominance, with the former two being considered the most relevant. Valence refers mainly to the degree of pleasantness of a stimulus (image, sound or word), ranging from pleasant to unpleasant, whereas arousal denotes the degree of internal activation or intensity of the stimulus, which ranges from calming to exciting. Moreover, high-valence emotions are usually high in arousal as well, whereas low-arousal emotions tend to be classified as neutral in valence. Regarding emotional words, they are words that describe emotional states like happiness or sadness as well as words that elicit these emotional states (e.g., rainbow, storm).

Both arousal and valence have been reported to attract the RC in the comprehension and production of ambiguous sentences with the structure $NP_1 + NP_2 + RC$ and change attachment preferences. For instance, in a sentence completion study in Spanish, Fraga et al. (2012) found that when arousal was kept constant in both NPs and none of them were emotional, participants revealed the high attachment preference. Nevertheless, a significant reversal of the tendency for high attachment was found when an emotional word (pleasant or unpleasant) was placed in the NP_2. In their second study, the authors compared low and high arousal nouns while keeping their affective valence constant. The results revealed that high arousal nouns attracted RC attachment independently of their position in the sentence (NP_1 or NP_2). In another sentence completion study, Díaz-Lago et

al. (2014), investigated the effect of affective valence in ambiguous RC by keeping arousal level constant (low) in both NPs and manipulating their affective valence, neutral-neutral (N–N), neutral-pleasant (N–P), and pleasant-unpleasant (P–U). The authors reported a marginal high attachment preference in the N–N condition, which was higher in the P-N condition. On the other hand, the participants reversed to a low attachment strategy when they found the pleasant noun in the NP_2 (N–P condition). The role of affective valence on RC disambiguation was further explored in a self-paced reading study by García-Orza et al. (2017). Valence was manipulated in both NPs to compare disambiguation in emotional-neutral (E–N) vs. neutral emotional (N–E) conditions. The results showed a clear NP_1 preference in the E–N condition, which disappeared but did not reverse in the N-E condition. Thus, showing that the emotionality of the nouns in NPs modulates RC attachment preferences.

In summary, the recent results concerning RC attachment preferences in Spanish – English bilinguals suggest that there are emotional, syntactic, structural, phonetic, and past experience factors that modulate the processing of this kind of sentence structure. Note, however, that all the tasks that the participants had to perform in the abovementioned studies were monolingual (within–language) tasks because the participants had to read for comprehension in either their L1 or their L2. Thus, in the current study, we raised the question of what would happen when bilinguals have to perform a bilingual (between–language) task, like translation, where activation and processing of information in both of their languages is required.

Relative clause ambiguity resolution in translation

Processing information across languages in translation may come about in several ways according to two different perspectives. On the one hand, the *Vertical View* (Fodor, 1978; Seleskovitch, 1976, 1999) maintains that the three general processes in translation (comprehension, reformulation, and production) take place in a serial manner. According to this perspective, after comprehension of the message in its original language or source language (SL) has occurred, the message is stripped from its superficial structure and then it is recoded in the language in which it is going to be translated (the target language, TL). Thus, information will flow in one direction, only one language will be active at a time in each process, and no interaction or overlapping will take place between the three general processing stages (comprehension, reformulation and production). On the other hand, the *Horizontal View* (Danks & Griffin, 1997; Gerver, 1976; Macizo & Bajo, 2005, 2006a, 2006b, 2007; Padilla et al., 2007) states that processing of both languages in translation occurs simultaneously. According to this perspective, activation of the TL lexical and syntactic properties comes about

while comprehension of the SL is taking place. Therefore, both SL and TL are active during comprehension of the SL. Empirical evidence seems to support the latter perspective (Balling et al., 2014; Jensen et al., 2009; Jakobsen & Jensen, 2008; Macizo & Bajo, 2006b; Maier et al., 2017; Padilla et al., 2007; Ruiz & Macizo, 2018; Ruiz et al., 2008; Schaeffer & Carl, 2017; Schaeffer et al., 2017; Togato et al., 2017). For example, the results of previous studies suggest that target language (TL) syntactic representations and syntactic processing strategies are active during comprehension of the SL in a translation task. Ruiz et al. (2008) asked Spanish (L1) – English (L2) bilinguals to read sentences in Spanish, word-by-word, to either repeat them in Spanish or translate them into English. To study the TL syntactic properties activation and the activation time course, sentences were divided into three regions (initial, middle and final) whose structure (word order) was either congruent or incongruent between Spanish and English. Syntactic congruency was manipulated by varying the noun-adjective (N–Adj) word order in the initial and final region and by including or dropping the subject pronoun of the embedded relative clause in the middle region. Hence, in SL sentences, the adjective was placed before the noun and the subject pronoun was included in the congruent sentences, whereas in the incongruent sentences the adjective was placed after the noun and the subject pronoun was dropped (see Table 1 for examples). As can be observed, the particular word order N–Adj and the absence of the subject pronoun are allowed in Spanish but not in English.

Table 1

Example of the experimental sentences used in Ruiz et al. (2008)

Condition	Sentence
Congruent	*La **bonita casa** que **yo alquilé** este verano tenía un **verde jardín**.* (The **nice house** that **I rented** this summer had a **green garden**.)
Incongruent	*La **casa bonita** que **alquilé** este verano tenía un **jardín verde**.* (The **nice house** that **I rented** this summer had a **green garden**.)

Note. The critical words are in bold. English translations are given in brackets. Congruent: sentence with the adjective before the noun in the initial and final regions and the subject pronoun before the verb in the middle region. Incongruent: sentence with the adjective following the noun in the initial and final regions and the dropped subject pronoun in the middle region.

It has been argued that the syntactic representation of a structure that follows the same word order in different languages is mentally stored only once (Shared-syntax account), while it is stored separately when the structure

follows a different word order (Bernolet et al., 2007; Gámez & Vasilyeva, 2019; Hartsuiker et al., 2004; Huang et al., 2019; Hwang et al., 2018; Togato & Macizo, 2020). This means that when a shared representation was active in one language, it would then be available to be used in the other language of a bilingual. Thus, if there was parallel activation of the TL and SL syntactic properties during comprehension of the SL in translation, then the congruent sentences would be read faster than the incongruent sentences. The results met the predictions: Ruiz et al. (2008) found faster reading times (RTs) for the congruent sentences relative to the incongruent sentences only in the translation task. As for the activation time course, the facilitation effect in the congruent vs. incongruent sentences was close to significant in the initial region, whereas it was significant in the middle region. Therefore, the results of this study suggested that the activation of the TL syntactic properties during comprehension of the SL in translation implies that (1) syntactic structure representations which are shared between SL and TL become activated in a translation task during the reading of the SL; (2) TL syntactic activation modulates SL syntactic processing (which involves a code-to-code connection at the syntactic level between both languages); and finally, (3) activation of the TL syntactic representations starts very early on in the comprehension phase of the SL.

Concerning syntactic processing strategies, Togato et al. (2017) investigated the strategy used by bilinguals to process ambiguous relative sentences in a translation task. Similar to Ruiz et al. (2008), Spanish (L1) – English (L2) bilinguals had to read sentences in Spanish, word-by-word, to either repeat them in Spanish or translate them into English. The sentences comprised of a complex NP (NP$_1$ + NP$_2$) with an ambiguous RC (i.e., *the dentist attended to the secretary of the director who divorced her husband*). After reading the sentences and completing the task, the participants had to answer a verification question focused on the agent of the ambiguous relative clause. The alternatives of the answer contained both antecedents (first antecedent/NP$_1$ and second antecedent/NP$_2$) as potential agents. When the bilinguals read to repeat, no differences were observed in the preference of choosing the first or second antecedent as the subject of the relative clause. However, when the bilinguals read to translate into English, the percentage of choice of the second noun was greater than that of the first noun. Thus, the bilinguals preferred the low attachment strategy when reading for translation, which is the syntactic strategy preferred by speakers of the TL (English). Therefore, the results suggested that the attachment strategy used to solve the syntactic ambiguity of the sentences depended on the nature of the task that the participants were performing.

As can be observed in the studies described above, the results suggest potential co-activation of the TL in translation tasks. If so, it will leave open the possibility of simultaneous activation of the syntactic structure representation and the processing strategies in RC attachment, and interaction between them in a translation task.

THE CURRENT STUDY

The activation of TL syntactic properties during comprehension in translation has been studied in the past (Macizo & Bajo, 2004; Ruiz & Macizo, 2018, 2019; Ruiz et al., 2008; Togato et al., 2017). Nevertheless, these studies investigated TL syntactic structure processing (word order) and TL attachment preferences separately. Furthermore, while SL–TL syntactic congruency in translation has been addressed with online indexes (RTs of critical sentence regions, Ruiz et al., 2008), processing strategies of RCs have been examined only with offline comprehension measures in translation tasks (attachment preferences after reading, Togato et al., 2017). The goal of our research was: (1) to explore the possible concurrent activation of both TL structure representation and TL attachment strategies in translation, (2) to look over a possible interaction between them during SL comprehension, and (3) to obtain both online and offline comprehension measures of TL co-activation during reading for translation.

Spanish (L1) – English (L2) bilinguals were instructed to read, word-by-word, complex NP (NP$_1$ + NP$_2$) sentences with a RC in Spanish (SL), to either repeat them in Spanish or translate them into English (TL). The adjective/noun word order of both antecedents was manipulated to achieve congruency between the SL and the TL sentence structure and explore the syntactic structure activation. The congruent condition was possible because the same word order is allowed in both the SL and the TL (Adj–N) whereas in the incongruent condition the word order in the SL (N–Adj order in Spanish) is not allowed in the TL (Adj–N order in English). Syntactic structure representations that follow the same word order in two languages are supposed to be stored only once and shared between those two languages (Bernolet et al., 2007). Hence, the activation of a particular structure during comprehension of the SL will make it available to use in the TL, as long as the syntactic structure follows the same word order in both languages.

In our study, we introduced the novelty of using reading times to explore RC attachment preferences in translation and extended Togato et al. (2017) results by means of evaluating online measures. Importantly, the use of online measures was not possible in that study because all the sentences

were ambiguous and thus, RTs were not informative of the online attachment strategy used by the participant. In contrast, in our study, we also introduced high and low attachment conditions to examine the possible online co-activation of the SL and TL attachment preferences in translation when participants read sentences in Spanish. These two conditions were identical in the initial and middle regions of the sentences (*Almudena llamó al joven sobrino*_{Initial Region} *de la simpático casera*_{Middle Region} *que fue a Barcelona cuando estaba… / Almudena called the young nephew*_{Initial Region} *of the nice landlady*_{Middle Region} *who went to Barcelona when he/she was…*; in Spanish and English, respectively). However, the adjective at the end of the sentence (final region) could only agree in gender with either the first antecedent in high attachment sentences (first noun: *sobrino/nephew*-masculine, final region: *casado/married*-masculine. *a* in Example 1) or the second antecedent in low attachment sentences (e.g., second noun: *casera/landlady*-feminine, final region: *casada/married*-femenine. *b* in Example 1). Example 1:

a. *Almudena llamó al joven sobrino*_{InitialRegion} *de la simpática casera*_{Middle Región} *que fue a Barcelona cuando estaba casado*_{FinalRegion} / Almudena called the young nephew_{InitialRegion} of the nice landlady_{MiddleRegion} who went to Barcelona when he was married_{FinalRegion}

b. *Almudena llamó al joven sobrino*_{InitalRegion} *de la simpática casera*_{MiddleRegion} *que fue a Barcelona cuando estaba casada*_{FinalRegion} / Almudena called the young nephew_{InitialRegion} of the nice landlady_{MiddleRegion} who went to Barcelona when she was married_{FinalRegion}

Thus, the RTs of the last word of the sentence allowed for further exploration of attachment strategy. To be more specific, if participants use the preferred attachment strategy of the TL in the reading for translation task (low attachment in English), then the RTs of the last word in the sentence will be faster in the low attachment condition than in that of the high attachment.

The main predictions of our study were the following: we expected to find (1) slower RTs in the reading for translation task in comparison to the reading for repetition task. If there is co-activation of both SL and TL during comprehension of the SL in reading for translation, then the additional processing resources needed to process the TL would increase RTs in comparison to the reading for repetition task. (2) We predicted activation of the TL syntactic properties when reading for translation. Namely, (a) syntactic structure representation and (b) RC attachment strategies.

Activation of the TL syntactic structure representation would imply faster RTs in the congruent condition vs. the incongruent condition, and also greater activation of the more frequent TL attachment strategy (low attachment) compared to the SL preferred strategy (high attachment). Finally, (3) we expected interaction between both syntactic factors when reading for translation. If the TL syntactic properties were active before finishing reading the sentences, then the already active TL structure representation would boost the use of the second antecedent (low attachment strategy). In other words, interaction would be reflected by a more frequent use of the TL most common attachment strategy vs. the SL most common attachment strategy in syntactically congruent sentences.

METHOD

Participants. The characteristics of the participants in the study are reported in Table 2. Twenty four Spanish (L1) – English (L2) bilinguals participated in the experiment. They were all living in Spain at the time of the experiment and were paid for their participation. None of the participants reported history of language disabilities and they had normal or corrected-to-normal visual acuity.The experiment took place at the Mind, Brain, and Behavior Research Center of the University of Granada, Spain (CIMCYC – UGR) and it was approved by the Ethics Committee at the University of Granada (Number issued by the Ethical Committee: 957/CEIH/2019).

All the participants filled out a language history questionnaire to self-rate their L1 and their L2. The proficiency scale ranged from 1 to 10 where 1 was not proficient and 10 was highly proficient. The three proficiency skills (speaking, reading, and speech comprehension) were combined to calculate their mean language proficiency. The participants' mean proficiency was higher in L1 than in L2, $t(24) = 10.43$, $p < .001$. The participants were unbalanced bilinguals, however, they were highly fluent in L2. Finally, in a combined percentage of the time the participants were, on average, exposed to each language at that time, and which should add up to 100%, the participants reported they were more exposed to their L1 ($M = 62.71$, $SD = 15.03$) than to their L2 ($M = 30.38$, $SD = 14.22$, $t(24) = 5.81$, $p < .001$) in their daily life.

Table 2

Characteristics of participants in the study

Demographic characteristics	
Age (years)	24.67 (6.02)
Age starting L2 learning (years)	5.75 (2.29)

Time lived in L2 speaking countries (months)		17.63 (23.70)
Language proficiency questionnaire		
	L1	L2
Speaking proficiency	9.58 (0.58)	8.08 (0.58)
Speech comprehension	9.75 (0.44)	8.50 (0.78)
Reading proficiency	9.75 (0.53)	8.58 (0.83)
Mean fluency	9.69 (0.10)	8.39 (0.27)

Note. The self-reported ratings in L1 (Spanish) and L2 (English) ranged from 1 to 10 where 1 was not fluent and 10 was very fluent. Standard deviations are reported in parentheses.

Materials. Sixty experimental sentences were constructed in Spanish. The sentences comprised of a subject relative clause (RC) which was preceded by a complex NP ($NP_1 + NP_2$) where NP_1 (first antecedent) and NP_2 (second antecedent) were the potential subjects of the RC (see Supplementary Material online for the complete set of materials used in the study). All the antecedents were animate and singular. The last word of the sentence (an adjective) agreed in gender and number with one or both antecedents and had to be attached to only one of them. Noun gender is marked in Spanish by placing the vowel -*a* (for feminine) and -*o* (for masculine) at the end of nouns. However, there are words whose gender is not marked with -*a* nor -*o* (e.g., *contrincante*, *representante* / *adversary*, *manager*; in Spanish and English, respectively). In that case, the gender is marked by the definite article *el* (*el contrincante*), for male, and *la* (*la representante*), for female, in singular (*the adversary, the manager*, in English, respectively).

Regarding descriptive adjectives in Spanish, they must always agree with nouns in gender and number. To change a singular masculine form of an adjective that ends in –*o* (*cansado*/tired) into feminine, the -*o* must be replaced by an -*a* (*cansada*/tired). To make it plural an -*s* must be added at the end of the word (cansado – cansados / cansada – cansadas). Adjectives that end in -*e* (*interesante*/interesting), -*ista* (idealista/idealist) or a consonant (*azul*/blue), except for -*or* (*trabajador*/worker or hardworker), -*ón* (*cabezón*/stubborn) or -*ín* (*afín*/related), agree with both masculine and feminine nouns but change for number.

Six versions were created for each experimental sentence (see Table 3 for examples). In the high attachment condition, the last word of the sentence agreed with the first antecedent (*casado, sobrino*/married, *nephew*; in Spanish and English, respectively), while in the low attachment condition the last word agreed with the second antecedent (*casada, casera*/married, *landlady*; in Spanish and English, respectively). There was also an ambiguous condition in which the last word of the sentence agreed with both antecedents (*sobrina, casera, casada*/niece, *landlady, married*; in Spanish and English,

respectively), which made the attachment of the relative clause ambiguous. This condition was introduced to replicate Togato et al. (2017) results. In other words, to explore whether the participants' ultimate interpretation of the RC in the offline measure was modulated by the activation of TL interpretation strategies after reading.

The syntactic congruency of the sentences was manipulated by placing an adjective next to each antecedent and varying their N–Adj word order. Adjectives can be placed either before or after nouns in Spanish, while in English, they are always placed before the noun. It should be mentioned that even if adjectives can be placed before nouns in Spanish, this word order is not the most common and, therefore, it is likely to be marked most of the time.

An anonymous reviewer of a previous version of this paper correctly pointed out that the position of descriptive adjectives in Spanish (pre- and postnominal) can produce variations in the semantic interpretation of N-Adj compounds. For example, there are differing semantic connotations in the N-Adj compound *hijo dulce* (sweet son) and the Adj-N compound *dulce hijo* (sweet son). In the first word order, the meaning relates preferably to the taste of sugar, while in the second one the meaning of the adjective refers primarily to the tenderness or kindness of the person. The position of adjectives in Spanish also provides additional meaning in terms of focalization (e.g., informative, contrastive) which makes it easier to identify the entity described in a sentence. Even though adjectives in the prenomimal position are marked, they are not focalized and can relate to an innate or already known characteristic of the noun they describe (e.g., *blanca nieve* / white snow). Alternatively, adjectives in the postnominal position are focalized despite being the unmarked form and more frequent structure in Spanish. When adjectives are placed after the noun, they provide more information about the noun and make it easier to identify it among other alternatives that are present, like other sons or people with different characteristics in the case of *hijo dulce*, for instance. Furthermore, sentence context helps to disambiguate meaning in situations where the same adjective can be interpreted in more than one way. For example, it is more plausible that in the context of the sentence *Pilar bailó con el hijo dulce de la maestra divertida que fue a la fiesta sin ser invitado* (Pilar danced with the sweet son of the fun female teacher who went to the party without him being invited), the *hijo dulce* compound would be interpreted as "the son that is tender or kind as a person" instead of "the son that tastes like sugar". Moreover, an adjective following a noun distinguishes that noun from others that may have different qualities, while placing an adjective before a noun implies that the quality expressed is naturally associated with that noun. Thus, manipulating

the order of the adjective and noun in our experiment could lead to differences in the standard constructions of Adj-N sentences (congruent sentences in our study) and N-Adj sentences (incongruent sentences in our study). Nevertheless, these possible differences in standardness between Adj-N and N-Adj sentences do not lead to differences in comprehensibility. For example, Ruiz et al. (2008) showed that comprehensibility judgements of sentences on a 5-point scale (1-easy to understand, 5-hard to understand) were similar in Adj-N sentences ($M = 2.40$) and N-Adj sentences ($M = 2.36$) ($p > .05$). Importantly, Ruiz et al. revealed that although the comprehensibility of Adj-N and N-Adj sentences were similar, the reading times of SL-TL syntactically congruent (Adj-N) sentences were lower than those of incongruent (N-Adj) sentences. Thus, we did not consider that possible differences in the standard and/or the semantic connotations associated with the adjective-noun compounds (N-Adj and Adj-N order) had a negative impact on the processing of sentences since previous studies show that both compounds are used in a flexible manner and modulate the comprehension of sentences depending on the syntactic congruency between the SL and the TL (Ruiz et al., 2008).

Therefore, in our study, congruent sentences between English and Spanish were constructed by placing the adjective before the noun in both antecedents (joven sobrino, simpática casera/*young nephew*, *nice landlady*; in Spanish and English, respectively), while in the incongruent version, the adjective was presented after the noun in Spanish (*sobrino joven*, *casera simpática*/*young nephew*, *nice landlady*; in Spanish and English respectively). Thus, for each attachment condition (low, high, and ambiguous) there were two word order conditions (congruent and incongruent). Finally, the sentences were divided into three regions for the purpose of analysis (initial, middle, and final). The first two regions comprised of an antecedent followed or preceded by an adjective, depending on the congruency condition. Thus, the initial region consisted of the first antecedent and an adjective; the middle region contained both the second antecedent and an adjective, and the final region only included the last word of the sentence (an adjective).

Table 3

Example of experimental sentences used in the study

Condition	Sentence
High-Congruent	*Almudena llamó **al joven sobrino** de **la simpática casera** que fue a Barcelona cuando estaba **casado*** (Almudena called the young nephew of the nice landlady who went to Barcelona when he was married).

High-Incongruent	*Almudena llamó* **al sobrino joven** *de* **la casera simpática** *que fue a Barcelona cuando estaba* **casado** (Almudena called the young nephew of the nice landlady who went to Barcelona when he was married).
Low-Congruent	*Almudena llamó* **al joven sobrino** *de* **la simpática casera** *que fue a Barcelona cuando estaba* **casada** (Almudena called the young nephew of the nice landlady who went to Barcelona when she was married).
Low-Incongruent	*Almudena llamó* **al sobrino joven** *de* **la casera simpática** *que fue a Barcelona cuando estaba* **casada** (Almudena called the young nephew of the nice landlady who went to Barcelona when she was married).
Ambiguous-Congruent	*Almudena llamó* **a la joven sobrina** *de* **la simpática casera** *que fue a Barcelona cuando estaba* **casada** (Almudena called the young niece of the nice landlady who went to Barcelona when she was married).
Ambiguous-Incongruent	*Almudena llamó* **a la sobrina joven** *de* **la casera simpática** *que fue a Barcelona cuando estaba* **casada** (Almudena called the young niece of the nice landlady who went to Barcelona when she was married).

Note. All the sentences were presented in Spanish. Critical words are in bold. English translations are given in brackets. High: The final region of the sentence agrees with the first antecedent. Low: The final region of the sentence agrees with the second antecedent. Ambiguous: The final region of the sentence agrees with both antecedents. Congruent: Antecedents with same word order (Adj-N) in Spanish and English. Incongruent: Antecedents with different word order in Spanish (N-Adj) and English (Adj-N).

To make certain that the two antecedents of each experimental sentence were similar in lexical properties, thus preventing the participants' bias towards attachment preferences, all the antecedents were animated and their lexical frequency in Spanish (per one-million count, Alameda & Cuetos, 1995) and English (per one-million count, Brysbaert & New, 2009), word length (number of letters in each word), and word gender were controlled. We found no significant statistical difference between the first antecedent ($M = 7.75$, $SD = 2.20$) and the second one in word length in Spanish ($M = 7.57$, $SD = 2.04$), $t(59) = 0.53$, $p = .60$ ($BF_{01} = 6.18$, $BF_{10} = 0.16$). Similarly, no statistical difference was found between the first antecedent ($M = 45.66$, $SD = 133.98$) and the second one ($M = 32.24$, $SD = 71.39$) in word frequency in the same language, $t(59) = 0.68$, $p = .50$ ($BF_{01} = 5.66$, $BF_{10} = 0.18$). Likewise, no significant differences were found in English either for word length between the first antecedent ($M = 7.52$, $SD = 2.65$) and the second one ($M = 6.80$, $SD = 2.18$), $t(59) = 1.51$, $p = .14$ ($BF_{01} = 2.43$, $BF_{10} = 0.41$) or the word frequency of the first antecedent ($M = 62.03$ $SD = 106.48$), and the second one ($M = 62.83$, $SD = 137.49$), $t(59) = 0.03$, $p = .97$ ($BF_{01} = 7.07$, $BF_{10} = 0.14$).

We also analyzed the emotional value of both antecedents for valence and arousal in Spanish (Fraga et al., 2018), and English (Warriner et al.,

2013). Since the gender of the first antecedent was manipulated to obtain two different sentence versions where both antecedents either were in a same gender (ambiguous sentences) or a different one (unambiguous sentences), we analyzed valence and arousal in both versions separately. Regarding the analysis of valence in Spanish sentences, there were no significant differences between the first antecedent ($M = 5.88$, $SD = 1.13$) and the second one ($M = 5.53$, $SD = 1.26$) in ambiguous sentences, nor between the first antecedent ($M = 6.14$, $SD = 1.02$) and the second antecedent ($M = 5.66$, $SD = 1.23$) in unambiguous sentences (all ps > .05). Analyses for valence in English did not show any significant difference between the first antecedent ($M = 5.78$, $SD = .91$) and the second one ($M = 5.62$, $SD = 1.21$), $t(49) = 0.93$, $p = .35$. Similarly, the analysis for arousal in Spanish showed no significant differences between the first antecedent ($M = 5.12$, $SD = .87$) and the second one ($M = 5.33$, $SD = 0.73$) in ambiguous sentences, nor between the first antecedent ($M = 5.10$, $SD = .66$) and the second one ($M = 5.20$, $SD = .78$) in unambiguous sentences (all ps > .05). The analyses for arousal in English showed a significant difference between the first antecedent ($M = 3.95$, $SD = .72$) and the second one ($M = 4.38$, $SD = 0.79$), $t(49) = -2.74$, $p = .00$.

Note, however, that this difference in the arousal of the English nouns was not problematic since it guides towards the preferred attachment preference in the TL (English), which would favor the evaluation of TL attachment strategy activation during the comprehension of the SL.

The percentages of feminine nouns (52%) and masculine nouns (48%) of the first antecedent were similar to the percentages of feminine (45%) and masculine nouns (55%) of the second antecedent, $\chi^2 = .98$, $p = .32$.

Each participant saw 120 experimental sentences divided into two blocks of 60 sentences. Participants were instructed to read and repeat the sentences in one block and to read and translate them in the other block. The order of these two blocks (reading for repetition, reading for translation) was counterbalanced across participants while the sentence order remained the same in both blocks. Nevertheless, participants neither read any sentence twice nor were they biased towards the same interpretation of the sentence because the version was different in each block and each version favored a different type of attachment. To make sure participants were reading the sentences to comprehend them, 20 non-ambiguous filler sentences were created and included in each block of trials randomly intermixed with experimental sentences. The filler sentences, which shared a similar structural complexity to that of the experimental sentences without adjectives, were followed by a true or false verification question. To avoid predictability of the type of question in the filler sentences, these questions dealt with contents located in different regions of the sentence. Regarding the

experimental sentences, we decided to use binary choice questions focused on the RC because it is the procedure used in previous works as a mean to know the reader's interpretation of the RC in ambiguous sentences (e.g., with offline measures, Togato et al., 2017; with online measures, Jegerski et al., 2016). The number of filler trials was determined by the balance between (a) obtaining a good number of experimental observations (sentences) for each treatment considered in the study, and (b) avoiding possible fatigue of the participants by having to repeat/translate a total of 160 sentences throughout the two blocks of the experiment.

Procedure. At the beginning of each block, participants were instructed to read and repeat the sentences in Spanish or to read and translate them into English, depending on the block. The order of the reading tasks (for repetition block and reading for translation block) was counterbalanced across participants. As in previous studies that dealt with translation tasks (Macizo & Bajo, 2006b; Ruiz et al., 2008), the moving window methodology was used (Just et al., 1982). E-prime experimental software was used for stimulus presentation and data acquisition (Schneider et al., 2002). The participants read the sentences word-by-word at their own pace by pressing the space bar to see the next word of the sentence. Afterwards, when the participants finished reading a sentence, the word *TAREA* (*task,* in English) appeared in the middle of the screen which indicated to the participants that they had to repeat or to translate the sentence, depending on the task. Once finished with the production task, the participants completed the verification task, in which the word *VERIFICACIÓN* (*verification*, in English) appeared in the middle of the screen, followed by a reading comprehension question. To answer this question, the participants had to identify the subject of the RC. Both antecedents were provided as alternatives in the experimental sentences (see Table 4) while in the filler sentences, the participants had to choose *Sí* or *No* (*yes* or *no*, in English) to answer the questions (see Table 5). The two response alternatives were randomly presented on the left and right side of the screen. Finally, after answering the question, participants had to press the space bar again to start reading the next sentence. All oral productions were recorded using an ICD-SX1000 Sony Digital Voice Recorder for later analysis.

Table 4

Example of experimental sentence with its verification question

Ambiguous-Congruent	*Almudena llamó a la joven sobrina de la simpática casera que fue a Barcelona cuando estaba casada* (Almudena called the young niece of the nice landlady who went to Barcelona when she was married).

Reading Comprehension Question	*¿Quién fue a Barcelona?* (Who went to Barcelona?)
Answers	*La sobrina – La casera* (The niece – The landlady)

Note. English translation is given in brackets.

Table 5
Example of filler sentence with its verification question

Filler Sentence	*El grupo fue a comprar unas cosas y luego volvió a su campamento que quedaba a tres kilómetros del pueblo* (The group went to buy some things and then returned to their camp which was three kilometers away from town).
Reading Comprehension Question	*El campamento estaba en el pueblo* (The camp was in town).
Answers	A. *Sí – No* (Yes – No)

Note. English translation is given in brackets.

Analyses. As mentioned previously, online and offline measures were taken into account in our study. The online analyses of the SL comprehension involved the RTs of all three regions. Thus, the type of task effect (reading for repetition vs. reading for translation) and the syntactic structure effect (congruent vs. incongruent) were examined in all three regions. Furthermore, we also conducted analyses on the type of attachment (high attachment, low attachment). However, only the final region was considered in the type of attachment analyses because this was the only region that disambiguated towards one of the antecedents, unlike the initial and middle regions. In the type of attachment analyses, we addressed whether the final region of the sentence (an adjective) agreed with either the first or second antecedent (high or low attachment, respectively), thus excluding sentences in the ambiguous condition because the adjective at the end of these sentences was congruent with both the first and second antecedent and did not reflect the type of attachment chosen by the participants at the end of the online reading. Faster RTs in the high attachment condition compared with the low attachment one at the final region would indicate that the participants had chosen the first antecedent as the subject of the relative clause, before reaching the end of the sentence. On the contrary, faster RTs in the low vs. high attachment condition would show that participants selected the second antecedent as the subject of the relative clause.

The offline comprehension analyses included the type of task (reading for repetition, reading for translation), the syntactic structure (congruent and incongruent sentences), and the alternative chosen to answer the verification

task, which was considered as the attachment strategy (high or low) used by the participants to interpret the sentences. The high and low attachment conditions were not considered in these analyses because unlike the ambiguous condition, there was only one correct alternative to answer the verification questions and, therefore, they would not provide information about the activation of the TL processing strategies. That is, disambiguation was forced by the gender of the adjective at the final region in the high and low attachment conditions, which means that only one of the two alternatives provided in the verification task agreed with the adjective. The only correct choice for the high attachment sentences was the first antecedent while the second was the only correct answer for the low attachment sentences.

RESULTS

Online comprehension difficulty was assessed by taking into account the RTs of the critical words in the sentences. The overall quality of the orally produced sentences was evaluated by the first author of this work (early bilingual with high proficiency in Spanish and English). The scoring system ranged from 0 to 5 where 0 indicated no produced answer, 1- very poor production, and 5 - very good production (see Ruiz et al., 2008). The scoring system for the repetition task measured the degree of similarity between lexical and syntactic forms of the output and those of the input. The scoring system for the translation task measured the degree of similarity between the lexical and syntactic forms of the input and the ones of the output as well, but it also evaluated the congruity between the meaning of the sentences in the SL and their translation in the TL. The sentences marked 3 or higher in both tasks were included in the analyses (see Table 6 for examples). A total of 81.6% of the sentences were included in the analyses of the reading for repetition task, while 77.5% were included in the analyses of the reading for translation task.

Table 6

Example of scores for correct oral productions

Example sentence		
Spanish	English	
El cura susurró algo a la tía delgada de la novia encantadora que se sentó fuera cuando se sintió mareada.	The priest whispered something to the thin aunt of the lovely bride who sat outside when she felt dizzy.	
Reading for Repetition	Reading for Translation	Score
El cura susurró algo a la tía delgada de la novia encantadora que se sentó fuera cuando se sintió mareada.	The priest whispered something to the thin aunt of the lovely bride who sat outside when she felt dizzy.	5

El cura le dijo algo a la tía de la novia encantadora que se sentó fuera cuando se mareó.	The priest said something to the aunt of the charming bride who sat outside when she wasn't feeling well.	4
Alguien le dijo algo a la tía de la novia que se sentó fuera cuando se mareó.	Someone said something to the aunt of the bride who sat outside when she wasn't feeling well.	3

Note. The scoring system fluctuated from 0 to 5 (5 = Very good production, 0 = no answer). Sentences marked 3 or higher were considered correct and included in the analyses.

The mean RTs for correctly produced sentences in each task and condition were computed and submitted to analyses of variance (ANOVA) with participants (F_1) and items (F_2) as random factors. With the aim of making our results comparable to those reported by Ruiz et al. (2008, p. 496), the RTs which were two standard deviations above the participant's mean for the critical words were replaced with the participant's mean for that word (4.9% of the data). The results were divided into two different sections. In the first section, we reported the online results by sentence region (initial region, middle region and final region), and in the second section, we presented the results of the attachment preferences.

Online results. *Initial Region.* An ANOVA was conducted on the average RTs of the critical words (the noun and the adjective of the first antecedent), with type of reading (reading for repetition, translation) and syntactic structure (congruent structure, incongruent structure) as within-participants factors. The results revealed that the type of reading effect was marginal by participants, $F_1(1, 23) = 3.74$, $p = .07$, $\eta_p^2 = .14$, but significant by items, $F_2(1, 58) = 19.62$, $p < .001$, $\eta_p^2 = .25$. Reading for translation was slower ($M = 823$ ms, $SE = 87$) than reading for repetition ($M = 720$ ms, $SE = 70$). Also, a significant main effect of syntactic structure was found, $F_1(1, 23) = 7.75$, $p < .001$, $\eta_p^2 = .25$, $F_2(1, 58) = 7.58$, $p < .001$, $\eta_p^2 = .12$. Participants were faster at reading the critical words of the initial region in the congruent condition ($M = 747$ ms, $SE = 61$) compared with the incongruent condition ($M = 796$ ms, $SE = 79$). Finally, the Type of reading x Syntactic structure interaction was not significant (F_1 and $F_2 < 1$).

Middle Region. In the identical manner as in the initial region, an ANOVA was conducted on the average RTs of the critical words (this time, the noun and the adjective of the second antecedent), with type of reading (reading for repetition, reading for translation) and syntactic structure (congruent structure, incongruent structure) as within-participants factors. The main effect of type of reading was not significant by participants, $F_1(1, 23) = 1.04$, $p = .32$, $\eta_p^2 = .04$, but it was by items, $F_2(1, 58) = 4.16$, $p < .001$, $\eta_p^2 = .07$. The mean RTs in the reading for translation was $M = 870$ ms (*SE*

= 85) and it was $M = 822$ ms ($SE = 87$) in the reading for repetition. A significant effect of syntactic structure was found, $F_1(1, 23) = 8.90$, $p < .001$, $\eta_p^2 = .28$, $F_2(1, 58) = 4.75$, $p < .001$, $\eta_p^2 = .08$. The critical words were read faster in the congruent condition ($M = 824$ ms, $SE = 24$) in comparison with the incongruent condition ($M = 873$ ms, $SE = 24$). No significant effect was found for the Type of reading x Syntactic structure interaction (F_1 and $F_2 <$ 1).

Final Region. An ANOVA was performed on the average RTs of the final word of the sentences which had to be attached to one of the antecedents, with type of reading (reading for repetition, translation), syntactic structure (congruent structure, incongruent structure), and type of attachment (high, low) as within-participants factors. No main effects or interactions between variables were significant in this region (Fs_1 and $Fs_2 < 1$). The mean RTs in each condition are reported in Table 7.

Table 7

Mean reading times

	Reading for Repetition		Reading for Translation	
	Initial Region			
Congruent	704 ms (48)		789ms (57.24)	
Incongruent	736 ms (52)		856 ms (68.29)	
	Middle Region			
Congruent	804 ms (60)		852 ms (60)	
Incongruent	841 ms (64)		888 ms (63)	
	Final region			
	High Attachment	Low Attachment	High Attachment	Low Attachment
Congruent	1193 ms (151)	1143 ms (150)	1252 ms (186)	1273 ms (146)
Incongruent	1267 ms (180)	1123 ms (118)	1482 ms (308)	1332 ms (253)

Note. Standard errors are reported in parentheses.

Offline Results. *Attachment Preferences.* We computed the percentage of low attachment preference when participants processed the ambiguous sentences and, afterwards, an ANOVA was carried out with type of reading (reading for repetition, translation) and syntactic structure (congruent structure, incongruent structure) as variables. The results revealed a significant main effect of the type of reading, $F_1(1, 23) = 11.04$, $p < .001$, $\eta_p^2 = .32$, $F_2(1, 58) = 23.77$, $p < .001$, $\eta_p^2 = .29$. The percentage of low attachment preference was higher in the reading for translation task ($M = 79.70\%$, $SE = 3.44$) than in the reading for repetition ($M = 66.35\%$, $SE = 3.86$). The syntactic structure effect was marginal, $F_1(1, 23) = 4.06$, $p = .06$, $\eta_p^2 = .15$, $F_2(1, 58) = 3.65$, $p = .06$, $\eta_p^2 = .06$. The percentage of low

attachment preference was higher in the congruent sentences ($M = 76.07\%$, $SE = 3.56$) than in the incongruent sentences ($M = 69.98\%$, $SE = 3.26$). The Type of reading x Syntactic structure interaction was not significant (F_1 and $F_2 < 1$).
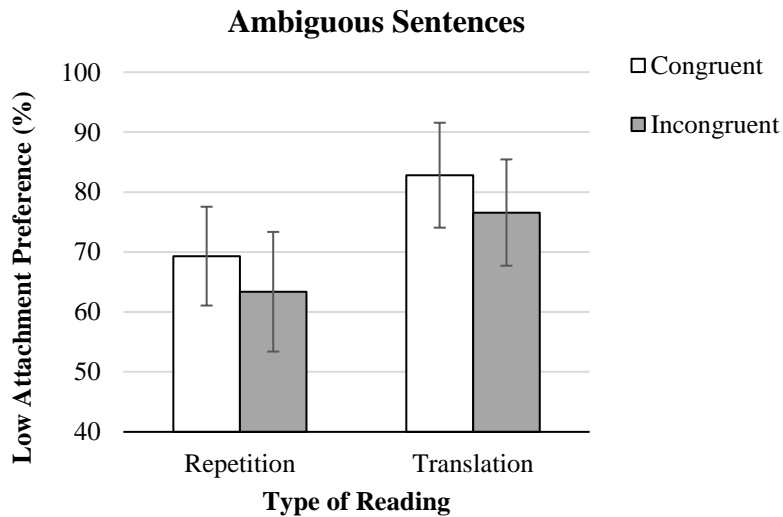
Ambiguous Sentences

Figure 1. Low attachment preference percentages in ambiguous sentences obtained in both types of reading (reading for repetition, translation) as a function of the syntactic structure (congruent, incongruent). Error bars represent 95% Confidence Intervals.

DISCUSSION

The goal of the present study was to investigate conjointly the activation of TL syntactic representations and TL attachment strategies during comprehension in translation, and to explore possible interactions between both syntactic aspects. According to the *Horizontal/Parallel View* of translation (Danks & Griffin, 1997; Gerver, 1976; Macizo & Bajo, 2007), the processing of both the SL and TL in translation occurs simultaneously. This view advocates that the TL lexical and syntactic properties are active while comprehension of the SL is taking place, and, moreover, it holds that a search for SL and TL equivalents occurs (reformulation process) before complete comprehension of the original message has been achieved. Therefore, this view of translation defends code-to-code links between the SL and TL, and the co-activation of both languages during SL comprehension. In the current study, we looked for possible interactions between the SL and the TL at the syntactic level of processing with online

and offline measures. We predicted slower RTs in the reading for translation task in comparison with the reading for repetition task; activation of the TL syntactic properties (syntactic structure and attachment strategies) which would be reflected in faster RTs in the congruent condition vs. the incongruent condition and a more frequent TL attachment strategy (low attachment) compared to the SL preferred strategy (high attachment); and finally, a possible interaction between both syntactic factors when reading for translation, which would be reflected by a higher use of the preferred attachment strategy in the TL compared to the preferred one in the SL. Below, we discuss the online and offline comprehension results.

Online comprehension in translation. Regarding online measures, we manipulated the syntactic structure of the sentences in the initial and middle regions of the sentence. In the final region, we considered whether the last word corresponded to high vs. low attachment in complex NP ($NP_1+ NP_2$) with a RC. The syntactic structure manipulation involved the congruency in word order (adjective and noun) of the first and the second antecedent in the SL (Spanish) and the TL (English). The type of attachment manipulation consisted of varying the gender of the last word of the sentences so it matched only one of the antecedents (high or low attachment).

The results obtained in the initial and middle regions of the sentences revealed a type of reading effect and a syntactic facilitation effect. Thus, reading for translation was slower than reading for repetition and the congruent sentences were read faster than the incongruent ones. The longer RTs obtained in the reading for translation task have been confirmed in several previous studies (Macizo & Bajo, 2006b; Ruiz et al., 2008) and could be an indicator of the additional time needed for TL activation and the search for SL-TL syntactic equivalences as suggested by the *Horizontal View* of translation (Macizo & Bajo, 2007). On the other hand, the syntactic facilitation effect was found in the initial and middle regions of the sentence in the current study. As we mentioned previously, even though both N-Adj and Adj-N word orders are allowed in Spanish, the latter is less common and, thus, considered marked. The fact that facilitation effects were found in the congruent condition, despite being the marked word order in Spanish, suggests potential TL modulation of the comprehension of the SL during reading for translation. Nonetheless, that result differed from the one obtained in Ruiz et al. (2008), in which the authors observed a marginal syntactic congruency effect at the beginning of the reading for translation that became significant in the middle region. It is possible that the different pattern of results between both studies was due to the location of the syntactic manipulation (Adj-N and N-Adj word order) at the beginning of the sentence. In Ruiz et al. (2008), this manipulation was implemented in the second word

of the sentence while, in the current study, there were at least a minimum of four words before the participants encountered the first antecedent that constituted the initial region. From the perspective of the translation task in our study, the number of words before the initial region would allow a minimal unit of the sentence to be understood before encountering the initial region. Therefore, TL activation and the reformulation process could have started by the time the participants read the initial region and continued when reading the middle region. This observation agrees with the standard principles in translation theory in which it is suggested that a minimum piece of information has to be understood in the SL before between-language reformulation takes place (Goldman-Eisler, 1972).

Nevertheless, the syntactic congruency effect was not found in the final region of the sentence. Similarly, Ruiz et al. (2008) did not observe differences between the processing of syntactically congruent and incongruent structures at the end of the reading for translation. This absence of a syntactic structure effect might be a consequence of the activation time course of the TL representations. Specifically, it is plausible that by the time the final word of the sentence was read, the activation course of the syntactic representation might have reached its threshold and such representation was then available to be used; demanding, thus, less cognitive resources for structural processing. Moreover, those resources could have been assigned to other comprehension processes such as the wrap-up mechanisms associated with online organizational and integrative semantic processing at the sentence boundaries; and most importantly, with increased RTs at the end of a sentence in comparison to the reading of other parts (Stowe et al., 2018; Warren et al., 2009, for a review).

In addition, the wrap-up effect might also explain the absence of the type of attachment effect at the final region, where no differences were found between the RTs in the low attachment and high attachment condition. We mentioned earlier that the final region was comprised of an adjective whose grammatical gender agreed with the first antecedent (NP$_1$/high attachment) or the second antecedent (NP$_2$/low attachment). We predicted that faster RTs in the final region in the high attachment condition compared with the low attachment one would indicate that the participants had chosen the NP$_1$ as the subject of the RC before reaching the end of the sentence, whereas faster RTs in the low attachment condition compared with the high attachment one would suggest that participants had selected the NP$_2$ before reaching the final region and, thus, they had employed a low attachment strategy.

The absence of online attachment preference has already been observed in Spanish-English bilinguals in Fernández (2003), which seemed to indicate that bilinguals use an amalgamation mechanism to process syntactic

information across their languages by using a combination of strategies from both (Morett & MacWhinney, 2013). Nevertheless, the age of onset of bilingualism was not controlled in Fernández (2003), contrarily to posterior studies with late Spanish - English bilinguals who showed online preference for low attachment (Dussias, 2003, 2004; Dussias & Sagarra, 2007) and early bilinguals who showed high attachment preference (Jegerski, Keating et al., 2016). As we mentioned earlier, those studies were conducted within the framework of the Tuning Hypothesis which suggests that in case of ambiguity, the amount of language exposure will modulate the interpretation of the sentence based on the language the individual has been more exposed to.

Hence, neither the Tuning Hypothesis nor the age of onset of bilingualism can account for the absence of the type of attachment effect in the final region of the current study. That is because (1) the online results at the final region did not reflect the preference favoured by either past language exposure (17.63 months living in an English speaking country) or current language exposure (they were all living in Spain by the time they participated in the experiment), and (2) the participants did not show the attachment preference (high) that would be favoured by their age of onset of bilingualism (5.75 years, early bilinguals).

There are, however, two factors which can account for the absence of the online type of attachment effect. The first one is the wrap-up effect that we mentioned earlier, and the second one is the moving-window methodology used in the experiment. With regard to the second one, reading sentences word-by-word could have overridden any influence of prosodic breaks in the interpretation of the relative clause because the sentences were read in segments, which in turn, would have prevented the participants from making one of the prosodic breaks.

Nevertheless, it is also likely that the attachment preference effect was simply not observed by the online measure, as was the case in some previous studies where an online attachment preference was absent in the critical region but appeared either later on or only in the offline measures (Costa et al., 2006; De Vincenzi & Job, 1995; Dussias, 2003; Gibson et al., 1996; Gibson et al., 1999; Kamide & Mitchell, 1997; Pynte et al., 2003; Jegerski, 2018).

Offline comprehension in translation. In our study, we obtained offline comprehension measures through the verification task at the end of the reading process. The results obtained in this task confirmed those found by Togato et al. (2017) in the reading for translation. That is, a higher percentage of low attachment was found in ambiguous sentences when

participants read for translation compared to the reading for repetition task. This pattern of data suggests that the attachment preference (low attachment) in the TL (English) was also available to be used after the participants finished reading the sentences in the SL (Spanish).

The use of TL strategies during reading for translation has been observed in previous studies with other types of syntactic cues. For example, in a study conducted by Ruiz and Macizo (2018, Experiment 3), Spanish (L1)-English (L2) bilinguals had to read two nouns (N) and one verb (V) in Spanish (SL) either to produce a sentence in Spanish or to translate and produce a sentence in English. The critical condition was that in which participants saw a VNN structure because it creates competition between Spanish and English. In particular, English monolinguals have a defined preference for the second noun as the agent of VNN sentences (von Berger et al., 1996) while in non-canonical word order structures (VNN and NNV), the first noun is always marked as the agent by Spanish speakers (Morett & MacWhinney, 2013; Reyes & Hernández, 2006). The results revealed that the participants interpreted and produced sentences as native Spanish speakers in the within-language task, while they performed as native English speakers in the translation task. Thus, the use of syntactic cues and attachment preferences depended on the task the participants performed (within vs. between-language tasks).

On the other hand, in our study, we examined for the first time whether SL-TL syntactic congruency determined the attachment preference chosen by the participants in ambiguous RCs. The results revealed that the low attachment preference was higher in the congruent version of the sentences (76%) than in the incongruent version (70%), which shows that when the word order between the SL and TL was congruent, participants chose the attachment strategy preferred in the TL (low attachment in English). Notwithstanding, the type of structure effect was only marginal and, thus, does not reflect a clear influence of the TL syntactic structure on the attachment preference. Thus, further research is needed on the subject to resolve that ambiguity.

The inspection of the results reported in Figure 1 shows that, although the preference for low attachment (the preferred strategy in the TL, English) was higher in translation than in repetition, the percentage of choosing the second antecedent as the subject of the RC was greater than 50% of the time in the repetition task. Since the repetition task was performed in Spanish, at first glance, this pattern of results would argue against the idea that Spanish is a high attachment language. However, the participants in our study were bilinguals, native speakers of Spanish and fluent in English as a second language, and previous studies show that Spanish-English bilinguals

preferentially use low attachment to interpret ambiguous RCs across their languages (Dussias, 2003). This pattern of results indicates that bilinguals are able to use the syntactic cues preferred in their L2 when understanding sentences in their L1 (i.e., backward transfer, Morett & MacWhinney, 2013).

On the other hand, earlier studies show evidence that activation of TL syntactic information during SL comprehension is higher when people read to translate vs. repeat sentences. For instance, Togato et al. (2007) found greater preference for the preferred attachment strategy in the TL when translating vs. repeating sentences. Thus, in our study, we predicted that the low attachment preference would be determined by an interaction between task and syntactic congruency (i.e., greater low attachment in syntactically congruent vs. incongruent sentences in translation compared to repetition). However, the magnitude of the syntactic congruency effect was independent of the task. One possible explanation for this pattern of results stems from the type of participants across studies. Togato et al. (2017) evaluated professional interpreters with an average translation experience of 4.85 years. In contrast, the participants in our study were fluent bilinguals but without training or professional experience in translation tasks. Grosjean (1997) proposed that bilingual language activation depends on different factors such as the context or the task they perform (language mode hypothesis). Due to their professional training, translators could flexibly adapt to the type of task by preferentially adopting a bilingual mode (L1 and L2 activation) during comprehension for translation and a monolingual mode (L1 activation) when comprehending for repetition. On the contrary, the bilinguals tested in our study opted for a bilingual mode by default and would not be sensitive to the type of task (repetition vs. translation).

To sum up, this study provides evidence for TL activation at different syntactic levels during the comprehension of ambiguous RCs in a translation task. The results suggest that the higher the number of active TL syntactic properties, the stronger the TL activation and interpretation of sentences according to the TL interpretation will be. In addition, the results are in line with the *Horizontal/Parallel View* of translation which suggests simultaneous activation and processing of both the SL and the TL during SL comprehension.

RESUMEN

El objetivo de nuestra investigación era estudiar la coactivación de la representación de estructuras sintácticas y de estrategias de adjunción de la lengua meta (LM) durante la traducción, y explorar una posible interacción

entre ambas. Con tal fin, participantes bilingües español (L1) – inglés (L2), debían leer en español oraciones de relativo ambiguas con doble antecedente para luego repetirlas en la misma lengua o traducirlas al inglés. La última palabra de las oraciones, así como la congruencia sintáctica de las mismas entre ambas lenguas fueron manipuladas. Los resultados mostraron coactivación de ambas propiedades sintácticas de la LM: los participantes interpretaron las oraciones mayormente según la estrategia preferida en la LM (adjunción baja) en la tarea de lectura para traducción, leyeron más rápido las oraciones congruentes, y utilizaron más la estrategia preferida en la LM en la versión congruente de las oraciones. Estos resultados sugieren activación de la LM en diferentes niveles sintácticos durante la compresión de la lengua fuente (LF) en la traducción.

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