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Lexico-syntactic interactions in the resolution of relative clause ambiguities in a second language (L2): The role of cognate status and L2 proficiency

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There is extensive evidence showing that bilinguals activate lexical representations in a non-selective way both when words are presented in isolation and in sentence contexts. Recent research has shown the existence of cross-language activation at the syntactic level as well. However, the extent to which the lexical and syntactic levels of representation interact during second language (L2) sentence processing, and how these interactions are modulated by L2 proficiency remain unclear. In this paper, we explore how native speakers of European-Portuguese (L1) who are learning English as an L2 at different levels of proficiency (intermediate vs. advanced) resolve relative clause (RC) syntactic ambiguities in their L2. European Portuguese and English native speakers were used as controls. Participants were asked to perform a sentence completion task, with cognates and noncognates critically embedded in the complex noun phrase (NP) preceding the RC, and which contained its antecedent. Results revealed that L2 learners, like English controls, preferred to attach the RC to the last host of the complex NP, regardless of L2 proficiency. Importantly, the cognate status of the complex NP modulated the results, although, contrary to our expectation, the presence of cognates induced less L1 syntax interference compared to noncognates.

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Over the last decades, a prominent line of research in Psycholinguistics has been devoted to second language (L2) acquisition, representation, and processing. Indeed, in today's globalized world, where the majority of people are able to communicate in more than one language, studying the processes and mechanisms that underlie the internal organization and the functional architecture of the bilingual mind is an increasingly important issue for bilingual and L2 acquisition research. Learning and mastering an L2 is a very complex process that goes beyond the mere recognition of individual words. It involves combining them into larger linguistic units (e.g., phrases, sentences) according to a specific set of rules (grammar) that may differ substantially across languages. However, the vast majority of studies conducted over the last 20 years have focused essentially on investigating how bilinguals access and/or retrieve individual words from their mental lexicon (Kroll, Dussias, Bice, & Perrotti, 2015, for a recent review), (see note 1), mostly through the use of translation equivalents that share orthography and/or phonology across languages (i.e., cognate words such as *atriz*[actress] in European Portuguese[EP] and English, respectively).

The massive study of these words (e.g., Comesaña, Soares, Sánchez-Casas, & Lima, 2012; Comesaña et al., 2015; Dijkstra, Grainger, & Van Heuven, 1999; Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010; Pureza, Soares, & Comesaña, 2016) has provided strong evidence for the fact that when a bilingual is processing words in one language, the other language is inevitably activated. The formal (orthographic and/or phonological) and semantic overlap of cognates across languages gives rise to the so-called *cognate effect*, i.e. the fact that cognates are processed faster and more accurately than noncognates (i.e., translation equivalents that share meaning but not form across languages, as in *criada*[maid] in EP and English, respectively). This facilitation effect, observed in the majority of studies (see, however, Comesaña, Sánchez-Casas et al., 2012; Comesaña et al., 2015, and Dijkstra et al., 2010 [Experiment 2] for reversed effects), has been interpreted as evidence of the simultaneous activation of the lexical and/or conceptual representations of these words in the bilingual mind, speeding up their recognition and processing (see Dijkstra et al., 2010 for a review of different theoretical proposals in accounting for the cognate effect).

The cognate facilitation effect has been observed not only when cognates are presented in isolation (e.g., Dijkstra et al., 1999, 2010), but also when they are embedded in sentence contexts, although the kind of semantic information provided by the sentence seems to modulate the emergence of the effect (e.g., Bultena, Dijkstra, & Van Hell, 2014; Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Schwartz & Kroll, 2006; Van Hell & De Groot, 2008). Specifically, in sentences in which the semantic information provided

before a given critical word (cognate vs. noncognate) is strong enough to allow for a reliable prediction of an upcoming word (i.e., high-constraint sentence), the cognate effect does not emerge. However, in sentences in which several words can close the sentence in similarly plausible ways (i.e., low-constraint sentences) the cognate effect emerges due to strong cross-language activation (see, however, Van Assche, Drieghe, Duyck, Welvaert, & Hartsuiker, 2011 for a recent eye-tracking study showing cognate effects both in low and high-constraint sentences).

Furthermore, research has also revealed that the magnitude of the cognate effect in a sentence context is modulated by stimulus properties such as the degree of formal overlap (the higher the overlap, the stronger the effect) (e.g., Duyck et al., 2007; Van Assche et al., 2011), the grammatical class of the cognate words used (e.g., stronger effects for nouns than verbs – e.g., Bultena et al., 2014; Van Hell & De Groot, 2008), and also by other variables such as participants' L2 proficiency (stronger effects in less proficient bilinguals – e.g., Bultena et al., 2014; Van Assche et al., 2011), task demands and/or the sensitivity of the behavioral measures used (e.g., Bultena et al., 2014; Duyck et al., 2007; Van Hell & de Groot, 2008; Van Assche et al., 2011).

However, despite these recent efforts to study L2 representation and processing beyond the single-word level, the focus of the above-mentioned studies continues to lie on the lexical domain. Indeed, researchers are mainly interested in analyzing whether the facilitation effect observed for cognates presented in isolation persists when they are presented in sentence contexts (see Van Asshe, Duyck, & Hartsuiker, 2012 for a recent review), neglecting the impact that they can have on other levels of processing. Indeed, reading is much more complex than recognizing individual words. To comprehend a sentence, readers should also conduct a syntactic analysis known as parsing that involves identifying the syntactic role that each word plays in the sentence, and constructing a syntactic structure that captures the relationships between those words in the sentence in order to extract meaning. Although languages do not vary randomly, each language has its own rules to arrange and combine words into sentences (i.e., a grammar), which affects the way native speakers process and comprehend sentences in their own language. For instance, studies on syntactic-ambiguity resolution involving a relative clause (RC) preceded by a complex noun phrase (NP), as in the famous "Someone shot the maid of the actress who was on the balcony" sentence from Cuetos and Mitchell (1988) work, have shown that native speakers differ considerably in the way they resolve this ambiguity across languages (see Fernández, 2003 for a review). Note that, in constructions like this, there are two potential ways to resolve the ambiguity. It is possible to attach the RC

"who was on the balcony" to the first/highest host of the complex NP (i.e., "the maid"), using a high-attachment (HA) strategy, or to attach the RC to the second/lowest host of the complex NP (i.e., "the actress"), using a low-attachment (LA) strategy, thereby leading to different grammatical structures and semantic interpretations. Although variability exists among native speakers in the way they resolve RC ambiguities in a given language (with native speakers showing both an HA and an LA strategy in the same language), studies have shown that, within the same language, the majority of native speakers tend to exhibit a specific preference, which has allowed researchers to characterize languages according to the dominant RC-attachment preference observed. For instance, while native speakers of English tend to associate the RC with the last constituent of the complex NP, thus showing an LA preference to resolve this ambiguity (e.g., Cuetos & Mitchell, 1988; Frazier & Clifton, 1996; Carreiras & Clifton, 1999), this is not the case for EP (Soares, Fraga, Comesaña, & Piñeiro, 2010). In EP, the majority of native speakers prefer to associate the RC to the highest host of the complex NP, thus showing an HA preference instead. Therefore, studying this grammatical structure offers an excellent opportunity to analyze how the human mechanism responsible for assigning a constituent structure to the linguistic input (parser) works in situations in which individuals master languages with different syntactic preferences (such as EP and English). The study presented here aims to address these questions and additionally to explore how the lexical and syntactic levels of representation interact during L2 sentence processing in the bilingual mind, a greatly unexplored issue in the bilingual and L2 acquisition literature.

Similar to the research on bilingual lexical processing, the research on bilingual syntactic processing conducted so far has focused mainly on exploring whether the syntactic representations and mechanisms underlying parsing in bilinguals are shared across languages (see Hartsuiker, Pickering, & Veltkamp, 2004; Hartsuiker, & Pickering, 2008). However, unlike bilingual lexical processing research, where the prevailing view favours a shared-lexicon account, in the bilingual syntax literature the question is more controversial, with some authors arguing that the sentence comprehension mechanism responsible for assigning a given structure to the sentence (syntactic parsing) behaves differently in the L1 and L2 (see Clahsen & Felser, 2006a,b,c; Felser, Roberts, Marinis, & Gross, 2003; Marinis, Roberts, Felser, & Clahsen, 2005; Papadopoulu & Clahsen, 2003; Ullman, 2005). For instance, Clahsen and Felser (2006a), in a review addressing the question of how native-like non-native language processing is, highlighted that, although natives and non-natives do not differ in the processing of morphological information (e.g., past tense of regular verbs), there is a significant difference

in the way they process syntactic information. Specifically, studies involving syntactic ambiguities suggested that the structural information provided by the sentence is largely ignored by bilinguals (i.e., they have less detailed or "shallower" L2 syntactic representations), and that they compensate this "deficit" by relying more on the lexical and semantic information provided, thus showing a more "lexically-driven" sentence processing in their L2 (see also Clahsen & Felser, 2006b,c; Felser et al., 2003; Marinis et al., 2005). According to this view, known as the Shallow Structure Hypothesis (SSH), L1 and L2 parsing is assumed to be qualitatively different across languages, thus making syntactic co-activation hard to find. Note, however, that other authors (e.g., Dekydtspotter & Renaud, 2014; Hopp, 2014; Omaki & Schulz, 2011; Witzel, Witzel, & Nicol, 2012), have suggested recently that the differences observed between L1 and L2 parsing may arise not from grammatical differences or from the mechanisms involved in L1 and L2 sentence processing, but from differences on the cognitive resources available for L2 sentence processing instead (e.g., working memory), which is much more demanding than in the L1. Sentence processing in the L2 might be slower and less automatic than in the L1 but, ultimately, the processes and mechanisms involved in L1 and L2 sentence comprehension might be identical or perhaps shared across languages, as the results obtained from different lines of research over the last decades have suggested.

Research focusing on exploring how the syntactic properties of the L1 affect the syntactic processing of the L2 (a phenomenon known as *language transfer*) has shown that bilinguals often use information from the L1 to construct the syntactic structures of the L2 (e.g., Carreiras & Clifton, 1999; Dussias, 2003; Dussias & Sagarra, 2007; Frenck-Mestre, 1997, 2002; Frenck-Mestre & Pynte, 1997). For instance, in a seminal eye-tracking study with L2 RC sentences, Frenck-Mestre (1997) showed that native speakers of Spanish who were non-proficient learners of French showed an HA preference – note that both languages showed an HA preference. Conversely, native speakers of English who were also non-proficient learners of French showed a trend towards an LA preference (note that in this case there is a mismatch in the RC attachment preference in the two languages). Frenck-Mestre interpreted these results as showing an influence of L1 syntactic preferences over L2 sentence processing, although subsequent studies with highly proficient L2 learners (e.g., Frenck-Mestre, 2002; Felser et al., 2003; Papadopoulou & Clashen, 2003) failed to show this effect. The impact of L1 RC attachment preferences on L2 RC processing seems thus to decline as proficiency increases, which is also consistent with the Competition Model of MacWhinney (2005), which states that, during the first stages of L2 acquisition, learners transfer the grammatical features of the L1 to help them

comprehend and produce L2 structures, but as the level of proficiency increases, the effects of the L1 over the L2 decreases, and L2 learners become more sensitive to the syntactic specificities of the L2 – note, however, that there are also studies showing that strong exposure to the L2 can change the parsing strategies that bilinguals use when processing sentences in their L1 (e.g., Dussias & Sagarra, 2007), in a bilingual reading system that seems to be highly permeable to the influences that can be established over time between the L2 and the L1.

Moreover, research focusing on the extent to which the production of a sentence with a particular structure in one language enhances the production of another sentence with the same structure in the other language, a research line known as *bilingual syntactic priming* (Loebell & Bock, 2003), has also provided strong evidence for an interactive view of syntax in bilinguals. Importantly, syntactic priming effects were observed when none of the items used in L1 and L2 sentences were repeated and in the absence of any thematic similarity between the sentences to be produced (e.g., Bernolet, Hartsuiker, & Pickering, 2009; Cleland & Pickering, 2003). Desmet and Declercq (2006) provided an elegant demonstration of the syntactic nature of this effect using the RC structure with high-proficiency Dutch-English bilinguals, two languages with opposite RC attachment preferences (HA and LA, respectively), as in the case of EP and English. In their experiment, participants were asked to complete ambiguous RC sentence fragments in English (L2), such as "John met the boss of the employees who..." after being exposed to non-ambiguous RC sentences in Dutch (L1) that were disambiguated either with an HA or an LA strategy by the relative pronouns ''*die*'' and ''*dat*'' in sentences such as "*De politie ondervroeg de veroorzaakster van het ongeval die/dat* . . ."[The police interrogated the causer of the accident that . . .]. Note that in that case the Dutch pronoun "*die"* can only refer to the noun associated with the determiner ''*de*'', while the Dutch pronoun "*dat"* can only refer to the noun associated with the determiner ''*het*'', hence forcing the RC to attach to either the first or the second host of the complex NP. Desmet and Declercq (2006) found that participants were more likely to produce an HA RC sentence in English after being exposed to an HA than to an LA RC sentence in Dutch, thus demonstrating not only that the RC structure is shared across languages (even in languages with different attachment preferences), but also that the locus of the effect is syntactic in nature. As Desmet and Declercq (2006) stressed, the syntactic priming effect observed cannot be lexically tied, because the syntactic representation of the two alternative attachments uses the same relative pronouns, so the lexical priming of function words cannot underlie the RC priming effect. Moreover, RCs are true modifiers that cannot be

represented in the argument structure of the lexical entities they modify. Finally, the effect cannot be explained in terms of the activation of context-free phrase structure rules, because representation of the both attachment alternatives were generated by the same set of phrase-structure rules. Therefore, the mental representation that appears to be primed in this case seems to be exclusively syntactic (see also Scheepers, 2003 for similar arguments).

Furthermore, recent studies also suggested that the magnitude of the syntactic priming effect across languages can be boosted if translation equivalents of the same verb are used in the sentences, particularly when the target sentence is produced in the L2 (e.g., "give'' in the English prime sentence and *geven*[give] in the Dutch target sentence vs. ''give'' in the English prime sentence and *verkopen*[buy] in the Dutch target sentence - see Schoonbaert et al., 2007 for details). Schoonbaert et al. (2007) explained this effect based on an extension of the lexical-syntactic model (LS) developed by Hartsuiker et al. (2004) to account for syntactic priming effects in bilinguals. According to Schoonbaert et al., the use of translation equivalents adds semantic activation to the syntactic activation produced by sharing grammatical structure across languages, hence explaining the syntactic priming boost when translation equivalents were used in the prime and target sentences. However, it is important to note that, besides meaning, translation equivalents such as given/*geven*, also share form across languages (i.e., they are cognate words), although the authors did not account for the cognate status of the translation equivalents used in the sentences. Given that cognates are activated faster and more strongly than noncognates, and, additionally, that L2 learners are expected to be more strongly affected by the lexical properties of the items embedded in the sentences (particularly at low levels of L2 proficiency), it is possible that the lexical co-activation generated by the use of cognates vs. noncognates may also affect bilingual syntactic processing. For instance, cognates can boost syntactic processing for shared syntactic structures or, conversely, hamper syntactic processing for structures that are not shared across languages or for structures where there is a mismatch between the syntactic preferences observed in each language, as is the case of the RC structure in EP and English (see however Cai, Pickering, Yan, & Branigan, 2011, for a syntactic priming study showing no advantage of cognates in the magnitude of the syntactic priming effect observed). Moreover, it is also important to note that although the Desmet and Declercq (2006) study showed syntactic priming effects for the RC structure in languages with different RC preferences, this effect was observed in an experimental setting that involved an explicit switch from the production of an L1 to an L2 sentence (L1-L2 switching), as in the majority of syntactic

priming studies, thus leaving open the question of whether this effect can also be observed in the absence of an explicit processing of the L1 sentence in a comprehension paradigm. Furthermore, it did not provide information on how cross-linguistic syntactic effects can be modulated by L2 proficiency (note that Desmet and Declercq used high-proficiency Dutch-English bilinguals) or by the lexical characteristics (i.e., formal overlap) of the translation equivalents used in the experimental sentences (cognates vs. noncognates).

The present work aims to address these questions by exploring how the embedding of cognate vs. noncognate words in the RC structure would affect the way native speakers of EP who are learning English as an L2 with different levels of L2 proficiency (intermediate vs. advanced) resolve RC ambiguities in a sentence completion task. This task was chosen as a first step in exploring cognate effects on L2 RC attachment preferences, since the differences in EP and English preferences have been shown to be more reliable in offline (e.g., sentence completion) than online tasks (e.g., self-paced reading, eye-tracking experiments) (see Soares et al., 2010; Carreiras & Clifton, 1993; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996). In this task participants were asked to provide plausible completions to sentence fragments in which cognates and noncognates were embedded both in the first (N1) and second position (N2) of the complex NPs that preceded the RC to be completed, in an orthogonal manipulation that yielded four experimental conditions: N1 Cognate and N2 Cognate (C-C condition); N1 Cognate and N2 NonCognate (C-NC condition); N1 NonCognate and N2 Cognate (NC-C condition); and N1 NonCognate and N2 NonCognate (NC-NC condition). Note that all these sentence fragments were considered ambiguous because participants could complete the sentences by associating the RC either with the first (N1) or the second (N2) host of the complex NP (which could be a cognate or a noncognate word), by using an HA or an LA strategy, respectively.

With this work, we aim to contribute not only to the study of how L1 RC syntactic preferences affect L2 RC resolutions, but importantly to analyze the extent to which the cross-language activation generated at the lexical level of processing will affect L2 RC resolutions. If the lexical and syntactic levels of representation interact during L2 sentence processing, L2 RC resolutions would be modulated by the cognate status of the complex NPs. Specifically, a cognate interference effect (i.e., more HA than LA completions) was expected in the presence of cognates than noncognates, since cognates would induce strong cross-syntactic competition for RC selection (bear in mind that EP and English showed opposite RC preferences). We also expect to observe stronger cognate interference when the cognate is presented in the first than

the second position of the complex NP, because occupying the first position would induce strong activation of the HA preference typically observed in the L1. Finally, concerning the influence of L2 proficiency, we expect to observe stronger L1 interference in lower than higher levels of proficiency (i.e., more HA completions for intermediate than advanced learners), not only because intermediate learners will be more prone to transfer L1 characteristics to L2 processing than advanced learners, but also because advanced learners will be more efficient in dealing with the cross-activation of the non-target language generated at the lexical level of processing. Thus, for higher levels of proficiency we expect L2 learners to show an English native-like way of resolving L2 RC ambiguities (i.e., more LA than HA preferences).

In order to test these predictions, we conducted two experiments. Experiment 1 was conducted as a previous control study with EP and English native speakers to make sure that the typical HA and LA preferences observed in these languages worked in our experimental materials, hence allowing us to assume HA sentence completions as a mark of L1 syntax interference. Experiment 2 was conducted with two groups of EP native speakers learning English as an L2 at different levels of proficiency (intermediate vs. advanced learners). It is worth noting that the decision to include in this study intermediate instead of novice learners (which could introduce higher proficiency contrasts) was due to the need to make sure that L2 learners would be sensitive to the grammatical structure under study.

GENERAL METHOD

Materials. A set of 48 target sentence fragments with a NP-V-N1-of[*de*]-N2 who/that[*que*]... structure was constructed in English along with their corresponding translations in EP. The subject of the matrix verb was a proper noun or an indefinite subject, and the direct object was a complex NP containing two nouns connected by the genitive marker "of" in English and "*de*" in EP. In each language, the 48 target sentence fragments were assigned to four experimental conditions depending on the cognate status of the two nouns embedded in the complex NPs that preceded the RC (N1-of-N2). Twelve sentence fragments were assigned to the Cognate-Cognate (C-C) condition, where both N1 and N2 are cognate words (e.g., "Britney recognized the guard of the prisoner who…"[*A Beatriz reconheceu o guarda do prisioneiro que…*]); twelve sentence fragments were assigned to the Cognate-NonCognate (C-NC) condition, where N1 is a cognate word and N2 is a noncognate word (e.g., "Bessie had tea with the fan of the singer who…"[*A Bruna foi tomar chá com a fã da cantora que…*]); twelve sentence

fragments were assigned to the NonCognate-Cognate (NC-C) condition, where N1 is a noncognate word and N2 is a cognate word (e.g., "The shopkeepers saw the thieves of the tourists who…"[*Os comerciantes viram os ladrões dos turistas que…*]); and, finally, twelve sentence fragments were assigned to the NonCognate-NonCognate (NC-NC) condition, where both N1 and N2 are noncognate words (e.g., "Molly loved the box of the cake that was…"[*A Maria adorou a caixa do bolo que…*]). The sentence fragments did not contain any other cognate words besides the cognates intentionally embedded in the complex NPs in the C-C, C-NC, and NC-C experimental conditions. Cognate and noncognate animacy in each sentence fragment was also controlled for. Thus, the nouns embedded in the complex NPs for all experimental conditions were both either animate or inanimate (see Desmet, De Baecke, Drieghe, Brysbaert, & Vonk, 2006; and also Soares et al., 2010 for studies showing how animacy modulates RC attachments). The full set of experimental sentence fragments used in the experiments reported here are presented in Appendix A. Note, however, that the cognate status manipulation is only relevant for Experiment 2 with L2 learners, as monolinguals of English and EP (Experiment 1) had no prior knowledge of EP and English, respectively, thus making the cognate status sentence assignment artificial in this case.

The fragment sentences were considered ambiguous because participants could complete the fragments using either an HA (i.e., by associating the RC to the first host of the complex NP) or an LA strategy (i.e., by associating the RC to the second host of the complex NP). It is worth noting that, although previous studies on L2 RC attachment manipulated the number of the nouns embedded in the complex NP (i.e., singular-plural or plural-singular) in order to facilitate syntactic disambiguation (e.g., see for instance Felser et al., 2003; Fernandéz, 2003; Frenck-Mestre, 1997, 2002), here we opted to keep the number of the nouns used in the complex NP constant (i.e., both plural or both singular), because in a previous sentence completion study with EP native speakers where the number of the nouns was manipulated (Soares, Oliveira, Comesaña, & Demestre, 2014) we did not find the expected HA preference observed for EP. We acknowledge, however, that using a semantic/pragmatic disambiguation can make the RC attachment harder to interpret since sentence completions will not contain an explicit morphological marker (e.g., number) that univocally associates them with one of its potential attachments hosts. The use of three independent Portuguese judges with specialized knowledge in English (i.e., philologists who were native-like users of English and who had extensive knowledge of the British and American cultures), and the strict inclusion of sentences that

were clearly classified as HA or LA in the analysis were ensured to minimize this potential problem as we will detail ahead.

Furthermore, cognates and noncognates were matched within and across conditions for each language and across languages attending to grammatical category (all nouns), length (number of letters), word frequency (Zipf measure – see Van Heuven, Mandera, Keuleers, & Brysbaert, 2014), and level of orthographic overlap (Normalized Levenshtein Distance [NLD]), as assessed by the NIM database (Guasch, Boada, Ferré, & Sánchez-Casas, 2013). Data concerning the words' grammatical category, word frequency, and length for EP were obtained from the Procura-PALavras (P-PAL; Soares et al., 2014) and SUBTLEX-PT (Soares et al., 2015) lexical databases. As for the English data, they were obtained from the N-Watch (Davis, 2005) and the SUBTLEX-UK (Van Heuven et al., 2014) databases. Table 1 displays the psycholinguistic characteristics of the nouns (N1 and N2) embedded in the complex NPs of the 48 English and Portuguese sentence fragments in each experimental condition (C-C, NC-C, C-NC, NC-NC), along with the results of the *t*-tests for paired comparisons between N1 and N2 characteristics in each language and the level of orthographic overlap of target nouns across languages in each experimental condition.

Table 1. Means and Standard Deviations (in brackets), for length (number of letters), word frequency (Zipf measure) in English and EP and for the orthographic overlap (Normalized Levenshtein Distance) for N1 and N2 for the four experimental conditions.

Cognate sentence condition	C-C			C-NC			NC-C			NC-NC		
Measures	N1	N2	*t*-test	N1	N2	*t*-test	N1	N2	*t*-test	N1	N2	*t*-test
Length English	7.1 (1.7)	6.4 (1.2)	$t(11) = 1.02$, $p = .33$	6.4 (3.3)	6.2 (1.8)	$t(11) = 0.23$, $p = .82$	6.1 (1.2)	7.3 (1.7)	$t(11) = -2.11$, $p = .16$	5.0 (2.1)	5.6 (1.8)	$t(11) = -0.64$, $p = .54$
Length EP	7.5 (1.8)	6.8 (2.0)	$t(11) = 0.79$, $p = .45$	6.9 (3.3)	8.0 (2.2)	$t(11) = -0.96$, $p = .36$	5.9 (1.7)	7.4 (2.4)	$t(11) = 1.64$, $p = .13$	5.6 (2.0)	5.9 (1.6)	$t(11) = -0.42$, $p = .66$
Frequency English	3.9 (0.9)	4.1 (0.4)	$t(11) = -0.78$, $p = .46$	4.4 (0.7)	4.3 (0.5)	$t(11) = -0.45$, $p = .66$	4.2 (0.5)	4.4 (0.5)	$t(11) = -1.72$, $p = .11$	4.3 (0.6)	4.6 (0.5)	$t(11) = -1.04$, $p = .33$
Frequency EP	4.1 (0.7)	4.1 (0.6)	$t(11) = 0.11$, $p = .92$	4.3 (0.7)	4.4 (0.8)	$t(11) = -0.36$, $p = .73$	4.3 (0.5)	4.4 (0.3)	$t(11) = -0.43$, $p = .67$	4.1 (1.2)	4.5 (0.5)	$t(11) = -1.27$, $p = .23$
Orthographic overlap	0.6 (0.2)	0.7 (0.2)	$t(11) = -0.79$, $p = .44$	0.6 (0.1)	0.2 (0.1)	$t(11) = 8.54$, $p < .001$	0.2 (0.1)	0.7 (0.1)	$t(11) = -12.09$, $p < .001$	0.1 (0.1)	.09 (0.1)	$t(11) = -0.75$, $p = .47$

Note: C-C_ Cognate-Cognate; C-NC: Cognate-NonCognate; NC-C: NonCognate-Cognate; NC-NC: NonCognate-NonCognate; EP: European Portuguese; N1: first-noun of the complex noun phrase; N2: second-noun of the complex noun phrase; Ortho. Overlap: Orthographic overlap

As expected, *t*-tests revealed that N1 and N2 did not differ significantly in length and word frequency in each experimental condition both in the English and EP materials. The analyses for the level of orthographic overlap also showed that, as expected, N1 and N2 differ significantly when comparing the C-NC and NC-C conditions (p_s < .001), but not when comparing the C-C and the NC-NC conditions (p_s > .44). Additionally, the ANOVAs for the N1 and N2 comparisons across conditions within each language showed that N1 and N2 did not differ significantly in length or word frequency both in English [length: N1, $F(3, 44) = 1.84$, $p = .15$; N2, $F(3, 44) = 2.45$, $p = .09$; word frequency: N1, $F(3, 44) = 1.53$, $p = .22$; N2, $F(3, 44) = 2.35$, $p = .09$], and EP [length: N1, $F(3, 44) = 1.76$, $p = .17$; N2, $F(3, 44) = 2.28$, $p = .09$; word frequency: N1, $F(3, 44) = 0.20$, $p = .89$; N2, $F(3, 44) = 1.40$, $p = .26$], but did differ in the level of orthographic overlap [N1, $F(3, 44) = 48.54$, $p < .001$; N2, $F(3, 44) = 79.79$, $p < .001$], as expected. Thus, pairwise comparisons revealed that for N1, orthographic similarity did not differ between cognates or noncognates (all *p*s = 1.00), but did differ between cognate status (all *p*s < .001). The same pattern of results was found for N2, i.e., no orthographic differences between cognates or noncognates (all *p*s = 1.00), but differences between cognate status (all *p*s < .001). Moreover, considering the characteristics of the sentence fragments as a whole, the results showed that they did not differ significantly across conditions both in mean number of letters (EP: $F(3, 47) = 1.89$, $p = .145$; English: $F(3, 47) = 0.58$, $p = .663$) or mean number of words (EP: $F(3, 47) = 0.09$, $p = .96$; English: $F(3, 47) = 2.81$, $p = .05$), though in the English materials the NC-NC sentences presented a slightly higher number of words than the sentences from the C-C condition ($M_{NC\text{-}NC} = 10.1$; $SD = 1.24$; $M_{C\text{-}C} = 9.0$; $SD = 0.85$, $p = .060$).

Finally, in addition to the 48 target sentence fragments, 52 fillers were created in English along with their corresponding translations in EP to distract the participants from the grammatical structure under study. The fillers presented different constructions from the target structure (e.g., "Daniel was reading a good book while he was listening to…"[*O Daniel estava a ler um bom livro enquanto ouvia…*]) and were intentionally created to be simpler and unambiguous (most of them could be completed using one simple word or phrase), to make the task easier for the participants. Two versions of the task were constructed, each of which comprised 100 sentence fragments in English (the English version of the task) and 100 sentence fragments in EP (the Portuguese version of the task) (see Appendix A). The English version was used both with the control group of English native speakers (Experiment 1) and the two groups (intermediate and advanced) of L2 learners (Experiment 2), while the Portuguese version was only used with

the control group of EP native speakers (Experiment 1). Experiment 1 was conducted as a previous control study to make sure that the RC attachment preferences typically observed in EP and English (HA and LA, respectively) were also found in our materials, thus supporting the use of the HA sentence completions as a mark of L1 syntax interference in Experiment 2 with the two groups of L2 learners. In Experiment 2 the level of proficiency of the L2 learners (intermediate vs. advanced), as well as the cognate status of the complex NP of the sentences (C-C, C-NC, NC-C, NC-C) were manipulated in a mixed factorial design. L2 proficiency was considered as a between-subjects factor, while the cognate status of the complex NPs as a within-subjects factor. Participants' performances were assessed by the number (%) of HA sentence completions (indicative of L1 syntax interference) presented in each condition. Since the cognate status of the sentence fragments was only relevant for the participants who are learning English as an L2, in Experiment 1 the % of HA completions were analyzed regardless of the cognate status of the sentences.

Procedure. The 100 sentence fragments either in the English or EP version were presented in a sentence completion task using the Qualtrics software (http://www.qualtrics.com/) for stimulus presentation and data collection. The sentence fragments were presented one at a time on a computer screen (17" monitor), left-aligned and in an 18-pt Arial font. An empty response box was displayed below each sentence fragment for participants to record their responses. After each sentence completion, participants pressed a key to proceed to the next sentence fragment. There was no time limit to complete the sentences, although participants were instructed to respond as quickly and accurately as possible.

In the experimental session participants were seated at a distance of approximately 60 cm from the computer screen. After completing the on-line version of the Language History Questionnaire (LHQ; Li, Sepanski, & Zhao, 2006) to obtain information about the subjects' linguistic background, participants were asked to read the sentences silently and carefully, and to complete each sentence (by writing down on the keyboard) with the first continuation that came to their mind, as long as it made sense. The sentences were presented in pseudo-random order to ensure that a filler separated two experimental sentence fragments. Before performing the task, written informed consent was obtained from all participants or their parents (for participants younger than 18 years old). The experiments reported here were conducted with the approval of the local Ethics Committees.

EXPERIMENT 1 (EP and English native speakers)

METHOD

Participants. Twenty-eight EP monolingual native speakers (24 females, M_{age} = 20.5 years, *SD* = 3.9) from the University of Minho (Braga, Portugal), and 28 English native speakers (26 females, M_{age} = 21.2 years; *SD* = 3.5) from the Royal Holloway University of London (England), took part in the experiment in exchange for course credits (EP participants) or a financial compensation (English participants). All had normal (or corrected-to-normal) vision and revealed none-to-low knowledge of Portuguese (English participants) or English (Portuguese participants).

Materials and procedure. EP native speakers responded to the Portuguese version of the sentence completion task, while English native speakers responded to the English version of the same task (see the General Method section). Data for EP were collected at the Human Cognition Laboratory (School of Psychology, University of Minho, Portugal), whereas data for English were collected at the Wolfson Laboratory (Department of Psychology, Royal Holloway University of London, England). The task was administered collectively in groups that did not exceed 6 persons per experimental session. The completion of the entire set of sentences (100) took about 30 min in each native group.

Results and Discussion. Completion responses were analyzed by three independent Portuguese judges with specialized knowledge in English (i.e., philologists who were native-like users of English and with extensive knowledge of the British and American cultures). Each judge assessed the 48 complete RCs in both groups of native speakers by assigning "1" if the sentence had been completed with an HA strategy (i.e., if the RC was clearly associated with the first noun of the complex NP); "2" if the sentence had been completed with an LA strategy (i.e., if the RC was clearly associated with the second noun of the complex NP); and "3" if the RC was ambiguous (i.e., if the RC could be associated with both of them) or made no sense. Judges were blinded concerning the objectives of the study. Responses that could not be classified univocally as HA ("1") or LA ("2") by at least two independent judges were excluded from further analysis (18.9% of the EP data and 19.1% of the English data). The inter-rater agreement was very high, being 95.5% for the EP native group data and 95.3% for the English native group data. The number of excluded completions in each group was considerable since, as mentioned in the General Method section, the option to keep the noun numbers in the complex NP constant made the RC

disambiguation harder to determine due to the absence of an explicit morphological marker. Nevertheless, because the number of reliable completions reached 80% in each native group, and did not affect them differently, $t(54) = -.14$, $p = .89$, we calculated the percentages of HA completions relative to the sum of all HA and LA responses per participant. Thus, the percentage of HA added to the percentage of LA was 100% in each group. Figure 1 shows the mean percentages of HA completions for both control groups. Note that, since we are dealing with a proportional measure, the mean percentages of LA completions for both groups are not represented in the figure but they can be directly derived from the HA responses.

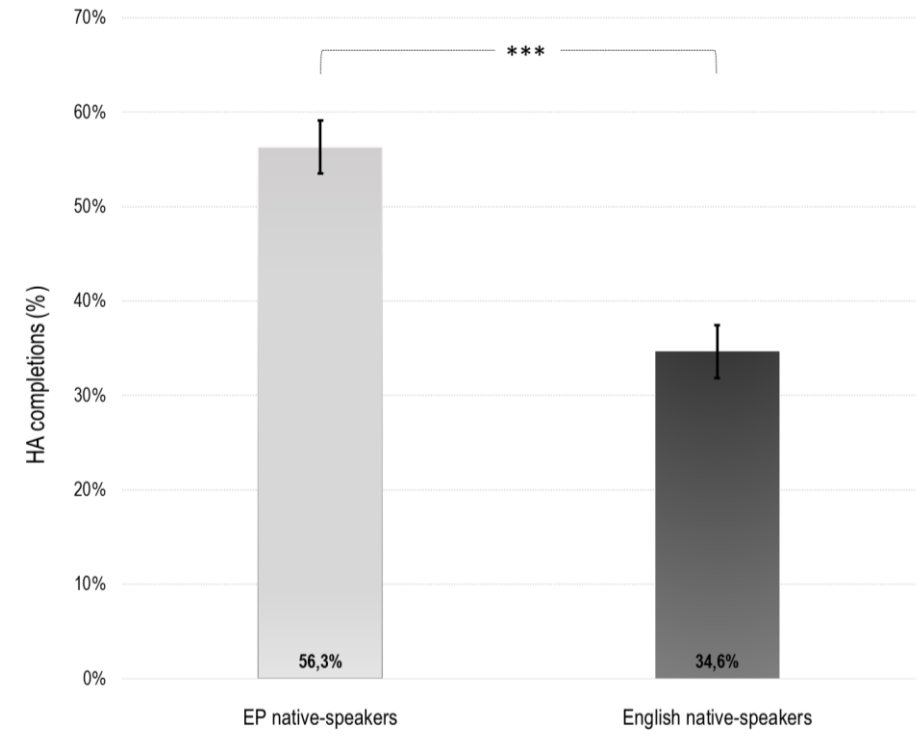

Figure 1. Mean percentages of High Attachment (% HA) in the sentence completion task performed by EP and English native-speakers. NOTE: Error bars reflect the Standard Error Mean (SEM). *** $p < .001$.

One sample *t*-tests comparing the total number (%) of HA completions against 50% in each group (note that 50% correspond to the absence of differences between HA and LA responses) revealed that EP native speakers choose the HA strategy to complete the sentence fragments significantly more times than what would be expected by chance, $t(27) = 2.25$, $p = .033$,

M = 56.3, *SD* = 14.9. However, in the English native-speaker group, the results indicated that the % of HA completions was significantly below the chance level, $t(27) = -5.45$, $p < .001$, *M* = 34.6, *SD* = 14.9, to complete the same sentence fragments. Moreover, the *t*-test for independent samples comparing the % of HA responses in the EP and English native-speaker groups showed, unsurprisingly, that EP native speakers presented significantly more HA completions than the English native speakers, $t(54) = -5.45$, $p < .001$. These results are consistent with previous findings showing an HA preference in EP (e.g., Soares et al., 2010), and an LA preference in English (e.g., Carreiras & Clifton, 1993, 1999; Cuetos & Mitchell, 1988), and provide an important support to further analyze how native speakers of EP learning English as an L2 at different levels of proficiency (intermediate and advanced) will resolve the same syntactic ambiguities assuming the HA sentence completions as a mark of L1 syntax interference.

EXPERIMENT 2 (Intermediate and Advanced l2 learners)

METHOD

Participants. Twenty-eight intermediate (18 females, M_{age} = 17.4 years, *SD* = 4.2) and 28 advanced learners (25 females, M_{age} = 20.6, *SD* = 5.0) of English as an L2 recruited from English teaching institutions in Portugal took part in the experiment. All participants had normal (or corrected-to-normal) vision and were native speakers of EP. The levels of L2 proficiency were obtained directly from the institutions where participants were learning English. All intermediate learners had a B level [independent user] and all advanced learners had a C level [proficient user] according to the Common Reference Levels of Language Proficiency (CRLLP) of the Council of Europe (see http://www.coe.int/t/dg4/linguistic/cadre1_en.asp). Additionally, information about the language history of each participant was obtained from the LHQ (Li et al., 2006). Responses to this questionnaire revealed that all the intermediate and advanced learners were firstly exposed to English before the age of 10 ($M_{intermediate}$ = 8.1 years, *SD* = 1.9; $M_{advanced}$ = 8.1 years, *SD* = 2.1, $t(50) = 0.29$, $p = .99$). Moreover, intermediate learners indicated spending fewer hours per day using their L2 than advanced learners did ($M_{intermediate}$ = 4.8, *SD* = 2.8; $M_{advanced}$ = 7.4, *SD* = 6.2, $t(50) = -1.97$, $p = .045$). They also reported taking fewer years of English training compared to advanced learners ($M_{intermediate}$ = 8.4 years; *SD* = 2.3; $M_{advanced}$ = 10.7 years; *SD* = 2.2, $t(50) = -3.72$, $p < .001$) as expected.

Materials and procedure. L2 learners responded to the English version of the sentence completion task used in Experiment 1. Data were collected in the English teaching institutions in which participants were enrolled. The completion of the entire set of sentences took about 60 min in the group of intermediate learners and 45 min in the group of advanced learners. As in Experiment 1 the task was administered collectively in groups that did not exceed 6 persons per experimental session.

Results and Discussion. Responses from the sentence completion task in the two groups of L2 learners were assessed by the same independent judges of Experiment 1, and using the same assessment criteria. As in Experiment 1, completions that could not be classified univocally as HA or LA by at least two independent judges were excluded from further analysis (24.3% in the intermediate group data and 18.4% in the advanced group data). The inter-rater agreement was also very high, being 96.2% in the intermediate group data and 97.2% in the advanced group data. To ensure that the amount of ambiguous (i.e., excluded) responses did not affect the four experimental conditions differently in each group, we conducted a repeated-measures ANOVA with sentence condition (C-C, C-NC, NC-C and NC-NC) as a within-subjects factor. Results showed no significant effects on the distribution of the ambiguous responses in the four experimental conditions in each group (intermediate: $F(3, 27) = .46$, $p = .50$; advanced: $F(3, 27) = 2.23$, $p = .15$), thus allowing us to calculate, as in Experiment 1, the percentages of HA responses relative to the sum of all HA and LA responses per experimental condition. Therefore, the percentage of HA added to the percentage of LA was 100% in each experimental condition. Figure 2 presents the mean percentages of HA completions in each of the four experimental conditions both for the intermediate and advanced L2 groups (as in Figure 1, the % of LA responses can be directly derived from the % of HA responses).

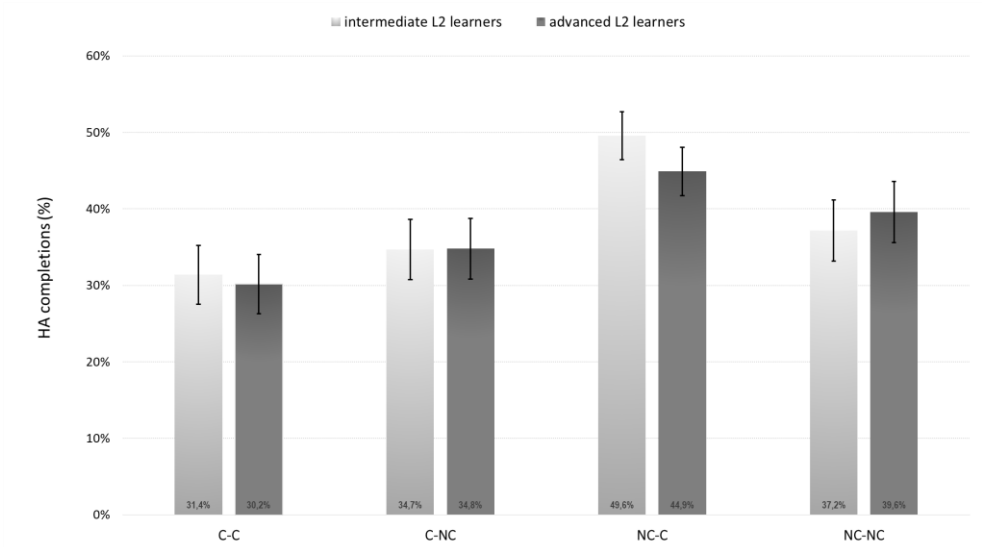

Figure 2. Mean percentages of High Attachment (% HA) in the sentence completion task performed by intermediate and advanced L2 learners per cognate condition. Note: C: Cognate-Cognate; NC-C: NonCognate-Cognate; C-NC: Cognate-NonCognate; NC-NC: NonCognate-NonCognate. Error bars reflect the Standard Error Mean (SEM).

One-sample *t*-tests considering the percentage % of HA responses against the null hypothesis (i.e., 50%) in each experimental condition and L2 group, showed that both groups of L2 learners chose the HA response significantly less to complete the sentence fragments of our study than what would be expected by chance in all experimental conditions, except in the NC-C condition in which the number of HA responses did not differ from what was expected by chance (Intermediates: C-C: $t(27) = -5.33$, $p < .001$; C-NC: $t(27) = -3.38$, $p = .002$; NC-C: $t(27) = -.14$, $p = .887$; NC-NC: $t(27) = -3.36$, $p = .002$; Advanced: C-C: $t(27) = -4.74$, $p < .001$; C-NC: $t(27) = -4.38$, $p < .001$; NC-C: $t(27) = -1.55$, $p = .132$; NC-NC: $t(27) = 2.49$, $p = .019$; $M = 39.57$, $SD = 22.12$). Thus, contrary to our expectations, the present experiment with intermediate and advanced L2 learners showed that L2 learners revealed a general LA preference to resolve the RC ambiguities in their L2 (except in the NC-C condition in which no preference was observed), seemingly revealing an English native-like way of resolving RC ambiguities, at least from an intermediate level of L2 proficiency onwards. It is possible that the differences in L2 RC preferences as a function of L2 proficiency would be noticeable only at lower levels of proficiency. This general LA preference in both L2 groups also suggests that the attachment strategies typically used for RC ambiguity resolution in the L1 (i.e., HA) seem to have little impact on L2 RC resolutions, which seems to provide support to a separate-syntax account (e.g., Clahsen & Felser, 2006a,b,c; Felser et al. 2003;

Ullman, 2005), as will be discussed later on in the General Discussion section.

Nevertheless, in order to analyze the extent to which this general LA preference exhibited by both groups of L2 learners reflects a truly English native-like L2 RC sentence processing (note that, if so, RC completions should not be modulated by the cognate composition of the complex NP, as L2 learners should base their parsing decisions more on the structural [syntactic] information provided by the sentence than on the lexical characteristics [cognate status] of the complex NP), repeated-measures ANOVAs were also conducted on the mean percentages of HA completions (indicative of L1 syntax interference) based on a 2 (L2 proficiency: intermediate vs. advanced) x 4 (Complex NP cognate status: C-C, C-NC, NC-C, and NC-C) mixed design both on the participants (F_1) and items (F_2) data. In the *F*1 analysis, the cognate status of the complex NP was considered as a within-subjects factor and L2 proficiency as a between-subjects factor. In the *F*2 analysis, L2 proficiency was considered as a within-items factor, while the cognate status of the complex NP as a between-items factor.

The ANOVAs showed a main effect of the cognate status in the complex NP which was only statistically significant in the participants analysis, $F_1(3, 162) = 14.961$, $MSE = 182.801$, $p < .001$, $\eta_p^2 = .22$, $F_2(3, 44) = 1.016$, $MSE = 1174.038$, $p = .395$, $\eta_p^2 = .065$. This effect revealed that, regardless of the L2 group, participants showed more HA completions in the NC-C condition (47.2%) than in any other cognate condition (C-C, $p < .001$; C-NC, $p < .001$; NC-NC, $p = .006$). Conversely, in the C-C condition, participants showed the lowest score of HA completions (30.8%), differing from all other conditions except from the C-NC in which the differences did not reach statistical significance (NC-C, $p < .001$; NC-NC, $p = .035$). In the NC-NC condition, participants revealed the second highest HA score (38.4%), differing from all the other conditions except again from the C-NC condition (C-C, $p = .035$; NC-C, $p = .006$). Importantly, the number of HA completions differ between the C-NC and the NC-C conditions ($p < .001$), with the C-NC condition presenting fewer HA completions than the NC-C condition (34.9% vs. 47.2%, respectively). Although the absence of a statistically significant cognate effect in the item analysis might suggest that the cognate effect observed in the participants data is not robust, it is important to note here that in the *F*2 analysis the cognate status of the complex NP was considered as a between-items variable, while in the *F*1 analysis it was considered as a within-subjects variable. This methodological difference had important implications in the results, making the power to detect a cognate effect much higher in the subject analysis than in the item analysis. Note that in the *F*1 analysis the means entered in the analysis were

averaged over the items that each condition entails and that the nuisance variance caused by differences in the responses to the different items of the same condition was excluded. However, in the *F*2 analysis, the means were averaged over participants, and hence the nuisance variance caused by differences in the responses to different items of the same condition cannot be excluded. Therefore, the variability in the responses for the item data is higher than the participant data, which made any *F*2 cognate effect much more difficult to observe. The only way to increase the power to detect a cognate effect in the item analysis would be to increase the number of sentence fragments per cognate condition, which was not possible due to the strict control that was imposed to the materials (see materials section). Besides this cognate effect in the *F*1 analysis, the ANOVA failed to show any other significant effect. The effect of L2 proficiency did not approach significance, and neither did the interaction between the two factors (both $F_s < 1$, both $p_s > .70$).

Thus, the results obtained from the ANOVAs on the data from participants' HA completions showed that, despite the fact that the differences between the two learner groups were statistically not significant, an important cognate effect emerged although not in the expected direction. Indeed, contrary to our expectations, the C-C condition showed fewer HA completions than the NC-NC condition (i.e., less L1 syntax interference) and, additionally, the C-NC condition showed fewer HA completions than the NC-C condition. Moreover, the results also showed that the NC-C condition presented a higher % of HA responses than the NC-NC condition, thus suggesting that presenting a noncognate in the first position of the complex NP followed by a cognate in the second position induced stronger L1 syntax interference than presenting two noncognates. Although this result was unexpected and is not easily interpreted in the light of the advanced hypotheses, what is important to highlight here is that, taking the results obtained as a whole, they clearly indicate that the NC-C and the NC-NC conditions induced stronger L1 RC interference than the C-C and the C-CN conditions, which did not differ between each other, hence suggesting that the cognate status of the word located in the first position of the complex NP (the L1 preferential position) seems to influence the extent to which the L1 RC preferences were activated during L2 RC completions (though when a cognate followed a noncognate the cross-language competition for RC attachment seems to become stronger). Thus, taken together, these results demonstrate that, despite the fact that none of our hypotheses were supported by the data, the cognate status of the words embedded in the complex NPs of the RC structure affected the extent to which the L1 RC preferences were activated, thus suggesting that the lexical and syntactic levels of

representation interact during L2 RC ambiguities resolution, as we aim to demonstrate in the present paper.

GENERAL DISCUSSION

In this work we used a sentence completion task to analyze how the embedding of cognate words in the complex NP of the RC structure affects the way native speakers of EP learning English as an L2 at different levels of proficiency (intermediate vs. advanced) resolve RC ambiguities in their L2. Considering, on the one hand, that RC resolution is assumed to be a hallmark of syntactic processing in both monolinguals and bilinguals (e.g., Desmet & Declercq, 2006; Scheepers, 2003), and, on the other hand, that cognate processing is understood as the hallmark of lexical co-activation across languages (e.g., Dijkstra et al., 1999, 2010), we reasoned that combining these two components in the same experiment should provide a fertile ground to study how the lexical and syntactic levels of representation interact during L2 sentence processing in the bilingual mind, an issue that has attracted growing interest in bilingual and L2 acquisition literature.

If the lexical and the syntactic levels of representation interact during L2 sentence processing, as we aim to demonstrate in this paper, the RC attachment preferences of L2 learners should be modulated by the cognate status of the words embedded in the complex NPs preceding the RC to be completed, and which contained its antecedent. Because previous studies have shown that EP and English exhibit opposite RC attachment preferences (HA vs. LA, respectively; e.g., Carreiras & Clifton, 1999; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996; Soares et al., 2010), we hypothesized that the embedding of cognates relative to noncognates would cause an L1 syntax interference effect (i.e., more HA than LA completions) since cognates would generate a stronger lexical activation of the non-target language (EP), which in turn would send feedforward activation to the syntactic level of processing, hence increasing the level of cross-language competition for RC attachment. Therefore, stronger cognate interference effects (i.e., more HA completions) were expected when the complex NP contained cognates (C-C) than noncognates (NC-NC), as well as more interference in the C-NC than NC-C condition. Presenting a cognate in the preferential L1 position (N1) was hypothesized to activate L1 RC preferences (HA) to a greater extent than when presented in a non-preferential position (N2) in the complex NP. We also hypothesized that the interference effect caused by the embedding of cognates in those structures would decrease as L2 proficiency increases (i.e., more LA than HA completions in the advanced than in the intermediate L2 groups). Moreover, as a control, we also conducted a previous study with

native speakers of EP and native speakers of English, to ensure that the HA and LA preferences typically observed in each language (e.g., Carreiras & Clifton, 1999; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996; Soares et al., 2010) were also observed in our experimental materials, thus supporting the use of the HA sentence completions as a mark of L1 syntax interference.

Results from Experiment 1 revealed that the RC preferences from the two groups of native speakers differed, as expected. EP native speakers showed more HA sentence completions while English native speakers showed more LA sentence completions. These results are in line with previous studies showing an HA RC preference in EP (Soares et al., 2010) and an LA RC preference in English (e.g., Carreiras & Clifton, 1999; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996), and provided important support to further analyze the influence of the L1 RC attachment preferences (HA) on L2 RC attachment resolutions in the two groups of L2 learners. However, results from Experiment 2 were unexpected. Indeed, although the findings clearly indicate that the level of form overlap of the translation equivalents used in the complex NPs (cognates vs. noncognates) affected the way L2 learners resolved the RC ambiguities in their L2, the direction of the findings did not confirm our predictions, and can be summed up as follows: (i) the cognate status of the words in the complex NPs affected L2 RC resolutions, but, contrary to our predictions, the embedding of noncognates induced stronger L1 syntax interference (i.e., more HA sentence completions) than the embedding of cognates; (ii) the level of L1 RC interference was modulated by the position in which the noncognate appeared in the complex NP, but, contrary to our predictions, presenting a noncognate in the first position induced stronger L1 syntax interference (i.e., more HA sentence completions) rather than presenting a cognate in the first position and (iii) the L2 proficiency did not affect the way L2 learners resolved the RC syntactic ambiguities in their L2, as both L2 learner groups showed, on the one hand, a general LA preference to resolve the RC ambiguities in their L2, and, on the other hand, that the cognate composition of the complex NP impacted L2 RC performance similarly.

Although these results were exactly in the opposite direction of what was expected (note that the hypotheses were only tentative since, to the best of our knowledge, no previous studies were conducted on this topic), what is important to emphasize here is that our findings clearly indicate that the cognate status of the words embedded in the complex NP of the RC structure affected the extent to which L1 RC preferences were activated during L2 RC ambiguity resolution, thus suggesting that the lexical and syntactic levels of representation interact during L2 sentence processing in a bilingual reading system that is not only highly interactive within each level of processing

(lexical and syntactic), as the previous research have shown (e.g., Bernolet, et al., 2009; Bultena et al., 2014; Desmet & Declercq, 2006; Dijkstra et al., 1999, 2010; Dussias, 2003; Dussias & Sagarra, 2007; Frenck-Mestre, 1997, 2002; Duyck et al., 2007; Hartsuiker et al., 2004; Hartsuiker, & Pickering, 2008; Schoonbaert et al., 2007), but, importantly, across different levels of processing, as we aim to demonstrate in this paper. It is also worth noting that, although these results did not support our hypotheses, they may not be entirely inconsistent with the advanced predictions. Indeed, assuming that L2 sentence processing is cognitively more demanding than L1 sentence processing (e.g., Dekydtspotter & Renaud, 2014; Hopp, 2014; Omaki & Schulz, 2011; Witzel et al., 2012), and, as argued, that embedding cognates might yield a greater activation of the RC attachment preferences from the non-target language than noncognates (bear in mind that L1 and L2 showed opposite RC attachment preferences as demonstrated in Experiment 1), it is also possible to anticipate that the higher cross-language competition for RC selection attachment generated by cognates relative to noncognates could also have contributed to overload L2 sentence processing, thus stimulating the use of an LA rather than an HA strategy.

Although there is a current debate about whether language processing is cognitively consuming and/or supported by domain-general or domain-specific cognitive resources (see Fedorenko & Thompson-Schill, 2014 for recent neuroscientific review), it is possible that in situations of higher cognitive demands - such as L2 RC ambiguity resolution, particularly in highly demanding tasks, as the L2 sentence completion task used in this work (note that participants were asked to complete a set of 100 English sentence fragments in a plausible way), the presence of cognates stimulates the processor to resolve the RC ambiguity by associating the RC with the last processed constituent of the complex NP (using a recency strategy). To lessen the cognitive load introduced by the higher cross-language competition for RC selection, the L2 learners from our study may have simply preferred to complete the sentence fragments in the C-C condition by associating the RC to the last processed item in the complex NP instead of items that are located back in the sentence, which would be cognitively more demanding. Note that non-local integration (i.e., attaching the incoming sentence to a constituent that had been processed earlier) requires the reactivation of an early constituent and the parser to construct a long-distance syntactic tree, which would consume cognitive resources that might be not available. This is why non-local integration (HA) is assumed to be more cognitively demanding than local (LA) integration (e.g., Frazier, 1979; Frazier & Rayner, 1982; Hopp, 2014). In this new perspective, the expected L1 RC interference effect caused by the embedding of cognates relative to noncognates would be

reflected in more LA completions rather than in more HA completions, as anticipated.

This line of reasoning can also be used to explain why more HA completions were found in the NC-C condition relative to the C-NC condition i.e., to account for the cognate position effect observed. In fact, assuming that embedding cognates in the first rather than in the second position of the complex NP strongly activates the attachment preferences of the non-target language (HA), it becomes readily apparent why more LA completions were observed in the C-NC compared to the NC-C condition. Presenting a cognate in the L1 preferential position (first) could have enhanced the cross-syntactic competition for RC selection, which in turn might have contributed to increase the cognitive load of L2 RC processing, thus stimulating the use of an LA strategy. Conversely, when cognates were embedded in the L1 non-preferential position (second) the level of cross-syntactic competition for RC selection might have been lessened, hence allowing the processor to consider other preferences in the resolution of L2 RC ambiguities. We acknowledge that this explanation is only tentative and that only future studies using online techniques such as eye-tracking or Event-Related Potentials (ERPs), that are sensitive to the temporal course of processing, can provide compelling data to test whether the embedding of cognates in this grammatical structure really induces stronger cross-language competition for RC selection than noncognates. The sentence completion task used in this study is an offline measure of syntactic processing that reflects the subjects' final interpretations rather than their performance during online sentence processing. As mentioned, this task was chosen as a first step to explore the lexico-syntactic interactions on L2 RC attachment, because differences in RC preferences between EP and English are more noticeable when offline tasks are used (e.g., Soares et al., 2010; Carreiras & Clifton, 1993; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996). Future studies using online measures of sentence processing to assess whether differences in the cognitive load can account for the results observed, are thus required.

Nevertheless, it should be also noted that our findings are consistent with the results recently obtained by Hopp (2017) in a study aimed to study syntactic co-activation of the L1 (German) during L2 (English) sentence processing by the embedding of cognates and noncognates in reduced relative clauses, although word order was used as a marker of L1 syntactic co-activation. Contrary to Hopp's expectations, and in line with our results, the author found stronger syntax co-activation of the L1 word order for noncognates than for cognates. Hopp explained this unexpected result based on the idea that L1 syntax interference might become more noticeable under conditions of increased lexical processing demands (i.e., for noncognates),

since the cross-language activation of cognates eases processing and frees resources for inhibiting L1 syntax more effectively. Following the same argument, we can consider that the stronger L1 syntax interference observed in the NC-NC condition relative to the C-C condition might have resulted from the fact that processing two noncognates is lexically more demanding than processing two cognates, thus not allowing enough resources to inhibit L1 syntax efficiently. Despite the attractiveness of this L1 syntax inhibition hypothesis, it is important to highlight that it cannot explain why in conditions of similar lexical demands (i.e., C-NC and NC-C conditions), a cognate position effect was also observed (with the former inducing less L1 syntax interference than the latter), or why under conditions of different lexical demands (as in the C-C and C-NC conditions), the differences in the number of HA completions were not statistically significant. Moreover, it also fails to explain why the NC-C condition induced strong L1 syntax interference (i.e., more HA completions) than the NC-NC condition, the condition in which the lexical demands should be the highest. As mentioned above, only future studies using online tasks/techniques can help to clarify whether the higher number of LA completions observed in the C-C and C-NC conditions relative to the NC-NC and in the NC-C conditions were due to a stronger cross-syntactic competition for RC attachment or to higher L1 inhibition.

Alternatively, it is also possible to assume, in line with the LS model developed by Hartsuiker et al. (2004; see also Schoonbaert et al., 2007), that because cognates share not only conceptual and lemma levels of representation, but also word-form levels of representation, this could have also contributed to enhance the level of activation of syntactic structures which, despite revealing different RC attachment preferences across languages, could be effectively shared among languages (Desmet & Declercq, 2006). Since participants performed the sentence completion task in English, the L2 node would be more activated, thus enhancing the probability of resolving the RC ambiguity by using the parsing strategy typically observed in that language (i.e., LA). The greater activation of both syntactic parsing systems generated by cognates relative to noncognates, might have made it easier to select an L2-like way of parsing (LA), particularly in the conditions where the cognates appeared in the L1 preferential position (i.e., note that the C-C and C-NC conditions did not differ, thus suggesting that as long as a cognate was embedded in the first position, a similar RC attachment effect was observed).

Finally, it is also worth noting that the results obtained here also indicate that, contrary to our expectations and to several studies on L2 sentence processing (e.g., Bultena et al., 2014; Frenck-Mestre, 2002; Hopp,

2017; Van Assche et al., 2011, 2013), the level of L2 proficiency did not affect the way the two groups of L2 learners resolved the RC ambiguities in their L2, as both groups showed, on the one hand, a general LA preference in their sentence completions (except in the NC-C condition in which no preference was exhibited), and, on the other hand, a similar effect of the cognate composition of complex NP on the activation of the L1 RC preferences (HA). Although the use of a general LA strategy by both groups of L2 learners seems to show that the intermediate and advanced learners of our study revealed an English native-like way of resolving the L2 RC ambiguities, it is important to highlight that the analyses conducted on the L2 completions considering the number of HA (indicative of the L1 syntax interference) attending to the cognate status of the complex NP showed a different scenario. Indeed, as mentioned before, if the L2 learners of our study showed a truly L2 native-like way of resolving the RC ambiguities, their sentence completions should not be modulated by the lexical properties (cognate status) of the items embedded in the complex NP, at least at higher levels of proficiency. However, the cognate effect observed for both groups clearly indicate that this was not the case. Intermediate and advanced learners seem to be quite sensitive to the lexical properties of the items embedded in the complex NP (particularly to those located in the L1 preferential position), thus showing that the computation of the abstract relationships among syntactic constituents was more lexically than structurally-driven, as predicted by the SSH (e.g., Clahsen & Felser, 2006a,b,c; Felser et al. 2003; Marinis et al., 2005). However, it is also important to point out that, contrary to the SSH account, the fact that the lexical status of the constituents affected the degree of activation of the L1 RC preferences also suggests that the syntactic representations and mechanisms that underlie bilinguals' L2 sentence processing might be shared across languages, as several studies claim (e.g., Bernolet et al., 2009; Desmet & Declercq, 2006; Dussias, 2003; Dussias & Sagarra, 2007; Frenck-Mestre, 2002; Felser et al., 2003; Hartsuiker et al., 2004; Hartsuiker & Pickering, 2008; Papadopoulou & Clashen, 2003; Schoonbaert et al., 2007).

Nonetheless, before any definitive conclusions can be drawn, it is important that future studies using other tasks/techniques, participants, and measures, particularly those that are sensitive to the time course of lexical and syntactic processing (e.g., eye-tracking, ERPs) are conducted. The use of online techniques is required not only because they allow for the examination of reading processes in real time, but, importantly, because they tap into more automatic and unconscious processes involved in sentence processing, thus minimizing the influence of additional metalinguistic factors that might have mitigated the potential differences that could be observed between the two

groups of L2 learners. It is also important that future studies increase the number of items per cognate condition in order to increase the probability to detect statistically significant effects in the item analysis. This line of studies will also contribute to shed light on the nature of the lexico-syntactic interactions established during L2 sentence processing in the bilingual mind, a research topic that has been poorly explored in the bilingual and L2 acquisition literature.

RESUMEN

Interacciones lexico-sintácticas en la resolución de cláusulas de relativo ambiguas en una segunda lengua (L2): El papel del estatuto cognaticio y del nivel de competencia en la L2. Existe abundante evidencia acerca de la existencia de una activación no selectiva de las representaciones de las dos lenguas de un bilingüe, tanto en el nivel léxico como en el nivel sintáctico. Sin embargo, no está claro en qué medida interactúan estos niveles durante el procesamiento de oraciones en una L2, o si la competencia en la L2 modula dicha interacción. En este trabajo analizamos el modo en el que hablantes nativos de Portugués Europeo (L1) que están aprendiendo inglés (L2) y que tienen distinto nivel de competencia en la L2 (intermedio vs. alto), resuelven cláusulas de relativo (CR) ambiguas en su L2. Monolingües de portugués europeo y de inglés formaron también parte del estudio como grupos control. Los participantes realizaron una tarea de compleción de oraciones en la que palabras cognadas y no cognadas fueron críticamente incluidas en el sintagma nominal complejo (SNC) que precedía a las CR y que contenía su antecedente. Los resultados mostraron que los aprendices de inglés preferían adjuntar la CR al último nombre del SNC, al igual que los nativos de inglés, independientemente de su competencia en la L2. Además, el status cognaticio del SNC moduló los resultados, aunque, en contra de lo esperado, los cognados indujeron menos interferencia sintáctica de la L1 que los no cognados.

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APPENDIX

Experimental sentence fragments used in the English and in the EP version of the sentence completion task by cognate condition.

Cognate condition	English version	EP version
C-C	They hired the guide of the alpinist who…	*Eles contrataram o guia do alpinista que…*
	The doorman welcomed the patient of the dentist who…	*O porteiro cumprimentou o paciente do dentista que…*
	Britney recognized the guard of the prisoner who…	*A Beatriz reconheceu o guarda do prisioneiro que…*
	My stepmother met the apprentice of the painter who…	*A minha madrasta conheceu o aprendiz do pintor que…*
	The announcer interviewed the trainer of the athlete who…	*O locutor entrevistou o treinador do atleta que…*
	Scarlett went to see the masseuse of the cyclist who…	*A Carlota foi a uma consulta com o massagista do ciclista que…*
	The army nabbed the aggressor of the victim who…	*O exército apanhou o agressor da vítima que…*
	They blackmailed the assistant of the judge who…	*Eles chantagearam o assistente do juiz que…*
	My grandmother dropped the tureen of the soup that…	*A minha avó deixou cair a terrina da sopa que…*
	The sightseers went to see the tunnel of the castle that…	*Os visitantes foram ver o túnel do castelo que…*
	The farmer picked the seeds of the fruits that…	*O agricultor apanhou as sementes dos frutos que…*
	The researchers found the treasure of the temple that…	*Os investigadores encontraram o tesouro do templo que…*
	Dylan met the student of the teacher who…	*O Diogo encontrou-se com o estudante do professor que…*

C-NC	Maisie picked up the baby of the hairdresser who…	*A Marta pegou na bebé da cabeleireira que…*
	The team hired the physiotherapist of the fighter who…	*O clube contratou o fisioterapeuta do lutador que…*
	Kendra saw the secretary of the mayor who…	*A Carina viu o secretário do presidente que…*
	Bessie had tea with the fan of the singer who…	*A Bruna foi tomar chá com a fã da cantora que…*
	The builders discussed the plan of the church that…	*Os construtores discutiam a planta da igreja que…*
	We stared at the photos of the fields that…	*Ficámos espantados com as fotos das plantações que…*
	The traveller was looking up the map of the route that…	*O viajante estava a consultar o mapa do percurso que…*
	The workers found the original moulds of the coins that…	*Os operários descobriram os moldes das moedas que…*
	The clerk fixed the computer of the office that…	*O técnico reparou o computador do escritório que…*
	Gabriel scratched on the title of the book that…	*O Gabriel riscou o título do livro que…*
	The landlady removed the curtain of the window that…	*A proprietária retirou a cortina da janela que…*
NC-C	They wounded the grandson of the ambassador who…	*Eles feriram o neto do embaixador que…*
	My father was talking to the driver of the minister who…	*O meu pai estava a falar com o motorista do ministro que…*
	The shopkeepers saw the thieves of the tourists who…	*Os comerciantes viram os ladrões dos turistas que…*
	The butler blamed the nanny of the princess who…	*O mordomo culpou a ama da princesa que…*
	A big scandal affected the niece of the bishop who…	*Um grande escândalo atingiu a sobrinha do bispo que*
	The priest met the mistress of the baron who…	*O padre recebeu a amante do barão que…*
	A thunderbolt hit the aerial of the television that…	*Um raio atingiu a antena da televisão que…*

	The blacksmiths rebuilt the bridge of the river that…	*Os serralheiros reconstruíram a ponte do rio que…*
	Alan kept the ticket of the concert that…	*O Abel guardou o bilhete do concerto que…*
	My roommate replaced the tyre of the bicycle that…	*O meu colega substituiu a roda da bicicleta que…*
	The couple was amazed at the picture of the museum that…	*O casal estava admirado com o quadro do museu que…*
	Shaniya asked for the label of the medicine that…	*A Sandra pediu o rótulo do medicamento que…*
NC-NC	The recorder heard the boyfriend of the girl who…	*O magistrado ouviu o namorado da rapariga que…*
	The relatives wanted to talk to the midwives of the twins who…	*Os familiares quiseram falar com as parteiras dos gémeos que*
	My cousin was fooled by the sister of the salesman who…	*O meu primo foi enganado pela irmã do vendedor que…*
	He fell in love with the maid of the queen who…	*Ele apaixonou-se pela aia da rainha que…*
	Ashley was looking at herself in the mirror of the shop that…	*A Joana estava ver-se ao espelho da loja que…*
	Molly loved the box of the cake that…	*A Maria adorou a caixa do bolo que…*
	The child ruined the cloth of the table that…	*A criança sujou a toalha da mesa que…*
	The storm brought the mud of the jungle that…	*A tempestade arrastou a lama da selva que…*
	The dressmaker gave back the hanger of the shirt that…	*A costureira devolveu a cruzeta da camisa que…*
	The boys were in the pool of the ship that…	*Os rapazes estavam na piscina do navio que…*
	The crazy man kicked the dog of the neighbour who…	*Um louco pontapeou o cão do vizinho que…*
	The farm tenant fed the cow of the landlord that…	*O caseiro alimentou a vaca do senhorio que…*

Note: C-C: Cognate-Cognate; C-NC: Cognate-NonCognate; NC-C: NonCopgnate-Cognate; NC-NC: NonCognate-NonCognate

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