D E L T A

Articles

The resolution of ambiguous anaphora in english, spanish, and portuguese

A resolução de ambiguidade anafórica em inglês, espanhol e português

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ABSTRACT

This study aims to determine how (a) ambiguity resolution differs in English, Spanish, and Portuguese; (b) L2 learners are influenced by their L1 regarding ambiguity resolution; and (c) the order of the clauses, (d) the salience of the anaphor, or (e) the choice of verbs may affect this process. A total of 181 people answered an online survey and selected the antecedent of the anaphor for 16 ambiguous sentences. The Position of Antecedent Strategy was tested for the three languages and the conclusion was that it applies to European and Brazilian Portuguese, but not for Spanish or English. While Spanish and English native speakers tend to interpret the subject of the subordinate clause as corresponding to the subject of the main clause, learners are influenced by their L1 and seem uncertain especially on how to resolve pronominal cataphora. Finally, we

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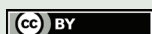
Amanda Maraschin Bruscato, Jorge Baptista

have concluded that semantics has a great influence on the resolution of ambiguous anaphora in these languages, and we suggest that it should be taken in consideration during the design of a study like this one.

Keywords: *ambiguity; anaphora resolution; position of antecedent strategy.*

RESUMO

Este estudo pretende determinar como (a) a resolução de ambiguidade difere em inglês, espanhol e português; (b) falantes de L2 são influenciados por sua L1 no que diz respeito à resolução de ambiguidade; e (c) a ordem das orações, (d) a saliência da expressão anafórica, ou (e) a escolha dos verbos pode afetar esse processo. Um total de 181 pessoas responderam a um questionário online e selecionaram o antecedente da expressão anafórica para 16 frases ambíguas. A Hipótese da Posição do Antecedente foi testada para as três línguas e a conclusão foi que se aplica ao português europeu e brasileiro, mas não ao espanhol ou inglês. Enquanto falantes nativos de espanhol e inglês tendem a interpretar o sujeito da oração subordinada como correspondendo ao sujeito da oração principal, os aprendizes são influenciados por sua L1 e parecem incertos especialmente em como resolver a catáfora pronominal. Finalmente, concluímos que a semântica tem uma grande influência na resolução de ambiguidade anafórica nessas línguas, e sugerimos que seja levada em consideração durante a preparação de um estudo como este.

Palavras-chave: *ambiguidade; anáfora; hipótese da posição do antecedente.*

1. Introduction

Ambiguity is a classic problem in anaphora resolution, and a considerable amount of literature has been published on this subject (Alonso-Ovalle *et al.*, 2002; Keating *et al.*, 2011; Lobo & Silva, 2016; Sorace & Filiaci, 2006; Valenzuela *et al.*, 2011). These studies tried to explain how L1 and L2 speakers solve ambiguity in different languages, but to date there has been little agreement on what theory would better describe this phenomenon.

This paper expands our previous research (Bruscato & Baptista, 2022a, 2022b) and compares ambiguity resolution in the three European languages most spoken in the world (Eberhard *et al.*, 2020): English, Spanish, and Portuguese. The objectives of this study are to determine: (a) how ambiguity resolution strategies differ in English, Spanish, and Portuguese; (b) how L2 learners are influenced by their L1 regarding ambiguity resolution; and whether (c) the order of the main and subordinate clauses, (d) the salience of the anaphor, or (e) the lexical choice of verbs may affect this process.

Data from Portuguese and Brazilian speakers who study English or Spanish in a Brazilian or a Portuguese university are compared to data from native speakers of these languages[3]. They volunteered to answer an online questionnaire that tested their proficiency level in the L2 and asked them to identify the subject of ambiguous sentences in their L1 and L2.

The paper has been organized in the following way: the second section provides a brief overview of the theoretical framework; the third section is concerned with the methodology used for the study; the fourth section presents and discusses the findings of the research; finally, the fifth section reports the conclusions.

2. Theoretical Framework

According to King and Lewis (2018, p. 1), in simple terms *anaphora* could be defined as "the phenomenon whereby the interpretation of an occurrence [the *anaphor*] of one expression depends on the interpretation of an occurrence of another [the *antecedent*]". The anaphor and its antecedent can be in the same or different sentences, and the anaphor can appear before or after its antecedent in the discourse. If the anaphor comes after its antecedent, there is an example of *forward*

Amanda Maraschin Bruscato, Jorge Baptista

anaphora or just *anaphora*; see example (1)[4]. Otherwise, there is an example of *backwards anaphora* or *cataphora* (2). In this study, we will use the term *anaphora* to talk about both, anaphora and cataphora, when it is not relevant to differentiate them.

(1)   John$_i$ ignored Mary while he$_i$ was on the phone.
(2)   While he$_i$ was on the phone, John$_i$ ignored Mary.

Examples (1) and (2) have *pronominal anaphora* since the anaphor is a pronoun. In Spanish or Portuguese, however, there is no need to use a pronoun in the subject position of the subordinate clause if the antecedent is also in the subject position of the main clause. These languages are called *pro-drop languages*, also known as *null subject* languages (Chomsky, 1981; Rizzi, 1982). They allow *null* or *zero anaphora* when the antecedent is grammatically or pragmatically inferable, as seen in (3).

(3)   João$_i$ ignorou Maria enquanto Ø$_i$ estava no celular. [*John$_i$ ignored Mary while Ø$_i$ was on the phone*.]

However, if the subject of the subordinate clause is different from the one of the main clause, Spanish and Portuguese speakers use a personal pronoun, as seen in (4).

(4)   João ignorou Maria$_j$ enquanto ela$_j$ estava no celular. [*John ignored Mary$_j$ while she$_j$ was on the phone*.]

The examples so far are not ambiguous, and it is not difficult to identify the anaphor's antecedent. But if we change the name *Mary* to *Peter*, as in (5), would people think that the anaphor's antecedent is the subject or the complement of the main clause? Or maybe another referent, altogether - someone not mentioned at all in the sentence?

(5)   João$_i$ ignorou Pedro$_j$ enquanto ele$_{i,j}$ estava no celular. [*John$_i$ ignored Peter$_j$ while he$_{i,j}$ was on the phone*.]

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4. In this work, the indices (i, j) will be used to indicate the correference between the anaphors and their antecedents; the symbol Ø is a null form; and capital letters are used to represent stress/emphasis.

This is what the present study aims to find out. In other words, the focus of this research will be on intrasentential, coreferential, pronominal and zero anaphora with nominal human antecedents.

Traditionally, it has been argued that there is a preference in English to correlate the pronoun in a subject position to the subject of the main clause (Chambers & Smyth, 1998; Crawley *et al.*, 1990), as seen in (6), unless it is stressed. In this case, stressed pronouns in subject position would impose a different (disjoint) interpretation from the subject of the main clause (Luján, 1986; Smyth, 1994), as seen in (7). This behavior would be analogous to what speakers of null subject languages do regarding the distinction between using zero anaphora (null pronoun) and pronominal anaphora (unstressed overt pronouns).

(6) John$_i$ ignored Peter while he$_i$ was on the phone.
(7) John ignored Peter$_j$ while HE$_j$ was on the phone.

Carminati's (2002) Position of Antecedent Strategy (PAS) explains that the interpretation of the anaphor in Italian sentences with intrasentential anaphora depends on the syntactic function of its antecedent. Null pronouns in the subject position usually point back to the subject of the main clause (as in (3)), while unstressed overt pronouns in the subject position usually point back to the complement of the main clause (as in (4)). However, it is not clear if this theory would apply to the differences between unstressed and stressed pronouns in a non-null subject language like English.

In this paper, we will test PAS with English and Spanish learners and native speakers, as well as with Brazilian (BP) and European (EP) Portuguese native speakers. Many authors (Duarte, 2000; Holmberg *et al.*, 2009; Kempchinsky, 1984) claim that Brazilian Portuguese, unlike European Portuguese, is one of the "partial null-subject languages, that is, languages which allow null subjects but under more restricted conditions than consistent null-subject languages" (Holmberg *et al.*, 2009, p. 1). Thus, ambiguity resolution might differ in these varieties.

Apart from the salience of the anaphor, the order of the clauses may also affect anaphora resolution. The hypothesis of the *Active Search Mechanism* (ASM), from Kazanina *et al.* (2007), suggests that, in cases

of pronominal cataphora in English (as in (8)), speakers would choose the first possible antecedent that appears after the anaphor. Usually, the first possible antecedent is the subject of the main clause.

(8)   While he$_i$ was on the phone, John$_i$ ignored Peter.

Previous studies have considered the effects of the order of the clauses and the salience of the anaphor on ambiguity resolution, as well as the influence of L1 on the process of anaphora resolution in L2. Sorace and Filiaci (2006) have tested the resolution of ambiguous anaphora in Italian, AlonsoOvalle et al. (2002) and Keating et al. (2011) in Spanish, Valenzuela et al. (2011) in Spanish and English, and Lobo and Silva (2016) in Portuguese. However, few studies compare anaphora resolution in multiple languages, and Portuguese is not usually included in them. They also do not specify semantic criteria for the verb selection in the exercises. Our study, on the other hand, not only specifies them, but investigates how different combinations of verbs can affect anaphora resolution.

Inspired by Valenzuela *et al.* (2011), the resolution of zero and pronominal forward and backwards anaphora in Spanish and Portuguese will be compared to non-emphatic and emphatic pronominal forward and backwards anaphora in English. After our pilot-studies (Bruscato & Baptista, 2022a, 2022b), we have expanded our research to investigate how L1 and L2 speakers solve ambiguity in these languages.

3. Method

As it was stated in the Introduction, the purpose of this study is to determine: (a) how ambiguity resolution strategies differ in English, Spanish, and Portuguese; (b) how L2 learners are influenced by their L1 regarding ambiguity resolution; and whether (c) the order of the main and subordinate clauses, (d) the salience of the anaphor, or (e) the lexical choice of verbs may affect this process.

A quantitative approach was employed to determine the factors that affect ambiguity resolution. A written questionnaire was designed based on Valenzuela *et al.* (2011) and, after approval from the ethics

committee was obtained, it was sent online to undergraduate students from the language department at the Federal University of Rio Grande do Sul (in March 2020) and at University of Algarve (in October 2020). The questionnaire, available in Google forms, was also shared on the researchers' social media to reach more English and Spanish native speakers. Everyone's participation was anonymous and voluntary, and respondents expressed their agreement to take part in the research.

A total of 181 people from 18 to 54 years old (median of 20 years) have answered the survey. Almost 70% of the sample was female, and more than 90% of them studied at a university. There were 78 Portuguese and 73 Brazilian undergraduate students who were learning English (61 and 56, respectively) or Spanish (17 and 17) as a foreign language, as well as 20 English and 10 Spanish native speakers.

In the first moment, Portuguese native speakers answered 20 questions from Cambridge or Cervantes' reading proficiency tests, distributed between levels A2, B1, B2 and C1. Then, participants were asked to select the subject of 20 sentences in each language, of which 16 were ambiguous sentences. Example (9), below, illustrates the task:

(9) Matthew harassed George when HE interviewed him.
      Who interviewed?
      a) Matthew
      b) George
      c) Another person

These sentences had a person's name in the subject position, a verb in the simple past, another person's name in the object position, the temporal conjunction *when/cuando/quando*, a third-person pronoun in the subject position (or ellipsis in Portuguese and Spanish), another verb in the simple past, and a third-person pronoun in the object position. The verbs were selected from the same type of a verbal constructions database (Baptista, 2013): in this case, the verb construction requires (or semantically selects) a human agent for subject, a human patient for object and no further complement. Respondents had to choose one of the three options for the antecedent of the reduced (pronoun or zero) subordinate clause's subject: this anaphor could refer to (a) the

subject of the main clause, (b) the complement of the main clause, or (c) another referent (who has not been mentioned in the main clause).

Half of the sentences had anaphora, and the other half had cataphora. Half of them had a salient anaphor (unstressed pronoun in Portuguese or Spanish; stressed pronoun in English), and the other half had a non-salient anaphor (ellipsis in Portuguese or Spanish; unstressed pronoun in English). Participants were instructed to consider pronouns written in capital letters as stressed[5]. Sentence (9), above, showed an example of stressed pronominal anaphora, while sentence (10), below, shows an example of unstressed pronominal cataphora in English.

(10) When he interviewed him, Matthew harassed George.

The examples above are part of the set of sentences designed to have a "neutral" combination of verbs, that is, where little, if any, semantic interference can be detected between the choice of the verbs and the reference resolution strategy adopted. Half of the sentences were designed in this way. The other half was designed to have "tendentious" pairs of verbs, that is, verbs that in that combination preferably point back either to the subject or to the complement of the verb in the main clause. Below, sentence (11) was designed to elicit a preference for resolving the anaphor as referring to the subject of the main clause; and in sentence (12) to the complement of the main clause.

(11) Julia disrespected Paula when she betrayed her.
(12) When she fined her, Laura bribed Lucy.

In the appendix of this paper, all sentences in the three languages are presented. In the next section, results are presented and discussed. Statistical analysis was performed using SPSS software (version 26). The small size of the dataset means that it is not possible to generalize conclusions. However, it contributes to test the syntactic and semantic hypothesis in the languages.

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5. Although we only had written data, we wanted to know if learners would consider the opposition between stressed and unstressed pronouns in English as the opposition between unstressed pronouns and ellipsis in Portuguese. However, we recognise that the lack of spoken data is a limitation of this study.

4. Results and Discussion

4.1. Proficiency test

As it was said before, Portuguese speakers answered a small reading proficiency test in their target language before performing the task of selecting the subjects of the ambiguous sentences. The results are shown in Table 1.

Table 1 – Proficiency test

	Portuguese students			Brazilian students		
	N	Mean	SD	N	Mean	SD
Advanced Spanish	13	18	1	8	18	1
Intermediate Spanish	4	13	2	9	12	1
Total Spanish	17	16	3	17	15	3
Advanced English	23	18	1	21	17	1
Intermediate English	38	13	2	35	13	2
Total English	61	15	3	56	14	3

In general, Portuguese and Brazilian students presented similar results in this initial test, though participants from Portugal and Spanish learners achieved a slightly higher score than the others, as seen in Table 1. To identify whether there is a difference in anaphora resolution depending on the respondents' proficiency level in the language, we have decided to divide the sample in two groups: intermediate and advanced learners of each language.

In the next section, we will analyse how Portuguese speakers resolve ambiguous anaphora in their native language. Then, we will analyse the results in Spanish and, finally, in English. The tables present the percentages of answers for the following situations:

– intrasentential anaphora and cataphora;

– anaphor: unstressed pronoun or ellipsis in Portuguese and Spanish, stressed or unstressed pronoun in English;

– antecedent: subject, complement or other;

– verb combination: neutral or biased.

Amanda Maraschin Bruscato, Jorge Baptista

The results related to the Position of Antecedent Strategy (PAS) were highlighted in **bold**. When we present the results for the biased sentences, we will mark the expected preference with an asterisk (*). Results are given in percentage of answers: for each cell in the tables, a pair of sentences was tested for all the participants in the sample.

4.2. Portuguese sentences

The Portuguese results were collected from 78 Portuguese and 73 Brazilian undergraduate students of languages. First, we will present the percentages of answers for the neutral sentences. Then, we will compare them with the biased ones.

Table 2 – Neutral sentences in Portuguese (%)

Subject		European Portuguese (N=78)			Brazilian Portuguese (N=73)		
		Comple-ment	Other	Subject	Comple-ment	Other	
Anaphora	Pronominal	23	**75.6**	1.4	29	**71**	0
	Zero	**75**	25	0	**90**	10	0
Cataphora	Pronominal	35	**57**	8	37	**59.6**	**3.4**
	Zero	**87**	13	0	**82**	18	0

As we can see in Table 2, results from EP and BP speakers are very similar, though in cases of zero anaphora Brazilians tend to relate the ellipsis with the subject more than Portuguese people do (90% and 75% respectively). They all seem to follow the Position of Antecedent Strategy. Nonetheless, the strategy is not as strong in cases of pronominal cataphora as it is in cases of pronominal anaphora. The alternative *other* was only chosen when the anaphor was a pronoun, and it was chosen much more often in cases of cataphora than of anaphora. These results indicate that pronominal cataphora is more difficult to resolve than the other types of anaphora.

Table 3 – Biased sentences in Portuguese (%)

Subject		European Portuguese (N=78)			Brazilian Portuguese (N=73)		
		Comple-ment	Other	Subject	Comple-ment	Other	
Anaphora	Pronominal	6.4	**93***	0.6	4	**96***	0
	Zero	**88***	12	0	**95***	5	0
Cataphora	Pronominal	68*	**28**	4	60*	**40**	0
	Zero	**45.5**	54.5*	0	**61**	39*	0

If we compare the results from Tables 2 and 3, it becomes clear that participants' answers were influenced by the biased sentences. When the verb combination resulted in a preference corresponding to PAS (cases of anaphora), those percentages have increased. On the other hand, when the verb combination resulted in a preference opposite to PAS (cases of cataphora), their preferential choice has changed. Participants seem to be more influenced by semantics than by syntax when trying to resolve ambiguous anaphora, except for Brazilians, who still seem to be influenced by PAS when there is an ellipsis in subject position. As we have seen in Table 2, in Table 3 the alternative *other* was only chosen when the anaphor was a pronoun, and especially in cases of cataphora. This time, however, this option was chosen only by Portuguese students.

4.3. Spanish sentences

While the Portuguese questionnaire was completed only by native speakers, the Spanish one was completed by 10 native speakers, 17 learners from Portugal, and 17 learners from Brazil. Again, the results for the neutral sentences will be presented before the results for the biased ones.

Table 4 – Neutral sentences in Spanish (%)

Subj.		Spanish native speakers (N=10) Adva. (N=13)			Portuguese students (N=17)					Brazilian students (N=17)			
					Inter. (N=4)			Adva. (N=8)		Inter. (N=9)		Adva. (N=8)	
		Subj.	Comp.	Other	Subj.	Comp.	Other	Subj.	Comp.	Subj.	Comp.	Subj.	Comp.
Anap.	Pron.	65	**35**	0	42	**58**	0	37.5	**62.5**	44	**56**	39	**61**
	Zero	**75**	25	0	**61.5**	38.5	0	**75**	25	**94**	6	**94**	6
Cata.	Pron.	60	**35**	5	34.5	**61.5**	4	62.5	**37.5**	56	**44**	50	**50**
	Zero	**90**	10	0	**73**	27	0	**75**	25	**69**	31	**83**	17

In our previous studies (Bruscato & Baptista, 2022a, 2022b), we had the participation of only 5 Spanish native speakers (all learners of Portuguese), and respondents seemed to follow PAS, except for cases of pronominal cataphora. Now that we have twice as many participants (not learners of Portuguese), we can see that the exception was not only in cases of pronominal cataphora, but also of pronominal anaphora. It seems that, although Spanish native speakers tend to interpret the ellipsis in subject position of the subordinate clause as corresponding to the subject of the main clause more than they do when the anaphor is a pronoun, they do not tend to interpret the unstressed pronoun in subject position of the subordinate clause as corresponding to the complement of the main clause. These results corroborate the findings of Alonso-Ovalle et al. (2002) and Keating et al. (2011).

Spanish learners tend to interpret ellipsis in the subject position of the subordinate clause as corresponding to the subject of the main clause, especially Brazilians in cases of zero anaphora. However, participants did not show a clear preference for the antecedent of the pronoun. Again, the alternative *other* was only chosen in cases of pronominal cataphora, and only by native speakers and Portuguese advanced learners. In fact, the two groups of EP speakers presented opposite results for pronominal cataphora, and the intermediate learners were closer to native speakers than advanced learners. It is important to say that the size of each group was very different, and the intermediate one only had 4 participants.

Table 5 – Biased sentences in Spanish (%)

Subj.		Spanish native speakers (N=10) Adva. (N=13)		Portuguese students (N=17)				Brazilian students (N=17)		
				Inter. (N=4)		Adva. (N=8)		Inter. (N=9)		
		Comp.	Subj.	Comp.	Subj.	Comp.	Subj.	Comp.	Subj.	Comp.
Anap.	Pron.	0	100*	11.5	88.5*	0	100*	25	75*	17	83*
	Zero	80*	20	81*	19	62.5*	37.5	100*	0	83*	17
Cata.	Pron.	85*	15	69*	31	50*	50	87.5*	12.5	67*	33
	Zero	30	70*	69	31*	62.5	37.5*	50	50*	72	28*

If we compare Tables 4 and 5, we can see that participants' answers were influenced by the verb combination of the biased sentences, especially the natives' ones. When there was a semantic preference corresponding to PAS, those percentages have increased, except for intermediate learners, whose preferential choice for zero anaphora has decreased, although it was still the subject of the main clause. When the semantic preference was opposite to PAS, native speakers were more influenced by semantics. Although learners were also influenced by semantics, their preferential choice has only changed for pronominal cataphora (except for Portuguese intermediate learners, who did not show a preference - but, again, there were only 4 participants in this group). As we have seen with the Portuguese biased sentences, Portuguese speakers still seem to be influenced by PAS when there is an ellipsis in subject position. Thus, their choice to correspond the ellipsis in subject position of the subordinate clauses to the subject of the main clauses decreased in cases of zero cataphora, but it was still their preference.

4.4. English sentences

Finally, the English questionnaire was completed by 20 native speakers, 61 learners from Portugal, and 56 learners from Brazil. As in the other sections, the results for the neutral sentences will be presented before the results for the biased ones.

13

Amanda Maraschin Bruscato, Jorge Baptista

Table 6 – Neutral sentences in English (%)

Subj		English native speakers (N=20) Adva (N=23)			Portuguese students (N=61)						Brazilian students (N=56)			
					Inter (N=38)			Adva (N=21)			Inter (N=35)			
		Comp	Oth	Subj	Comp	Oth	Subj	Comp	Oth	Subj	Comp	Subj	Comp	Oth
Anap	Stres	72.5	**22.5**	5	46	**54**	0	43	**57**	0	31	**69**	41	**59**	0
	Unstr	**65**	35	0	**59**	41	0	**51**	49	0	**60**	40	**53**	47	0
Cata	Stres	65	**27.5**	7.5	54	**46**	0	49	**51**	0	26	**74**	61.5	**37**	1.5
	Unstr	**87.5**	12.5	0	**74**	24	2	**63**	35.5	1.5	**50**	50	**49**	51	0

As we have reported in previous studies (Bruscato & Baptista, 2022a, 2022b), English native speakers do not seem to be influenced by the order of the clauses or the salience of the anaphor. They tend to interpret the anaphor as corresponding to the subject of the main clause. Learners, on the other hand, do not show a clear preferential interpretation. They seem uncertain in most of the cases, except for Brazilian advanced students, who seem to interpret the stressed pronoun in subject position of the subordinate clause as corresponding to the complement of the main clause; and Portuguese students, who seem to interpret non-emphatic pronominal cataphora as corresponding to the subject of the main clause.

Table 7 – Biased sentences in English (%)

Subj		English native speakers (N=20) Adva (N=23)			Portuguese students (N=61)						Brazilian students (N=56)			
					Inter (N=38)			Adva (N=21)			Inter (N=35)			
		Comp	Oth	Subj	Comp	Oth	Subj	Comp	Oth	Subj	Comp	Subj	Comp	Oth
Anap	Stres	37.5	**57.5***	5	15	**85***	0	24	**76***	0	21	**79***	25.5	**73***	1.5
	Unstr	**80***	20	0	**76***	24	0	**66***	34	0	**57***	43	**67***	33	0
Cata	Stres	**80***	15	5	78*	**17.5**	4.5	**87***	13	0	**83***	17	76*	**24**	0
	Unstr	45	55*	0	54.5	43.5*	2	**46**	52.5*	1.5	38	62*	47	51.5*	1.5

Finally, when we compare Tables 6 and 7, it becomes clear that participants are again influenced by the biased sentences. However, although learners are influenced by semantics regarding non-emphatic pronominal cataphora, they still seem uncertain about the best alternative for the antecedent of the pronoun.

After the percentages presented in the tables were obtained from SPSS, multiple t-tests were conducted to determine what may have affected the choice of the antecedent in the pairs of sentences. The tests have shown that Portuguese speakers' results were influenced at the 0.001 significance level by the salience of the anaphors in the three languages when there was no semantic opposition to the Position of Antecedent Strategy. Although Spanish and English native speakers were not influenced by the order of the clauses or by the salience of the anaphors, participants from all languages were influenced by the semantic relation between the verbs (p < 0.03). Students from different Portuguese varieties and with distinct proficiency levels did not significantly differ from one another.

5. Conclusions

This study expanded previous research (Bruscato & Baptista, 2022a, 2022b) and aimed to determine: (a) how ambiguity resolution strategies differ in English, Spanish, and Portuguese; (b) how L2 learners are influenced by their L1 regarding ambiguity resolution; and whether (c) the order of the main and subordinate clauses, (d) the salience of the anaphor, or (e) the lexical choice of verbs may affect this process.

A total of 181 people answered an online survey and selected the antecedent of the anaphor for 16 ambiguous sentences. We tested the Position of Antecedent Strategy (PAS) for the three languages and compared the influence of semantics and syntax on the resolution of ambiguous anaphora.

We have concluded that Portuguese native speakers seem to follow the Position of Antecedent Strategy to resolve ambiguous anaphora and that Brazilian speakers tend to interpret zero anaphora as corresponding to the subject of the main clause more than Europeans do. For participants from both varieties, however, it seems that pronominal cataphora is more difficult to resolve than the other types of anaphora. Although most of the participants only chose the subject or the complement of the main clause as the antecedent of the anaphor, some of them chose another referent (which was not previously stated

in the sentence) as the antecedent in cases of pronominal cataphora, as it had been observed before in Italian by Sorace and Filiaci (2006).

The Position of Antecedent Strategy was not confirmed with Spanish nor with English native speakers. Both native groups tend to interpret the subject of the subordinate clause as corresponding to the subject of the main clause, though Spanish native speakers have a stronger preference to establish that correspondence in cases of zero anaphora rather than of pronominal anaphora.

When learning a foreign language, Portuguese native speakers seem to be influenced by their L1 anaphora resolution strategy (PAS) regardless of their level of proficiency in the L2. In Spanish, Brazilians again tend to interpret zero anaphora as corresponding to the subject of the main clause more than Europeans do. However, learners have shown some uncertainty to choose the antecedent of the pronoun in Spanish (especially in cases of cataphora) and in English.

Finally, the results from the "neutral" and "biased" sentences were quite different. Although Portuguese speakers were still influenced by PAS, especially when the anaphor was an ellipsis in Portuguese or Spanish, we have concluded that the lexical choice of verbs and the meaning relation between them has a great influence on the task resolution of ambiguous anaphora. This aspect of the study has received little attention (if any) in previous studies. In view of these results, we posit that the semantics of the verb combination should also be considered when producing ambiguous sentences for anaphora resolution tasks.

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Conflict of interests

The authors declare they have no conflict of interest.

Credit Author Statement

We, Amanda Maraschin Bruscato and Jorge Baptista, hereby declare that we do not have any potential conflict of interest in this study. We have all participated in study conceptualization, study design, data collection, data analysis, and editing. All authors approve the final version of the manuscript and are responsible for all aspects, including the guarantee of its veracity and integrity.

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Appendix 1

Sentences in English
    1. Anna insulted Carolina when SHE blackmailed her.
    2. When she blackmailed her, Anna insulted Carolina.
    3. Mary hugged Joanna when she hired her.
    4. When SHE hired her, Mary hugged Joanna.
    5. Anthony strangled Carl when he tortured him.
    6. When HE tortured him, Anthony strangled Carl.
    7. Matthew harassed George when HE interviewed him.
    8. When he interviewed him, Matthew harassed George.
    9. Julia disrespected Paula when she betrayed her.
    10. When SHE betrayed her, Julia disrespected Paula.
    11. Laura bribed Lucy when SHE fined her.
    12. When she fined her, Laura bribed Lucy.
    13. John handcuffed Peter when he kidnapped him.
    14. When HE kidnapped him, John handcuffed Peter.
    15. Luke castigated Louis when HE confronted him.
    16. When he confronted him, Luke castigated Louis.
    17. Arthur helped Alice when SHE called him.
    18. When she called him, Arthur helped Alice.
    19. Diana kissed Daniel when she visited him.
    20. When SHE visited him, Diana kissed Daniel.

Sentences in Spanish
    1. Ana insultó a Carolina cuando ella la chantajeó.
    2. Cuando la chantajeó, Ana insultó a Carolina.
    3. María abrazó a Juana cuando la contrató.
    4. Cuando ella la contrató, María abrazó a Juana.
    5. Antonio estranguló a Carlos cuando lo torturó.
    6. Cuando él lo torturó, Antonio estranguló a Carlos.
    7. Mateus acosó a Jorge cuando él lo entrevistó.
    8. Cuando lo entrevistó, Mateus acosó a Jorge.
    9. Julia irrespetó a Paula cuando la traicionó.
    10. Cuando ella la traicionó, Julia irrespetó a Paula.
    11. Laura sobornó a Lucía cuando ella la multó.
    12. Cuando la multó, Laura sobornó a Lucía.
    13. Juan esposó a Pedro cuando lo secuestró.
    14. Cuando él lo secuestró, Juan esposó a Pedro.
    15. Lucas castigó a Luís cuando él lo confrontó.
    16. Cuando lo confrontó, Lucas castigó a Luís.

17. Arturo ayudó a Alice cuando ella lo llamó.
18. Cuando lo llamó, Arturo ayudó a Alice.
19. Diana besó a Daniel cuando lo visitó.
20. Cuando ella lo visitó, Diana besó a Daniel.

Sentences in Portuguese

1. Ana insultou Carolina quando ela a chantageou.
2. Quando a chantageou, Ana insultou Carolina.
3. Maria abraçou Joana quando a contratou.
4. Quando ela a contratou, Maria abraçou Joana.
5. António estrangulou Carlos quando o torturou.
6. Quando ele o torturou, António estrangulou Carlos.
7. Mateus assediou Jorge quando ele o entrevistou.
8. Quando o entrevistou, Mateus assediou Jorge.
9. Júlia desrespeitou Paula quando a traiu.
10. Quando ela a traiu, Júlia desrespeitou Paula.
11. Laura subornou Lúcia quando ela a multou.
12. Quando a multou, Laura subornou Lúcia.
13. João algemou Pedro quando o sequestrou.
14. Quando ele o sequestrou, João algemou Pedro.
15. Lucas castigou Luís quando ele o confrontou.
16. Quando o confrontou, Lucas castigou Luís.
17. Artur ajudou Alice quando ela o chamou.
18. Quando o chamou, Artur ajudou Alice.
19. Diana beijou Daniel quando o visitou.
20. Quando ela o visitou, Diana beijou Daniel.