Ambiguity recognition and resolution in L1 Arabic–English bilinguals: Exploring the role of structure type

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Prior studies have not researched whether different ambiguity types modulate recognition and resolution behaviours in sentence processing. The present study examines the processing of multiple ambiguity types. The objective is to establish if differences in structure type exert influence upon recognition frequency and resolution choice. Offline questionnaires were modified from previous studies and used in two experiments. Questionnaires contained 40 sentences: 20 ambiguous and 20 unambiguous. Target sentences included two types of local ambiguity and six types of global ambiguity. Participants were English monolinguals and L1 Arabic–English bilinguals. Bilinguals completed both experiments in Arabic and English to test for L1 influence upon L2 processing. Experiment 1 found that clause length ambiguities were recognised more frequently than relative clause attachment. Local ambiguity was recognised more frequently than global in both bilinguals' languages. Experiment 2 found that bilinguals preferred resolution choices with high attachment and long clauses modifying short clauses, even when ambiguity type and input language were varied (p = 0.01). Overall, ambiguity recognition was found to be sensitive to ambiguity type, but ambiguity resolution was not. Resolution results also show that L1 exerts considerable influence on L2 parsing decisions.

Keywords: *Ambiguity type, recognition, resolution, bilingual, language transfer*

1. Background

Research into the *recognition* and *resolution* of syntactic ambiguities provides insight into how languages are acquired, stored, retrieved and processed (Clifton & Staub 2008; Harley 2014). Ambiguous syntax has provided fertile grounds for psycholinguistic research into the parsing mechanisms used in offline and online sentence processing. Early studies focused on monolinguals, with a particular emphasis on the processing of reduced relative clauses (Frazier & Rayner 1982; Trueswell & Tanenhaus 1991; Pickering & Traxler 1998) and relative clause (RC) attachment (Cuetos & Mitchell 1988; Gibson et al. 1996; Abdelghany & Fodor 1999; Ehrlich et al. 1999). In the past two decades, a dramatic rise in *bilingual* educational environments coupled with increased interest in second-language processing mechanisms has shifted the research focus toward bilingualism. These studies contribute important findings on how the brain houses and processes multiple languages. Much of this research explores the theory that L1 and L2 interact during sentence processing. The bilingualism literature shows that different types of *language transfer* can occur in ambiguity resolution tasks. Fernandez (1998) and Frenck-Mestre (2002) found L1 transfer in L2 processing, whereas Dussias (2003) found L2 transfer in L1 processing. Both these studies reported evidence of language co-activation during the parsing of syntactic ambiguity in sentences. This raises an important question about whether the syntax processing mechanisms activated in bilinguals' sentence comprehension are different from those activated in monolinguals. Therefore, when exploring the nature of bilingual syntax processing, studies have frequently compared monolingual and

bilingual data (Fernandez 1998, 2002, 2003; Dussias 2003; Ahn Ha 2005; Dussias et al. 2007; Dussias & Scaltz 2007; Hsieh 2010; Papadopoulou & Clahsen 2003). This comparative approach is taken in the present study.

The motivation for this study comes from two sources: a gap in the literature and a strong theoretical interest in testing the limits of language transfer in L1/L2 processing. Despite the volume of studies in the field, none have addressed questions of whether *ambiguity type* modulates recognition rates or resolution choices. While some studies have established language transfer effects on L1/L2 processing, these effects were derived from only one ambiguity type. The question of whether such effects are observable across a range of ambiguity types is still unanswered. The answer has important implications for existing theories of syntactic ambiguity processing in bilinguals. In addition to this, the question of whether L1 influences L2 processing, or vice versa remains unresolved. In the present study the term 'ambiguity type' refers to ambiguous structures which are different with respect to their grammatical construction. The term 'ambiguity form' refers to local ambiguity or global ambiguity.

2. Literature review

2.1 *Studies into recognition and resolution of syntactic ambiguity*

The majority of psycholinguistic research into syntactic ambiguity processing has selected one specific ambiguous syntactic structure, or ambiguity type, for investigation. Selected examples include personal pronoun (PP) ambiguity (Frenck-Mestre & Pynte 1997), RC attachment (Bidaoui et al. 2016; Dussias 2003; Fernandez, 2002), garden path sentences (Frazier & Rayner 1982; Marefat & Nushi 2005), direct object vs embedded subject local ambiguities (Dussias & Scaltz 2007) and reduced relative clauses (Ni et al. 1996). Few studies have examined the recognition or resolution of multiple ambiguity types, and this continues to be the case, especially in understudied Semitic languages like Arabic.

Prideaux & Baker (1976) compared recognition rates between *lexical* and *structural ambiguities*; their *anova* and t-test calculations revealed a significant difference between both ambiguity domains, suggesting that word-based vs structural-based ambiguity was more likely to be recognised. However, this paper did not compare types of syntactic ambiguity and did not investigate bilinguals, thus limiting its value in predicting results. Early studies focussing on the development of metalinguistic processes in children shed light on cognitive distinctions in the behaviours of monolinguals and bilinguals (Bialystock 1988; Cromdel 1999). These findings showed that although monolingual and bilingual children were equally capable of detecting grammatical violations in meaningful sentences (e.g. *Apples growed on trees*), bilinguals were more accurate at identifying semantic anomalies (e.g. *Apples grow on noses*). For such anomalies, Bialystok & Craik (2010) argue that effective performance needs the skill to 'ignore…misleading meaning and focus only on the grammar' (pp.3-4). In their paper, it is argued that bilinguals' superior performance in evaluating sentence acceptability is unrelated to metalinguistic knowledge but associated with a concentration advantage for 'selectivity and inhibition' core components of executive functioning (Bialystok & Craik 2010: 19–20). In other words, a *bilingual advantage* for sentence acceptability judgements is unconnected with metalinguistic knowledge but related to "selectivity and inhibition", core components of executive functioning (Bialystok & Craik 2010: 19–20). However, this understanding of the

bilingual advantage in relation to sentence acceptability is not universally shared. Cook (1997) discusses a similar study into grammatical awareness by Goldin-Meadow (1990), which found that bilingual children moved through the initial stage of 'content-orientated awareness' more rapidly than their monolingual counterparts (pp.16). He argues that bilinguals experience of an L2 improves their metalinguistic knowledge (Cook, 1997). There is further evidence of a bilingual advantage for tasks involving conflict monitoring, cognitive control and garden-path recovery (Mischler et al. 2011; Teubner-Rhodes et al. 2016). This advantage is characterised in the context of a theory involving the monitoring of conflict (Costa et al. 2009; Hilchey & Klein 2011), whereby bilingualism confers "a superior ability to detect conflict" and exercise cognitive control for its resolution (Teubner-Rhodes et al. 2016: 224). The tasks in question were recognition, memory and sentence comprehension, making these experimental findings relevant for the present study. Although prior research offers little insight into the impact of ambiguity type for recognition, more recent studies suggest a bilingual advantage for linguistic recognition tasks (Mischler et al. 2011; Teubner-Rhodes et al. 2016). These studies are helpful as they suggest that monolingual and bilingual recognition data will be different.

To understand the cognitive architecture of language processing in bilinguals, it is important to consider whether both languages interact, overlap, inhibit or dominate each other. Is bilingual ambiguity resolution an interactive process or a language-independent affair? The question has been extensively investigated in offline, online and neurolinguistic studies that have chiefly focused on lexical and syntactic linguistic phenomena. There is compelling evidence against language-independent processing behaviours. According to Fernandez (2002: 210) "language dominance" effects in L1 Spanish–English bilinguals explain comparable "attachment preferences" in both input languages. Language dominance findings have been replicated using online experiments; eye-tracking studies have shown that advanced bilinguals exhibit "native-like" structural ambiguity sensitivities and processing behaviours in their second language (Frenck-Mestre 2002: 12). A seminal study (Dussias 2003) found evidence of L2 dominance for L1 processing; L1 Spanish–English and L1 English–Spanish bilinguals all favoured low attachment despite cross-linguistic differences in attachment preferences in Spanish and English. There is evidence that bilinguals incorporate information for sentence processing differently from native speakers (Papadopoulou & Clahsen, 2003). The study investigated how L1 Spanish–Greek, L1 German–Greek and L1 Russian–Greek bilinguals and Greek monolinguals behaved in tasks involving grammaticality judgement and on-line self-paced reading. Both tasks involved the processing of temporarily ambiguous sentences. Findings showed that bilinguals, despite possessing 'native-like mastery' of target constructions under scrutiny, exhibited different RC attachment preferences in their L2 than monolinguals. The study argues that bilinguals relied more upon lexical cues than 'structurally-based parsing' mechanisms; whereby the L2 parser delays disambiguation until adequate lexical content biases interpretation toward low attachment (Papadopoulou & Clahsen 2003: 2).

Investigations into different script bilinguals have offered experienced-based accounts of ambiguity processing, whereby L2 exposure and age of L2 acquisition modulate L2 processing in L1 Korean–English bilinguals (Ahn Ha 2005) and L1 processing in L1 Spanish–English bilinguals (Dussias et al. 2007). Recent research into temporal ambiguity resolution in L1 Portuguese–English bilinguals (Soares et al. 2019) characterises age of acquisition as a powerful indicator of parsing strategies. Their study showed that low proficiency bilinguals displayed language-independent ambiguity resolution preferences in online resolution tasks, whereas high proficiency bilinguals exhibited L1-like syntax interference for L2 processing;

results showed that high L2 proficiency makes interactive parsing more likely than language-independent behaviours. The predicate proximity account (PPA; Gibson et al. 2006; for application to Arabic, see Bidaoui et al. 2016) presents another alternative to early theoretical models of ambiguity resolution preferences. This theory asserts that the structural properties of a language govern attachment preferences. Languages that allow greater distances between verbs and their complements are statistically likelier to favour high attachment, an important consideration for the present study. Application of the PPA to our study is discussed further in Sections 2.3 & 5.

2.2 *Syntactic ambiguity in English and Arabic*

Structural ambiguity is highly pervasive in natural language settings, literary works and informal conversation. Consider the newspaper headline (1), the Shakespearian quotation (2) and a common reported statement (3), as outlined below:

(1) *Red Tape Holds Up Bridge*

(2) *I do love nothing in the world so much as you*

(3) *John saw the man with binoculars*

In (1), the ambiguity arises because the idiomatic and literal meanings of 'red tape' briefly compete for selection before the reader realises the implausibility of the subject modifying a physical bridge. Such a sentence can be described as temporal or *local ambiguity*; such sentences mislead a reader to an incorrect parse, forcing reanalysis of the syntactic structure before arriving at the correct interpretation. In (2), the ambiguity is derived from two competing comparisons: (a) the speaker's love for the world vs the speaker's love for the recipient or (b) the speaker's love for the world vs the recipient's love for the world. Like (1), the ambiguity persists only temporarily before the reader selects (a) as the most plausible interpretation given the romantic context. In (3), it is unclear whether 'with binoculars' (PP) modifies 'the man' (N2) or 'John' (N1). This ambiguity persists, making (3) an example of *global ambiguity*; competing interpretations remain unresolved despite syntactic reanalysis. In (3), the attachment site of the PP has been shown to differ cross-linguistically: N2 for English (Frazier 1978, 1987; Frazier & Rayner 1982) and N1 for Arabic (Bidaoui et al. 2016). In addition to cross-linguistic differences in resolution preferences for RC attachment, the languages have other grammatical differences. These differences impact whether syntactic ambiguities map across both languages, a consideration for stimuli design.

Before examining how syntactic ambiguity is characterised in Arabic, some distinguishing features of Arabic grammar need to be presented. These features impact how syntactic ambiguity may dissipate when English sentences with syntactic ambiguity are translated into Arabic. Arabic sentence structure exhibits high syntactic flexibility with Verb-Subject-Object, Subject-Verb-Object and Verb-Object-Subject functioning as acceptable word order formats. In Arabic, PPs are added to verbs, as in 'My father, he lives in Pembrokeshire'. Relative pronouns do not distinguish between humans and inanimate objects, and the pronouns' object is retained in a restrictive RC: 'Here is the student, which you met her last week'. Nouns are multifunctional and can function as prepositions, adverbs, quantifiers and adjectives. Arabic sentences possess rich morphological-syntactic agreement, which involves five

features: number, gender, case, person and definiteness (Abi Samra 2003; Attia 2008). Therefore, the ambiguous syntax in English, which relies upon a rigid word order, a reduced RC or limited agreement morphology, may not be ambiguous when translated. To effectively map ambiguous syntax across both languages, ambiguous sentences that exist in both languages must be identified. According to Diami (2001), there are five categories of syntactic ambiguity found in Arabic, as explained in Table 1 below:

Table 1: Categories of syntactic ambiguity in Arabic

CATEGORY	SUB-CATEGORY WITH EXAMPLES
I. Ambiguity in Anaphoric Reference *Definition and commentary* This category involves attachment to nouns, whereby latent personal pronouns (LPP) and connected personal pronouns (CPP) combine with nouns in ambiguous ways. In both i) and ii), 'to go/he is doing well' may modify either Ahmad (N1) or Ali (N2).	**i) Latent Personal Pronouns** سأل احمد علي أن يذهب *Yadhab an Ali Ahmed Sa'al* Ahmad asked Ali to go. **ii) Connected Personal Pronouns** أخبر أحمد علي أن مستواه جيد. *jaydun Musawah anaa Ali Ahmed akhbara* Ahmed told Ali that he is doing well.
II. Ambiguity in Control *Definition and commentary* In sentences exhibiting this ambiguity type, a circumstantial object or an adjective may modify either of two nouns. In (i), the circumstantial object, or verb in English, modifies either N1 or N2; in (ii), the adjective does likewise.	**i) The Circumstantial Object** استقبل احمد علي مبتسما. *mobtaseman Ali Ahmed istaqbala* Ahed received Ali smiling. **ii) The Adjective** كاتبة قصص عراقية *irakiya quessassin katibato* Iraqi novels writer.
III. Ambiguity in Prepositional Phrase (PP) or Adverb Attachment *Definition and commentary* The ambiguous region may be the adverb or prepositional phrase (PP), causing conflict in clause length interpretation. In (i), the phrase 'it is cold on the mountain' may link to the adverb, or, 'on the mountain' may modify the main clause. In (ii), a similar conflict applies.	**i) The Adverb** قال حمد فوق الجبل الجو بارد *.baredun aljawoo aljabalee fawqa Ahmed qala* Ahmed said it is cold on the mountain. **ii) The Prepositional Phrase** قال احمد في البيت الجو بارد *.baredun aljawo albaytee fee Ahmed qala* Ahmed said it is cold at home.
IV. Ambiguity of Scope *Definition and commentary* This category includes 'the attracted', attachment to nouns or coordinations and verb case ambiguities. In (i), either the speaker saw a woman carrying two people (boy & girl) or saw a woman carrying a boy and a girl (somewhere else). In (ii), the adjective modifies either 'students' or both	**(i) The Attracted** رأيت أمرأة حاملة طفلاً و طفلة *tiflatan wa tiflan hamelatan imra'atan ra'ayto* I saw a woman carrying a boy and a girl. **(ii) Attachment to nouns or coordinations** جاء الطلاب و المدرسون المتميزون

'students and teachers'. The sentence in (iii) is ambiguous in Arabic; the flexible word order means that 'saqata-mata' or 'saqata-sama' could be the attracted-attractive pair.	*almutamayezun almudarysun wa altalabo ja'a* The distinguished students and teachers came. **(iii) Attachment to Verbs** مات الرجل ما أن سمع بالخبر وسقط على الأرض *.alardi ala saqata wa balkhabar samaa an ma alrajol mata* The man died and fell on the floor when he heard the news.
V. Ambiguity in Comparatives *Definition and commentary* The noun after a superlative noun (in Arabic) causes attachment ambiguity. Either a) *Yousif* (N2) and *Marwan* (N3) are being compared, or b) N1-N2 are being compared with N2-N3.	**(i) Attachments to Verbs and Noun** .يحترم احمد علي أكثر من زياد *Ziad min akthir Ali Ahmed yahtarim* Ahmed respects Ali more than Ziad.

Modified from Diami (2001)

In Arabic, ambiguity categories (I)–(V) show sentences that are locally or globally ambiguous in English; sentence (I).ii is an exception because it violates English grammar rules. It is important to recognise that Arabic grammar functions to disambiguate some ambiguous syntax in English, an issue that is given further consideration in the methods.

2.3 *The present study*

The first experiment sought to establish whether different ambiguity types have different recognition frequencies. The goal was to ascertain whether some structures are easier or more difficult to perceive in sentences, relative to each other. In relation to the ambiguity form, the ungrammatical nature of locally ambiguous structures makes them more recognisable than global ones. Some research has argued that certain types of local ambiguity, i.e. reduced relative structures, occur more infrequently in natural language than main verb structures or others (Bever 1970 as cited from Long & Prat 2008: 375). For these reasons, it was expected that local ambiguity would be more frequently recognised than global. Regarding different types of local or global ambiguity, no predictions were made as to whether certain types would be recognised more or less frequently than others. It was further predicted that bilinguals would demonstrate greater recognition accuracy vs monolinguals, operationalised in the present study as a lower number of misrecognised ambiguous sentences. In other words, bilinguals should make fewer errors when identifying ambiguous sentences; less unambiguous sentences should be recognised as ambiguous. This prediction is in line with recent findings of a bilingual advantage across a range of linguistic tasks (Teubner-Rhodes et al. 2016).

The second experiment presented participants with eight different types of ambiguous structure: two types of local ambiguity and six types of global. This approach facilitated the observation of any changes in resolution preferences according to the specific type of

ambiguous structure under processing. Consider the global ambiguity in examples (4), (5) and (6) below:

(4) *The waiter served the parent of the actor who ordered* fruit juice.

(5) *Maria told Misha she was doing well.*

(6) *One afternoon, I visited the tiger in a bad mood.*

In (4), the RC may be modified by *the parent* (N1) or *the actor* (N2). In (5), the verb phrase (VP) may be modified by *Maria* (N1) or *Misha* (N2), and in (6), the prepositional phrase (PP) is modified by either *I (*N1) or *the tiger (*N2). Although the regions of ambiguity in examples (4), (5) and (6) are grammatically distinct (RC vs VP vs PP), they are all resolved using one of two possible attachment sites: either N1 (high attachment) or N2 (low attachment). The study asked whether bilinguals would resolve (4), (5) and (6) in the same way, e.g. using high attachment, or whether ambiguity type exerts control over resolution preference. The question holds substantial implications for existing models of bilingual syntactic ambiguity resolution, specifically regarding theories of language dominance and transfer in L1 or L2 processing.

Of further interest in this study is the resolution preference of bilinguals for ambiguity types such as (4), (5) and (6). There is some theoretical guidance on this question. The PPM of ambiguity resolution (Gibson et al. 1996) argues that languages that allow a greater distance between verbs and complements, such as Arabic, are statistically likelier to favour high attachment rather than low. A recent research finding on RC attachment in Arabic confirms this theoretical prediction; high attachment was found both in Arabic monolinguals and non-native Arabic bilinguals (Bidaoui et al. 2016). Taken together, this suggests that high attachment will be favoured in bilinguals' L1 for RC ambiguities. Prior studies offer little insight into whether high attachment will be favoured for other ambiguity types which are resolved using the same resolution choice. It is also predicted that high attachment will be favoured in bilinguals' L2, in accordance with L1 transfer evidence (Frenck-Mestre 1997, 2002; Fernandez 1998, 2002; Soares et al. 2019).

2.4 *Research questions*

The study aimed to answer these questions:

1. Are bilinguals' ambiguity recognition rates sensitive to the type of structure being read? More precisely, are some ambiguity types recognised more frequently than others?
2. Are bilinguals' ambiguity resolution preferences sensitive to the type of structure being resolved? The question applies to ambiguity types that share an interpretation choice but differ structurally in the region of ambiguity.

3. Methods

The current study focused on two aspects of bilingual processing: the recognition of multiple ambiguous structures and how these structures are resolved. The first task required participants to read forty sentences and identify those containing syntactic ambiguity. This was a self-paced

reading activity which involved sentence processing and comprehension. To achieve this, participants were required to evaluate the sentence on the basis of its' syntax and possible meanings. The second task required participants to resolve the ambiguous sentences identified in task one. This task required the interpretation of meaning from syntactic structure; participants were required to select one interpretation from a choice of two. Both tasks involved processing and comprehension, but the first linked these processes to recognition whilst the second linked them to resolution. Neither task required the collection of reaction data or response times, nor did these tasks require online observation of regions of ambiguity or processing difficulty. With this in mind, offline questionnaires were selected as the method of data collection, an approach tried and tested in the literature (Ahn-Ha 2005; Dussias 2003; Fernandez 2002). Offline questionnaires are an experimental approach that closely resembles reading activities in natural settings, an important factor in the experiment selection. The findings are discussed in relation to monolingual data.

3.1 *Participants*

There were two groups of participants in this study. The first group included twenty monolingual native English speakers (mean age 39.8, range 29–50). The second group included twenty-one Arabic–English bilinguals (mean age 35, range 26–43). All participants were English teachers at higher education institutions in the Kingdom of Saudi Arabia. The monolinguals were from three different English-speaking countries: Australia, the United States, and the United Kingdom. The bilinguals came from six different Arabic speaking countries: Syria, Jordan, Saudi Arabia, Palestine, Egypt and Algeria. The results of a self-evaluation language proficiency questionnaire showed that bilinguals exhibited strong proficiency in reading and writing, equivalent to an upper-intermediate or advanced level on the common European framework for languages. Bilinguals had studied English (L2) for a mean average of 5.4 years (standard deviation = 1.04) and had received a mean average of 3.9 years of university level education (standard deviation = 1.24). All bilingual participants held an academic IELTS qualification of 6 or higher. The questionnaire screened out seven participants whose L2 proficiency was inadequate for the experiments. Of those bilingual participants who were screened out, all had self-reported lower reading and writing proficiency levels than IELTS band 6 or equivalent. There were two main reasons for this. Firstly, 5 participants were not actively using English in academic settings on a regular basis, thus impacting their reading and writing skills. Secondly, 2 participants had not studied English, in any educational setting, for long enough to develop the required level of competency required for both experimental tasks. All 7 excluded participants had markedly lower L2 proficiency levels than the twenty-one accepted bilingual participants.

3.2 *Materials*

In Experiment 1, the questionnaire was designed to include two types of local and six types of global ambiguity. These eight ambiguity forms were carefully selected and comprised grammatical structures known to be ambiguous in Arabic and English. Selection of ambiguous structures was based on two needs: testing variants of an ambiguous structure and comparing

local and global ambiguities. The questionnaire contained 40 items: 20 ambiguous sentences (SAS) and 20 unambiguous sentences (SUS). Stimuli are outlined in Table 2.

Table 2: Syntactic ambiguity types in stimuli

Ambiguity type (LOCAL)	**Interpretation options**	**Example sentence**
A. Garden Path Sentence	High attachment vs. low attachment	*The horse raced past the barn fell.*
B. Ambiguity in Comparatives	N2 + N3 are compared N1 + N3 are compared	*Julia likes Martin more than James.*
Ambiguity type (GLOBAL)	**Interpretation options**	**Example sentence**
C. Relative clause attachment	High attachment vs. low attachment	*The waiter served the parent of the actor who ordered fruit juice.*
D. Verb phrase attachment	High attachment vs. low attachment	*Maria told Misha she was doing well.*
E. Prepositional phrase attachment	High attachment vs. low attachment	*One afternoon I visited the tiger in a suit.*
F. Adjective attachment ambiguity	High attachment vs. low attachment	*The decent college lecturer was invited to a talk.*
G. Clause length ambiguity	SC + LC vs. LC + SC	*The professor said on Monday he would give an exam.*
H. Ambiguity of scope	SC + LC vs. LC + SC	*The beautiful dancers and singers entered onto the stage.*

Stimuli contained two sentences with local ambiguity; one for ambiguity type (AT) A and one for AT. B. The remaining eighteen, with global ambiguity, were distributed as follows: four for AT. C, six for AT. D, one for AT. E, one for AT. F, two for AT. G and four for AT. H. The abbreviation SC + LC stands for short clause modifies long clause. Likewise, LC + SC stands for long clause modifies short clause. In Experiment 1, the participants were required to answer 'Y' if they perceived ambiguity in a sentence and 'N' if they did not. All participants' responses were checked against an answer key to determine whether their ambiguity perception choices were correct. This process enabled percentage calculations of correctly identified SAS and correctly identified SUS (see table 3). In Experiment 2, participants resolved the ambiguities they identified in Experiment 1. This was achieved by presenting participants with the sentence and its two possible resolution choices, as illustrated below.

Example (D): *Who was doing well?*

(i) Maria
(ii) Misha

3.3 *Retaining meaning and ambiguity in translation*

Translating syntactically ambiguous English sentences into Arabic can cause problems if the translation fails to retain the syntactic ambiguity embedded in the original sentence. Consequently, bilingual participants would find the Arabic version unambiguous but the English version ambiguous. Monolinguals would not face this issue. Consider the example below:

(7) *The distinguished dancers and instructor came.*

The ambiguity in English derives from the adjective 'distinguished', whether it modifies (a) 'the dancers' or (b) 'the dancers and instructor'. In the Arabic translation, the problem arises due to word agreement rules not implicit in the original English sentence. The adjective 'distinguished' in Arabic is pluralised because it agrees with the noun 'dancers' in number. This means that only interpretation (a) is possible, making the Arabic translation unambiguous. To retain the ambiguity in an Arabic translation of (7), there are two options. Either both nouns should be singular, or both should be plural. If both nouns are singular, then the singular Arabic adjective 'والمتميز' (Rom: al-mutamayezur, Eng: distinguished) should be used. If both nouns are plural, then the plural Arabic adjective 'ونمتميزال' (Rom: al-mutamayezun, Eng: distinguished) should be used. Either way, providing that (12) is modified to read, 'The distinguished dancer and instructor' or 'The distinguished dancers and instructors', ambiguity is retained across both languages.

3.4 *Procedure*

Before the experiments were conducted, bilingual participants were selected based on the results of their language background questionnaires. Both participant groups were tested individually in rooms designed for research purposes at KSU. Monolinguals then completed the recognition task (Experiment 1) in hard copy. Afterwards, bilinguals completed Experiment 1 in Arabic (L1). After one week, bilinguals repeated Experiment 1 in English (L2) to minimise the influence of L1 upon L2 processing. Then, Experiment 2 was conducted. Monolingual participants were tested first. After that, bilingual participants completed the experiment in Arabic (L1). Then, after a waiting period of seven days, bilinguals repeated Experiment 2 in English (L2).

4. Results and data analysis

4.1 *Experiment 1: Syntactic ambiguity recognition*

Table 3 presents recognition data for all participant groups. The data shows the number of SAS, SUS, local ambiguities (LA) and global ambiguities (GA) recognised in Experiment 1. The data is presented as mean percentages and provided for monolinguals (G1), bilingual responses in English (G2) and bilingual responses in Arabic (G3).

Table 3: Ambiguity recognition expressed as mean percentages

Group	$\overline{x}$ % SAS	$\overline{x}$ % SUS	$\overline{x}$ % LA	$\overline{x}$ % GA
G1. Monolinguals	59	7.3	80	58
G2. L1 bilinguals	42	4.3	57	40
G3. L2 bilinguals	47	0.7	57	43

Results indicated that all groups found more LA than GA and that both bilingual groups identified less LA and GA in comparison to monolinguals. Only 0.7% of L2 bilingual responses resulted in a mistakenly identified ambiguous sentence, rising to 4.3% in L1 bilinguals and to 7.3% in monolinguals. All bilinguals identified less ambiguity than monolinguals across all categories.

4.2 *Experiment 1: Recognition frequencies for different types of global ambiguity*

Table 4 shows the percentage of participants per group that identified different categories of ambiguous sentences. Adjective phrase ambiguities are AP, and clause length ambiguities are represented as CLA. Some interesting findings emerged: first, CLAs were recognised more frequently than RC, VP and AP ambiguities in both bilinguals' languages. Bilinguals appeared to recognise all ambiguity types more frequently in English (L2) than in Arabic (L1); this is discussed in the next section. Monolinguals found more of all ambiguity types than both bilingual groups, and RC and VP ambiguities were found least frequently by monolinguals and bilinguals in both their languages. See details below.

Table 4: SAS identification by ambiguity type

	% RC (A)	**% VP (B)**	**% AP (F)**	**% CLA (E)**
G1 Monolinguals	40	63	66	68
G2 (Bilinguals, L1-Arabic)	38	34	46	50
G3 (Bilinguals, L2-English)	40	44	52	67
G2 and G3 (All bilingual data)	39	39	49	59

To examine the question of whether ambiguity recognition is sensitive to the type of input ambiguity, it is helpful to analyse group performance comparisons. Table 5 presents between-group comparisons for all ambiguity categories described in Table 3. It also presents ambiguity type (local vs global) comparisons for each group. The data deals with discrete choices and contains relatively low population numbers with an absence of asymmetrical distribution. An ideal non-parametric test that satisfies these criteria is Pearson's chi-squared test with Yate's correction. Yate's correction was required because the chi-squared test tends to be biased upwards for two by two contingency tables.

Table 5: Significance of between-group and between-ambiguity form comparisons

Group comparison for SAS	χ^2	Yate's correction	p-value	Yate's correction
G1 vs G2	23.25	22.58	0.00	0.00
G1 vs G3	11.58	11.06	0.00	0.00088
G2 vs G3	2.92	1.92	0.14	0.16488
G1 vs G2 + G3	22.31	21.74	0.00	0.00

Group comparison for SUS	χ^2	Yate's correction	p-value	Yate's correction
G1 vs G2	3.33	2.81	0.06	0.09392
G1 vs G3	23.33	21.63	0.00	0.00000
G2 vs G3	10.98	9.57	0.00092	0.00197
G1 vs G2 + G3	15.80	14.60	0.00007	0.00013
Group comparison for LA	χ^2	Yate's correction	p-value	Yate's correction
G1 vs G2	0.53	0.25	0.47	0.62
G1 vs G3	0.19	0.049	0.66	0.82
G2 vs G3	0.00	0.41	1.00	0.88
G1 vs G2 + G3	0.70	0.02	0.41	0.53
Group comparison for GA	χ^2	Yate's correction	p-value	Yate's correction
G1 vs G2	23.50	22.79	0.00	0.00
G1 vs G3	16.45	15.86	0.00	0.00
G2 vs G3	0.66	0.54	0.42	0.46
G1 vs G2 + G3	26.30	25.64	0.00	0.00
Ambiguity form GA vs LA	χ^2	Yate's correction	p-value	Yate's correction
G1 vs G2	0.72	0.46	0.40	0.50
G1 vs G3	4.45	3.78	0.03	0.05
G2 vs G3	3.01	2.47	0.08	0.11
G1 vs G2 + G3	7.37	6.76	0.01	0.01
All groups	7.24	6.74	0.01	0.01

Monolinguals recognised more SAS in comparison to all bilingual groups ($p < 0.01$); there is a 0.01% probability that this result occurred by chance. Comparing data on monolinguals' misidentification of SUS with L2 bilinguals revealed no significant difference, although comparisons of monolinguals with L1 bilinguals (G3) and both bilingual groups (G2 + G3) together produced a different result ($p < 0.01$). Recognition rates for SUS in L2 vs L1 bilinguals were also different ($p < 0.01$); a difference in these calculations is unlikely to have occurred by chance. These results indicate that bilinguals were more accurate at identifying ambiguity than their monolingual counterparts, especially when identifying ambiguous sentences in Arabic (L1).

Regarding the recognition of LA, the results are interesting. While all participant groups identified more LA than GA (Table 3), there were no significant differences between groups. This indicates that monolinguals and bilinguals, in statistical terms, performed similarly. For GA recognition, monolinguals were significantly different from all bilingual groups, with no significance between L2 bilinguals and L1 bilinguals. The picture with regard to LA vs GA recognition is more complex. Between-group comparisons for monolinguals, L2 bilinguals and L1 bilinguals revealed no significant findings at the threshold of $p < 0.01$. However, when monolinguals were compared with both bilingual groups, and when all participant data was combined, significant findings were seen. This suggests that participants found more LA than GA overall, although this finding is not duplicated in group comparisons. There is no possibility at the $p < 0.01$ level that the relative difference in GA vs LA perception levels for

both bilingual groups and all groups combined occurred by chance. Local ambiguity was found more frequently in target sentences than global ambiguity; with GA vs LA, differences were apparent in combined rather than individual group comparisons ($p < 0.01$).

4.3 *Experiment 2: syntactic ambiguity resolution*

This study asked whether bilinguals' ambiguity resolution decisions are affected by modifications in the structure of syntactic ambiguities. To answer this, participants' ambiguity resolution decisions were first examined, as shown in Table 6. In this paper, a strong preference for an ambiguity resolution choice is defined as a 2:1 ratio in resolution choice outcome for a participant group or > 66% in the mean percentage figures. A weak preference is defined as 60%–66% of all participants favouring a particular attachment site.

Table 6: Interpretation decisions for all ambiguity types – mean percentages

Ambiguity Type	Relative Clause Attachment (C)		Verb Phrase Attachment (D)		Prep. Phrase Attachment (E)		Adjective Attachment (F)	
Interpretation Choice	HA	LA	HA	LA	HA	LA	HA	LA
G1 (monolingual)	74	26	66	44	73	27	75	25
G2 (L1 bilingual)	68	32	84	16	72	28	14	86
G3 (L2 bilingual)	78	22	82	18	79	21	50	50
Ambiguity Type	Clause Length Ambiguity (G)		Ambiguity in Scope (H)		Garden Path Sentence (A)		Ambiguity in Comparatives (B)	
Interpretation Choice	LC + SC	SC + LC	LC + SC	SC + LC	HA	LA	N2 + N3 comp.	N1 + N3 comp.
G1 (monolingual)	74	26	78	22	44	56	100	0
G2 (L1 bilingual)	66	34	86	14	60	40	100	0
G3 (L2 bilingual)	75	25	62	38	64	36	80	20

Bilinguals who completed the experiment in Arabic favoured high attachment (HA) for ambiguity types A, C, D and E. For adjective attachment ambiguities (F), low attachment (LA) was favoured. Strong HA preferences are seen in C–E, with a weak preference in A. Bilinguals who completed Experiment 2 in English (their weaker language) also favoured HA in ambiguity types A, C, D and E, with strong HA preferences in C–E and a weaker preference in A. For ambiguity type F, no preference was found. This finding is very interesting because it shows that bilinguals' ambiguity resolution is not impacted by input language. There is evidence that ambiguity type (AT) has a minor impact upon ambiguity resolution since the processing of AT.F resulted in LA in Arabic and no preference in English. This apparently

anomalous result is removed when the data is considered from another angle (Table 6). L1 bilinguals resolving AT.G and AT.H showed strong preferences for a long clause (LC) + short clause (SC) interpretation. L2 bilinguals showed a strong LC + SC preference in AT.G and a weak LC + SC preference in AT.H. Nevertheless, both types of global ambiguity were resolved in the same way regardless of input language or modifications in AT. All participant groups showed a very strong preference for N2 + N3 interpretations of the local AT.B, suggesting that for many, the alternative interpretation was either implausible or impractical. This indicates that for AT.B, semantic and contextual cues played a dominant role in ambiguity resolution instead of structural constraints imposed by L1 or L2 grammar. It is also helpful to examine resolution data from the perspective of interpretation choice because grouping ATs by their interpretation choices provides a more holistic overview; see Table 7 below.

Table 7: Resolution decisions according to categories of ambiguity type

Ambiguity Type / Category	**Category 1** (A, B, C, D and G)		**Category 2** (E and F)		**Category 3** (H)	
Interpretation Options	High vs. low attachment		LC + SC vs. SC + LC		(N2) comp. to (N3) vs. N1+N2 comp. N2 + N3	
Interpretation Choice (mean %)	HA	LA	LC + SC	SC + LC	N2 comp. to N3	N1 + N2 comp. to N2 + N3
Group 1	61	39	76	24	100	0
Group 2	66	34	79	21	100	0
Group 3	73	27	68	32	80	20

For ambiguous sentences that were resolved via high or low attachment (Category 1), all groups preferred HA in differing degrees. Monolinguals, L1 bilinguals and L2 bilinguals had weak, moderate and strong HA preferences, respectively. Ambiguous structures in Category 2 were resolved via clause length decisions; all participant groups favoured LC + SC. L1 bilinguals had the strongest LC + SC attachment preference, followed by monolinguals and L2 bilinguals, respectively. All monolingual and bilingual Arabic (G2) ambiguity resolution decisions for Category 3 sentences were identical; these participants decided that N2 and N3 were being compared. Only a small mean percentage of bilingual English responses showed the alternative interpretation. In each interpretation choice category, monolinguals were compared with both bilingual groups via chi-squared tests, which revealed no significant between-group differences at the $p < 0.01$ level.

The findings showed a low correlation between AT and resolution choice. Adjective attachment ambiguities appear to be resolved differently by monolinguals and L1 bilinguals, although no preference is seen in bilinguals' non-native language. Four out of the five ATs in Category 1 were resolved via high attachment, a finding impervious to input language and

modifications in ambiguous structure. All participant groups favoured LC + SC interpretations in Category 2 despite the grammatical difference between AT.E and AT.F structures.

5. Discussion

The first objective of this study was to determine if bilinguals' ambiguity recognition is sensitive to AT. Two key findings emerged. First, all participants identified more LA than GA, suggesting that LA are easier to recognise in both languages. Second, in both bilingual groups, CLAs were identified more frequently than RC attachment structures, providing clear evidence that different ATs possess different recognition probabilities. These findings show that both ambiguity form (local vs. global) and AT (e.g. CLA and RC attachment) impact recognition likelihood. Monolinguals recognised more ambiguous sentences than bilinguals, although bilinguals were more accurate in their recognition decisions. Taken together, the data from Experiment 1 provides evidence that syntactic ambiguity recognition in L1 Arabic–English bilinguals is sensitive to AT.

The fact that local ambiguity was more frequently identified than global is unsurprising. Global ambiguity is subtle, making its detection challenging as the parsing mechanism interprets the syntactic structure swiftly (Harley 2014). By contrast, LA possesses inherent structural problems; the grammar is usually poorly conceived and frequently deviates from accepted grammatical norms. This makes LA easier to perceive. LA in sentences simply looks odd and is often due to artificially conceived syntax. The fact that AT exerted an influence upon recognition probability is interesting. CLAs and RC attachment ambiguities are both globally ambiguous; despite this, they did not result in equal recognition rates. One explanation for this lies in bilinguals' experience of processing similar structures in their native language. The Arabic language possesses more CLAs than RC attachment structures. Consequently, these ATs may have been encountered more frequently and were, therefore, more recognisable to bilinguals in their L1. However, this explanation cannot be extended to English. CLAs in English possess approximately the same occurrence frequency in natural language as other ATs, but they were recognised more often. There are two plausible explanations. CLAs are syntactically more overt than other types of global ambiguity; they are distinguishable from ATs. Strict syntactic 'parameter settings' govern the English language; one of these is clause length. English sentences may be simple, compound or complex; the latter two forms are created by combining main and subordinate clauses. The recognisability of a CLA such as example (8) below is high, primarily because both native and non-native English speakers encounter parsing difficulty after 'said', which may modify either a long subordinate clause or may form part of the main clause.

(8) The doctor said on Tuesday he would perform an operation

It is argued here that sentences containing CLA violate clause length rules or assumptions about meaning. If both native and non-native speakers have tended toward LC + SC interpretations of similar syntactic structures in the past, it follows that they would continue to do so. The different recognition frequencies between CLA and RC ambiguities are illogical for another reason. RC attachment ambiguities occur in many languages (Papadopolou 2006: 4). Although no research has presented statistics as to their frequency in written texts or natural language settings, the researchers have found from their language and educational experiences that RC

ambiguities occur regularly in English and Arabic sentences. Therefore, it seems logically implausible that RC ambiguities might be more difficult to recognise than other types of ambiguity that possess similar occurrence frequencies. However, some explanations might account for this. It is possible that both monolingual English speakers and L1 English–Arabic speakers subconsciously resolve RC attachment ambiguities more often than other types. If an AT occurs often enough in a natural language, eventually the human parser will automatically disambiguate such ambiguity in accordance with experience. Therefore, in experimental settings, certain ATs will be naturally biased toward automatic disambiguation and effectively be less ambiguous than other types. Further research needs to be conducted in this area with a greater number of target sentences that are more evenly distributed across the different ATs.

The second objective explored whether bilinguals' ambiguity resolution preferences were sensitive to the type of structure being resolved. Bilinguals' interpretation decisions for eight different ATs indicated similar attachment preferences for structures sharing an interpretation choice. Table 5 shows that adjective attachment ambiguities (AT.F) produced contradictory data. However, when AT.F is placed in Category 1 (Table 6), it does not affect the overall preference for high attachment. These results suggest that grammatical modifications in the region of ambiguity do not affect resolution decisions. This statement applies to ATs that share a resolution choice (Table 7). Although RC, VP and PP ambiguities are grammatically distinct in structure, bilingual participants showed a preference for HA rather than LA in both their languages. The question of AT influence on resolution is understudied in the literature. In the present study, we must differentiate between bilinguals' performance which results from their attention to ambiguity rather than ambiguity processing, or cognitive functioning. Performance which comes from attention to ambiguity may be influenced here by several factors. Firstly, all tasks utilized the same stimuli and secondly, half of sentences were target stimuli. Therefore, for bilinguals, it is possible that bilingual ambiguity resolution may be more indicative of attention to ambiguity rather than cognitive function, or ambiguity processing. Furthermore, the fact that participants were language teachers, with different nationalities, may enhance their metalinguistic knowledge; thus increasing their ambiguity recognition and resolution abilities. Participant profiles may well have influenced experiment outcomes, especially for English questionnaires, as respondents were English language teachers. These participants would possess extra metalinguistic knowledge especially in relation to syntactic structures; a fact which could explain why grammatical modifications in the region of ambiguity did not impact resolution decisions. Although attention to ambiguity is the most likely explanation for bilingual performance, we must also consider ambiguity processing and the impact of L1. Therefore, in the discussion below, we proceed with caution and consider the limitations described above.

The current findings may also indicate that bilinguals' Arabic grammar exerts a strong influence upon their ambiguity resolution decisions in both languages. The PPM (Gibson et al. 1996) predicts that high attachment is favoured for languages that allow a greater distance between verbs and their complements; this has been shown in native and non-native Arabic speakers (Bidaoui et al. 2016) and the present study. The finding that bilinguals exhibited a high attachment preference in English may indicate that first-language dominance affects second-language processing; a hypothesis which has been supported in other offline studies of bilingual sentence processing (e.g. Fernandez 1998; Frenck-Mestre 2002). In the case of CLAs, bilinguals' L1 grammar system (Arabic) biases them toward long noun phrases, particularly for AT.F. AT.F sentences contain an adjective that the majority of participants perceived as modifying both nouns. This is because, in Arabic, morpho-syntactic agreement features include

a numerical agreement between a modifier and its referents. Prior studies into syntactic ambiguity resolution in bilinguals have not tested multiple structures of globally ambiguous sentences. The profile of participants in relation to their extra metalinguistic knowledge of syntactic structures provides a strong explanation for L2 resolution preferences when ATs that share resolution options are modified. It is also possible that current theories of L1 transfer for L2 processing may explain L2 resolution preferences. Findings indicate a bilingual processing model that uses a single set of routines, regardless of the input language. In summary, resolution preferences in both languages may be governed by bilinguals' extra meta-linguistic knowledge of syntax or L1, with little evidence of L2 transfer. It is also argued that the PPM can explain attachment preferences for RC ambiguities and, to a lesser extent, VP and PP ambiguities.

6. Conclusions

This study used ambiguity recognition and resolution tasks to test whether different ATs exerted a controlling influence upon their perception and subsequent resolution. Results showed that recognition is sensitive to AT, but resolution is not. CLAs are more recognisable than RC attachment ambiguities, while LA was more recognisable than GA. Recognition findings can be explained in relation to the frequency with which certain ATs occur naturally in English and Arabic sentences, although RC ambiguity recognition findings suggest some level of automatic disambiguation due to bilingual's prior language experience. Bilingualism may confer an advantage here for ambiguity recognition, a task that occurs regularly during the L2 acquisition process. Further research is needed to explore any bilingual advantage for such tasks. Resolution choices for similar ATs that differed slightly in the region of ambiguity showed that type was not a modulating factor in interpretation. The researchers speculate that greater modifications to existing syntactic structures might be required to produce different resolution choices for different ATs. Findings support a bilingual model of sentence processing that uses universal parsing strategies where L1 strongly impacts L2 processing. Further online and neuro-linguistic experiments would help shed further light on this topic.

References

Abdelghany, Hala & Fodor, Janet. 1999. Low attachment of relative clauses in Arabic. (Poster presented at the *Architectures and Mechanisms of Language Processing*. Edinburgh).

Abi Samra, Nada. 2003. *An analysis of errors in Arabic speakers' English writings*. American University of Beirut, Education 345. (http://www.nadasisland.com/languageacq-erroranalysis.html) (Accessed 2020-05-07.)

Ahn-Ha, Jeeyoung. 2005. Age related effects on syntactic ambiguity resolution in first and second languages: Evidence from Korean-English bilinguals. *Proceedings of the 7th Generative Approaches to Second Language Acquisition Conference (GASLA 2004)*, Dekydtspotter, Laurent & Sprouse, Rex A. & Liljestrand, Audrey (eds.), 111–123. Somerville, Massachusetts: Cascadilla Proceedings Project.

Attia, Mohammed. 2008. *Handling Arabic morphological and syntactic ambiguity within the LFG framework with a view to machine translation*. UK: University of Manchester. (Dissertation.)

Bialystok, Ellen. 1988. Levels of bilingualism and levels of linguistic awareness. *Developmental Psychology* 24(4). 560–567.

Bialystok, Ellen & Craik, Fergus I. M. 2010. Cognitive and linguistic processing in the bilingual mind. *Current Directions in Psychological Science* 19(1). 19–23.

Bidaoui, Abdelaadim & Foote, Rebecca & Abunasser, Mahmoud. 2016. Relative clause attachment in native and L2 Arabic. *The International Journal of Arabic Linguistics* 2(2). 75–95.

Cook, Vivian. 1997. The consequences of bilingualism for cognitive processing. In A. de Groot & J.F. Kroll (eds.), 1997 *Tutorials in Bilingualism: Psycholinguistics Perspectives,* Lawrence Erlbaum, 279-300.

Costa, Albert & Hernandez, Mireia & Costa-Faidella, Jordi & Sebastian-Galles, Nuria. 2009. On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition* 113(2). 135–149.

Clifton, Charles Jr. & Staub, Adrian. 2008. Parallelism and competition in syntactic ambiguity resolution. *Language and Linguistics Compass* 2(2). 234–250.

Cromdal, Jacob. 1999. Childhood bilingualism and metalinguistic skills: Analysis and control in young Swedish–English bilinguals. *Applied Psycholinguistics* 20(1). 1–20.

Cuetos, Fernando & Mitchell, Don C. 1988. Cross-linguistic differences in parsing: restrictions on the use of late closure strategy in Spanish. *Cognition* 30(1). 73–105.

Diami, Kevin. 2001. Identifying syntactic ambiguities in single-parse Arabic sentence. *Computers and the Humanities* 35. 333–349.

Dussias, Paola E. 2003. Syntactic ambiguity resolution in L2 learners: Some effects of bilinguality on L1 and L2 processing strategies. *Studies in Second Language Acquisition* 25(4). 529–557.

Dussias, Paola E. & Sagarra, Nuria & Bajo, Maria Teresa & Cramer, Tracy & Gerfen, Chip & Hoshino, Noriko & Kroll, Judy & Misra, Maya. 2007. The effect of exposure on syntactic parsing in Spanish-English bilinguals. *Bilingualism: Language and Cognition* 10(1). 101–116.

Dussias, Paola E. & Scaltz, Tracy R. Cramer. 2007. Spanish–English L2 speakers' use of subcategorization bias information in the resolution of temporary ambiguity during second language reading. *Acta Psychologica* 128(3). 501–513.

Ehrlich, Kate. & Fernández, Eva M. & Fodor, Janet, D. & Stenshoel, Eric. & Vinereanu, Mihai. 1999. Low attachment of relative clauses: New data from Swedish, Norwegian, and Romanian. *Twelfth Annual CUNY Conference on Human Sentence Processing*, New York, USA.

Fernandez, Eva M. 1998. Language dependency in parsing: Evidence from monolingual and bilingual processing. *Psychologica Belgica* 38(3/4). 197–230.

Fernandez, Eva M. 2002. 8 relative clause attachment in bilinguals and monolinguals. *Advances in Psychology* 134. 187–215.

Fernandez, Eva M. 2003. *Bilingual sentence processing: Relative clause attachment in English and Spanish*. Amsterdam: Benjamins.

Frazier, Lyn. 1978. *On comprehending sentences: Syntactic parsing strategies*. Storrs: University of Connecticut. (Unpublished PhD dissertation.)

Frazier, Lyn. 1987. Sentence processing: A tutorial overview. In Colheart, M. (ed.), *Attention and performance XII: The psychology of reading*, 559–586. Mahwah, NJ: Erlbaum.

Frazier, Lyn & Rayner, Keith. 1982. Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive Psychology* 14(2). 178–210.

Frenck-Mestre, Cheryl. 2002. An on-line look at sentence processing in the second language. In Heredia, R. & Altarriba, J. (eds.), *Bilingual sentence processing*. New York: Elsevier Science Ltd.

Frenck-Mestre, Cheryl. & Pynte, Joel. 1997. Syntactic ambiguity resolution while reading in second and native languages. *Quarterly Journal of Experimental Psychology* 50A(1). 119–148.

Gibson, Edward & Pearlmutter, Neal & Canseco-Gonzalez, Enriqueta & Hickok, Gregory. 1996. Recency preference in the human sentence processing mechanism. *Cognition* 59(1). 23–59.

Harley, Trevor A. 2014. *The psychology of language*: *From data to theory* (4th ed.). New York: Psychology Press.

Hilchey, Matthew D. & Klein, Raymond M. 2011. Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin & Review* 18. 625–658.

Hsieh, Yu-Fen. 2010. *Sentence processing in Chinese and Chinese-English bilinguals: Syntax-semantics interaction during syntactic ambiguity resolution*. Michigan: The University of Michigan. (Unpublished PhD thesis.)

Long, Debra & Prat, Chantel. 2008. Individual differences in syntactic ambiguity resolution: Readers vary in their use of plausibility information. *Memory & Cognition* 36(2). 375–391.

Marefat, Hamideh & Nushi, Musa. 2005. Syntactic ambiguity resolution: A case of L2 learners. *Journal of Cognitive Science* 6. 55–71.

Mischler, Alan. & Teubner-Rhodes, Susan. & Corbett, Ryan. & Novick, Jared. M. 2011. The bilingual advantage: Does learning a second language improve working memory? *University of Maryland: CASL*. https://www.casl.umd.edu/node/1760 (Accessed 2020-05-08).

Ni, Weijia.1996. Sidestepping garden paths: The contribution of syntax, semantics and plausibility in resolving ambiguities. *Language and Cognitive Processes* 11(3). 283–334.

Papadopoulou, Despina. 2006. *Cross-linguistic variation in sentence processing: Evidence from RC attachment preferences in Greek.* Netherlands: Springer.

Papadopoulou, Despina & Clahsen, Harald. 2003. Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition* 25(4). 501–528.

Pickering, Martin J. & Traxler, Matthew J. 1998. Plausibility and recovery from garden paths: An eye-tracking study. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 24(4). 940–961.

Prideaux, Gary. D. & Baker, William. J. 1976. The recognition of ambiguity. *Human Communication* 1. 51–58.

Soares, Ana Paula & Oliveira, Helena & Ferreira, Marisa & Comesaña, Montserrat & Macedo, António Filipe & Ferre, Pilar & Acuña-Fariña, Carlos & Hernández-Cabrera, Juan & Fraga, Isabel. 2019. Lexico-syntactic interactions during the processing of temporally ambiguous L2 relative clauses: An eye-tracking study with intermediate and advanced Portuguese-English bilinguals. *Plos One* 14. e0216779.

Teubner-Rhodes, Susan E. & Mishler, Alan & Corbett Ryan & Andreu, Llorenç & Sanz-Torrent, Monica & Trueswell, John C. & Novick, Jared M. 2016. The effects of bilingualism on conflict monitoring, cognitive control, and garden-path recovery. *Cognition* 150. 213–231.

Trueswell, John C. & Tanenhaus, Michael K. 1991. Tense, temporal context and syntactic ambiguity resolution. *Language and Cognitive Processes* 6(4). 303–338.

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In SKASE Journal of Theoretical Linguistics [online]. 2020, vol. 17, no. 5 [cit. 2020-12-01].Available on web page http://www.skase.sk/Volumes/JTL47/pdf_doc/13.pdf. ISSN 1336-782X