

LANGUAGE DEPENDENCY IN PARSING: EVIDENCE FROM MONOLINGUAL AND BILINGUAL PROCESSING

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Language dependency in parsing results when the parsing strategies used by bilinguals depend on the language of the input, in the case that cross-linguistic differences in processing exist. If bilingual parsing is language independent, on the other hand, bilinguals will process all input using the same strategies—those of L1, those of L2, or an amalgamated or compromised set of L1 and L2 strategies. This discussion evaluates existing research on bilingual processing, regarding how well it addresses questions related to the language dependency issue, as well as recent research on cross-linguistic differences in parsing. As a preview into the future of bilingual sentence processing research, this paper also reports preliminary evidence on bilingual sentence processing which shows that language history strongly influences strategy use in the second language of bilinguals.

Introduction

This paper explores sentence processing in bilinguals by asking whether or not the parsing strategies of monolinguals are similar to those used by bilinguals in each of their languages, in other words, whether or not there is *language dependency* in parsing. If parsing is language dependent, then the parsing strategies used by a particular individual will vary as a result of variance in the language of the input, assuming, of course, that parsing strategies differ cross-linguistically. I will emphasize the theoretical importance of understanding processing strategies in bilinguals as well as monolinguals in order to answer the questions I raise regarding language dependency in parsing, and I will propose several aspects of this problem that need to be investigated in the future.

The study of sentence processing is a central area in the domain of linguistic performance, the module responsible for the production and perception of sentences. It is part of human cognition, and I take it to be separate from

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cognitive processes not directly linked to language.¹ It is also different from linguistic competence, or the knowledge of language and its structure that speaker/hearers of a particular language (or languages) have and use to distinguish well-formed from ill-formed strings. This paper will focus on the performance mechanisms involved in perception; production processes will not be addressed (for discussion of monolingual production models, see Levelt, 1989, and Garrett, 1990, 1988; for bilingual production models, see De Bot, 1992, and Poulisse, 1997). The parser, or syntactic processor, will be the main focus of this discussion.

We want to know the extent to which sentence processing in bilinguals, who quite efficiently deal with input in two languages, is language dependent. If parsing is language dependent, and in the case that cross-linguistic differences in processing exist, a bilingual will use the strategies associated with the language of the input and will be able to shift to the other set of strategies when the language of the input changes. If parsing is language independent, on the other hand, bilinguals will process all input using the same strategies—those of L1, those of L2, or an amalgamated or compromised set of L1 and L2 strategies.

The study of language dependency in parsing, particularly in the way it is introduced in this paper, also has certain consequences for some of the prevalent models of sentence processing. A very convincing argument for the existence of cross-linguistic differences (and some degree of language dependency) in parsing would be evidence that bilinguals exhibit language-particular behaviors in the perception of sentences in their two different languages. It is thus that research along these lines becomes important not only in the advancement of knowledge of bilingual processing, but also in the enhancing of our understanding of human sentence processing in general.

Although processing in bilinguals is an area of research that has in the past been largely neglected, two major exceptions apply (among other also notable studies not surveyed here because they are not directly related to the issues under discussion; see, e.g., Clahsen & Hong, 1995; Eubank, 1993; Frenck-Mestre & Pynte, 1997; Gass, 1979; Harrington & Sawyer, 1992; McPartland-Fairman, 1989). In the first place, as part of a growing body of literature on prelexical encoding routines, the language dependency question from a bilingual perspective has been addressed in two notable studies which compare the behavior of bilinguals to that of monolinguals (Cutler et al., 1992, and Bradley et al., 1993). However, as there is no reason to suppose that prelexical segmentation strategies pattern in any way similar to parsing strategies, we must look elsewhere for background models.

¹ This is not an assumption made by all researchers working in this field. For explicit discussion of this issue see Fodor (1983).

The second exception is research under the Competition model (Bates & MacWhinney, 1981; MacWhinney, 1997; for a review, see Gibson, 1992), often cited as paradigmatic concerning the study of sentence processing in bilinguals and second language learners. I will discuss, in section 2, various aspects of research under this framework which are of interest to the question of language dependency in bilinguals. However, I will show how the Competition model is difficult to integrate into standard models of sentence processing.

The question of language dependency in bilingual parsing can therefore only be explored by covering new ground. In section 3, I will describe recent research on cross-linguistic differences in parsing and I will propose a way of analyzing the language dependency question that capitalizes on these findings. Some preliminary research described in section 4 provides support for this proposed new trend in bilingual processing research.

The Competition Model: Overall Findings

The Competition model (CM), developed by Elizabeth Bates and Brian MacWhinney (for an overview, see MacWhinney, 1997) and further researched in numerous studies (among others, Bates & MacWhinney, 1981; Hernández et al., 1994; Liu et al., 1992; Sasaki, 1994; see MacWhinney, 1997 for further references on both bilingual and monolingual studies) has explicitly dealt with the question of whether bilinguals process input with one set of language-independent strategies or two sets of language-dependent strategies, with the language of the input determining the set of strategies to be used. Under CM, both L1 and L2 acquisition are data-driven processes relying on universals of cognitive structure, rather than universals of linguistic structure (MacWhinney, 1997, p. 114). CM requires addressing the question of language dependency in processing because it further proposes that sentence processing is language specific. As such, CM is faced with the task of explaining the nature of bilingual processing, where other parsing models which propose a universal parser take bilingual processing to be identical to monolingual processing.

According to CM, in second language acquisition considerable amounts of transfer will be experienced by the L2 learner, especially in the early stages of acquisition, since the new network of cognitive structures for the L2 will be deeply interconnected with the structures already existing for the L1; this transfer takes place at all levels of linguistic representation—lexical, syntactic, phonological. The transferred grammar and lexicon for L2 gradually become more independent of L1, such that learners—i.e., incipient bilinguals—are eventually able to build a “firewall” to prevent interference between L1 and L2 by strengthening within-language links rather than between-language links (MacWhinney, 1997, p. 120). This process achieves “a certain limited form of

emergent linguistic modularity" (p. 120). In other words, balanced bilingualism is viewed as a state in which within-language links are strong, while some between-language links remain, to allow for the connections that yield the ability of bilinguals to translate from one language to the other and to experience something in one language and recall or retell it in the other language. But no matter how strong the within-language links and how weak the between-language links, the language system is still unitary. It is therefore plausible and totally within the framework of CM for there to be overt transfer (and thus language independence in processing) between the two languages of a bilingual, or for there to be differentiation (or language dependence). The model itself does not preclude either of these alternatives; in effect, it predicts high degrees of variability—based on factors like age of acquisition, proficiency in L1 and L2, use of L1 and L2, etc.—as far as strategy use is concerned.

Research in the CM framework derives its empirical data from observation of speakers as they read or listen to sentences where cues (e.g., agreement or gender morphology, word order, etc.) compete with each other for the attention of the processing device. This idea requires more explicit illustration, for which we will consider two contrastive languages, Spanish and English. Spanish has a rich agreement morphology but relatively free word order, while English has strict word order but a rather impoverished agreement morphology. In the two sentences in (1) below (word-by-word equivalents in English and Spanish), neither word order nor agreement are anomalous. In (2), however, because there is no plural noun to agree with the plural verb, agreement is anomalous, while in (3) word order is anomalous because VNN is a non-canonical word order in both Spanish and English.

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|--------|----------------------------------|--------------------------|
| (1) a. | The elephant breaks the pencils. | word order ✓ agreement ✓ |
| b. | El elefante rompe los lápices. | |
| (2) a. | The elephant break the pencil. | word order ✓ agreement ✗ |
| b. | El elefante rompen el lápiz. | |
| (3) a. | Breaks the elephant the pencils. | word order ✗ agreement ✓ |
| b. | Rompe el elefante los lápices. | |

Of the English (a) sentences in the three examples above, the easiest to understand, or process, seems to be (1a) and the hardest (3a), with (2a) somewhere in the middle. With the Spanish (b) sentences, the intuition is slightly different: (1b) is easiest (like in English), but (3b) seems to be less problematic

than (2b), contrasting with the English preferences.² This suggests that the strategies used in the two languages to process input place differing importance on the contrastive cues. Word order matters more in English than in Spanish, whereas agreement is a cue lent more attention in Spanish than in English.

Differences Between Monolinguals and Bilinguals Under the Competition Model

In a study examining the processing costs associated with different cue interactions, Hernández et al. (1994) provide empirical support for the intuitive ranking just discussed. In their study, Hernández et al. analyzed the interaction, in both Spanish and English, of not only word order and agreement, but also animacy, and established that the rank-order of the three cues is as shown in (4), based on the performance of Spanish and English monolinguals in an on-line sentence reading task³ (where ">" indicates "is more important or valid a cue than"):

- (4) a. English: word order > agreement > animacy
- b. Spanish: agreement > animacy > word order

Given these facts about English and Spanish monolingual processing, we would expect that if bilinguals process linguistic input as monolinguals do, then Spanish/English bilinguals should have the Spanish ranking shown in (4b) when processing input in Spanish, and the English ranking in (4a) when processing input in English. However, such possible *differentiation* of strategies (language dependent processing) is not the only logically possible alternative for bilingual processing. Bilinguals may transfer their L1 strategies into L2 (*forward transfer*) or their L2 strategies into L1 (*backward transfer*). In both of the transfer cases, bilinguals use only one set of strategies, independent of the language of the input, such that they behave like monolinguals of only one of their two languages. The fourth (and final) possibility is *amalgamation*, i.e., the case where the bilingual also uses one set of strategies when processing both L1 and L2 input, only this set consists of a blend of L1 and L2 strategies. The

² It's not altogether clear the effect that the grammaticality status of these sentences has on their processing difficulty. (In English, (2a) and (3a) are ungrammatical, in Spanish only (2a) is ungrammatical.) Furthermore, ungrammatical stimuli may not be processed in the same way as grammatical stimuli (see Gibson, 1992, for explicit discussion of this problem).

³ The data analyzed by Hernández et al. (1994) to establish this ranking were the reaction times to visual stimuli of monolingual Spanish and English speakers (25 English monolinguals, 30 Spanish monolinguals). The task involved showing subjects the following: first, two words (e.g., *elephant* and *pencils*); then a sentence like the ones in (1)-(3) above; and finally pictures corresponding to the two words (e.g., an elephant and some pencils), side by side. The subjects were asked to push a button (e.g., on the right corresponding to the pencils, on the left corresponding to the elephant) indicating which of the two pictures corresponded to the noun which they thought carried out the action of the sentence.

four possible types of bilingual language processing (after Hernández et al., 1994) are summarized in Table 1 classified into two supergroups (language dependent and language independent), according to the terminology presented in this paper.

Table 1
Four Bilingual Processing Types

Differentiation:	Separate strategies for each language $L1 \Rightarrow L1, L2 \Rightarrow L2$	} Language Dependent
Forward Transfer:	Strategies for L1 used also in L2 $L1 \Rightarrow L1, L1 \Rightarrow L2$	
Backward Transfer:	Strategies for L2 used also in L1 $L2 \Rightarrow L1, L2 \Rightarrow L2$	} Language Independent
Amalgamation:	Amalgamated set of strategies (<i>A</i>) used for both languages $A \Rightarrow L1, A \Rightarrow L2$	

In addition to testing Spanish and English monolinguals, Hernández et al. (1994) analyzed the strategies used by 45 Spanish/English bilingual subjects from Southern California. For these subjects, usage and proficiency in both languages (as reported by the subjects themselves by the use of self-rating scales) were both very balanced.⁴ Hernández et al. found that their Spanish/English bilinguals fell "in between" the monolinguals of both languages they tested, apparently having developed a "compromised", or *amalgamated*, set of strategies (Hernández et al., 1994, p. 440).

However, as noted above, CM does not make any predictions regarding the type of processing bilinguals use in their two languages. This is reflected in the CM literature, where many different patterns of results have been obtained, depending on a number of different variables. Even the bilinguals studied by Hernández et al. showed evidence of differentiation in some specific sub-tasks and under specific types of statistical analysis. Other studies have looked at bilinguals less proficient in one of their languages, and the overwhelming finding is evidence of forward transfer, typically related to greater dominance in or more use of L1.

Liu et al. (1992) compared the processing strategies used by different speakers of Chinese and English: monolinguals of each language, late bilinguals (who learned their L2 after age 20), and early bilinguals (who learned their L2

⁴ The average self-rating on usage (on a scale of 0-20) was 10.75 for Spanish, 10.62 for English. The average self-rating on skill (on a scale of 0-30) was 25.48 for Spanish, 24.89 for English. The mean time speaking Spanish for these bilinguals was 19.75 years, with slightly less time (14.35 years) speaking English.

before age 16). In the late bilingual group, half were speakers whose L1 was English, and half speakers whose L1 was Chinese. In the early bilingual group, all bilinguals spoke Chinese as an L1; some learned English as infants, others as children, and others as teenagers. In this experiment, word order cues were contrasted with animacy cues. According to Liu et al., animacy cues are stronger than word order in Chinese, in contrast to English, where word order is stronger (cf. Hernández et al., 1994). The monolinguals of each language behaved as predicted: Chinese monolinguals were more sensitive to anomalies in animacy while English monolinguals were more sensitive to anomalies in word order. Liu et al. found very little evidence of amalgamation in any of their bilingual subgroups. They report some evidence of differentiation in the child and teen learners and some evidence of backward transfer in the infant learners. In contrast, the results of the late bilinguals overall showed clear evidence of forward transfer, but the sub-group whose L1 was English exhibited some differentiation of strategies not exhibited by the late bilinguals whose L1 was Chinese.

Using a slightly different methodology,⁵ Sasaki (1994) found some interesting differences between Japanese/English and English/Japanese bilinguals in responding to English and Japanese stimuli. In the materials for this experiment, three contrastive cues—word order, animacy, and case-marking—were manipulated. The experiment tested 10 subjects in each of the following three language history categories: (i) native speakers of English beginning to learn Japanese as a second language (students in the seventh week of a semester in a beginning Japanese class), (ii) native speakers of English with intermediate knowledge of Japanese, and (iii) native speakers of Japanese with advanced knowledge of English. In both English and Japanese, case-marking is a very important cue, while word order is less important in Japanese than in English. Sasaki's results point to divergent use of strategies in Japanese by the subjects, depending on their native language. The Japanese learners of English relied on Japanese-like case-based strategies in both languages, while native English speakers learning Japanese adjust their cue reliance differently for each language, paying closer attention to word order cues in English than in Japanese. Thus, while the native Japanese speakers learning English transfer their L1 strategies into L2, the native English speakers learning Japanese differentiate between strategies used to process input in L1 and L2.

⁵ Sasaki (1994) presented acoustic stimuli to subjects, who were instructed to respond by reporting orally what they thought the subject of the sentence was.

Summary

Research under the CM framework has to date produced a varied and vast body of literature. The most important contribution of this work with respect to our current understanding of bilingual cognitive architecture is at the procedural level, regarding how to go about designing experiments with bilinguals. It is possible that CM research may also provide some useful indices of L2 performance. However, we don't yet know how CM would interarticulate with current models of sentence processing (and language acquisition; see Gibson, 1992, for further discussion). The results of the experiments discussed above could very well reflect some sort of post-syntactic, global processing of sentences which could vary cross-linguistically as far as whether speakers pay attention to this or that aspect of sentential structure after they have carried out a syntactic analysis of the sentence under consideration, which could turn out to be universal after all.⁶ CM is thus not a very useful model under which to study syntactic parsing in bilinguals. In the following section, I sketch an area of research in the parsing literature which, instead, does prove to be quite promising in this respect.

Relative Clause Attachment

Late Closure is one of the strategies proposed under the Garden Path model of sentence processing, a model dating back to research from the late 1970s (Frazier & Fodor, 1978; Frazier, 1978; for a review, see Mitchell, 1994). According to the Garden Path model, the parser uses heuristic strategies (Minimal Attachment, Late Closure) to determine the attachment of incoming information to the phrase structure tree it has been building. Thus, under the Garden Path model, sentences that are difficult to process violate these principles in some way.

The Late Closure principle states that incoming structure is attached to the phrase currently being processed (Frazier, 1978; Frazier & Fodor, 1978). For example, consider the following translation equivalent sentences in (5) below:

(5) a. Rose sold the book that she had published to her friend.

b. Rosa vendió el libro que había publicado a su amigo.

These two sentences are hard to process in both languages. The explanation of the difficulty under the Garden Path model is that the parser wants to attach the

⁶ MacWhinney (1997) cites evidence from recent on-line studies under the CM framework which have found that the predictions of CM break down in speeded tasks: "...under conditions of speeded on-line judgments, full cue integration does not occur" (p. 132). Clearly, such findings call for either a revised version of the model to accommodate them, or for an admission that the model's domain of operation is post-syntactic.

phrase *to her friend* in (5a) (*a su amigo* in (5b)) to the phrase it has been processing most recently, i.e., the lower verb, *published* (*había publicado*), rather than the higher verb, *sold* (*vendió*), where, in fact, it belongs. In order to get the correct interpretation (that Rose sold her published book to her friend), the parser must violate the Late Closure principle and attach high.⁷

Difficulty in processing, according to the Garden Path model, results from violation of the processing principles—which are themselves a consequence of the architecture of human cognition (and thus have correlates to other aspects of cognition, such as short term memory limitations; see Frazier, 1978). One observable behavioral effect of processing difficulty or cost (and in the case of severe garden paths, processing breakdown)⁸ is longer times in correctly understanding a particular sentence. Readers (of both Spanish and English) should take a longer time to read sentences like the ones in (5) above than equivalent sentences that do *not* violate Late Closure. For example, a sentence like (5a) should take longer to read than the same sentence with the phrase *to her friend* substituted with a phrase like *last summer*. Intuitions of speakers of both Spanish and English agree with this prediction; see Fernández (in progress) and Igoa (1995, 1996) for empirical evidence also confirming this assumption.

Beginning in the late 1980s, experimentation with Spanish monolinguals has found that Late Closure is not always operational in certain types of constructions, namely, in constructions containing a complex NP and a relative clause ambiguously modifying either one of the two nouns in the complex NP, as in the example below:

- (6) a. Andrew met the niece of the teacher that belongs to the communist party.
- b. Andrés conoció a la sobrina del maestro que está en el partido comunista.

In such sentences, monolingual Spanish speakers have consistently been found to prefer attaching the relative clause (*que está en el partido comunista*, 'that

⁷ Note the difference between the type of explanation given for the processing difficulty in (5) by the Garden Path model and the type of explanation for the processing difficulty in (1)–(3) above by CM. The CM account of difficulty is much more global (speakers pay more attention to some overarching aspect of the structure), while the Garden Path account is much more concerned with local events (speakers attach an incoming phrase in some particular way).

⁸ Processing difficulty is gradient as can be seen by contrasting the following examples:

- (i) John knew the girl at the bakeshop was hungry.
- (ii) While Mary was mending the sock fell off her lap.

The difference between such sentences has been studied at length in current work on reanalysis; see Ferreira & Fodor (1998) for a comprehensive collection of articles on this topic. The more difficult a sentence is to process – as, for instance, sentence (ii) above, where encountering *off her lap* causes a very noticeable garden path – the more obvious and severe the processing difficulty becomes. In contrast, hearers may be able to recover from processing difficulty, almost without noticing it, with easier sentences – like (i) above, where the initial analysis of *the girl at the bakeshop* as the direct object of *knew* is easily and possibly quite imperceptibly reanalyzed into the subject of an embedded clause.

belongs to the communist party') to the higher noun (*la sobrina*, 'the niece') than to the lower noun (*el maestro*, 'the teacher'). This preference holds both on- and off-line (Cuetos & Mitchell, 1988; Carreiras, 1992; Mitchell & Cuetos, 1991; Carreiras & Clifton, 1993), and it violates Late Closure. (Recall that, according to Late Closure, the attachment should be to the lower noun, *el maestro*, since it is the phrase having been most recently processed.)

Monolingual English speakers, on the other hand, given materials like (6a), tend to prefer attaching the relative clause to the lower noun, therefore not violating the Late Closure principle. This preference, however, is only uncontroversially evident off-line (Cuetos & Mitchell, 1988; see discussion in Corley, 1995); on-line data are not as clear. Monolingual English speakers have no on-line preference (Carreiras & Clifton, 1993; see also work cited in Corley, 1995), though with some types of disambiguators in the relative clause (in particular, with reflexive pronouns)⁹ monolingual English speakers exhibit a preference to attach low (Clifton, 1988, as reported in Frazier, 1990). Even so, some monolingual English speakers are consistent high attachers (Corley, 1995; see also discussion of Corley's experiments below, in section 4).

Several proposals regarding the reason for this apparent cross-linguistic variation currently coexist in the literature. I will briefly discuss three important proposals: the grammar-based account of modifier attachment under the Construal hypothesis of Frazier & Clifton (1996); the exposure-based account of the Tuning hypothesis (Brysbaert & Mitchell, 1996; Cuetos et al., 1996; Mitchell & Cuetos, 1991; Mitchell et al., 1995); and the recent proposal of Fodor (1998) where the prosodic processor is responsible for the cross-linguistic variation. While these three are not the only existing explanations, they reflect the flavor of the answers to the critical questions under debate (for a more complete review of this literature, see Mitchell & Brysbaert, 1998).

Construal

A very thorough account of the cross-linguistic variation in relative clause attachment is the Construal hypothesis, outlined in Frazier & Clifton (1996; see also Carreiras & Clifton, 1993; Gilboy & Sopena, 1996; Gilboy et al., 1995; Igoa, 1995, 1996; for a review, see Fernández, 1996, Mitchell & Brysbaert, 1998). Though Construal was developed to account for a greater body of evidence than just cross-linguistic differences in relative clause attachment, I will focus only on the characteristics of this explanation relevant to this discussion. Construal proposes that the initial attachment of what are referred

⁹ This is the type of disambiguation in sentences such as *The doctor called in the son of the pretty nurse who hurt himself* (high attachment) / *herself* (low attachment).

to as "non-primary phrases"¹⁰ is *not* guided by the universal principles of the Garden Path hypothesis (Late Closure, etc.), in contrast to "primary phrases", which are attached by the universal Garden Path model principles. Non-primary phrases are *construed* or *associated* (rather than *attached*) to the current processing domain, and interpreted using any and all available information, including both structural and non-structural material (see Frazier & Clifton, 1996, pp. 31-32, for an exact definition). Thus, a relative clause will be associated to the tree the parser has been building, and the specific interpretation of any given association will vary depending on information (both syntactic and non-syntactic) contained within the association site and within the relative clause. Where the syntax allows two possible attachments, the first non-syntactic principle to apply is Relativized Relevance (attach to the main assertion of the sentence; Frazier, 1990, p. 321). The relative clause in a structure such as (6) will associate to the whole complex NP (which includes both sites—*the niece* and *the teacher*), and will be ultimately interpreted as referring to the more relevant higher NP, *the niece*, unless other information (including other discourse principles) suggests otherwise. Spanish listeners follow the preferences dictated by Relativized Relevance and with a sentence such as (6) opt for the analysis where the relative clause modifies *the niece*.

English listeners, on the other hand, ultimately prefer to attach low, a preference accounted for under Construal by assuming that other discourse principles cause this preference against what Relativized Relevance dictates. The grammar of English generates an unambiguous way of asserting that it was the niece, and not the teacher, who was in the communist party, using the Saxon genitive construction (*the teacher's niece*):¹¹

- (7) Andrew had dinner yesterday with the teacher's niece who was in the communist party.

While Relativized Relevance predicts that, post-syntactically, the preference should be to attach a relative clause to the main assertion of the sentence (i.e., in a sentence like (6), to *the niece*), English perceivers also assume that their interlocutors are producing sentences that are as informative as possible, following the Gricean maxim of quantity (Grice, 1975), that the speaker should be as informative as necessary for the purposes of the conversation, providing neither too little nor too much information to the interlocutor. Then, if the speaker of (6) had meant that it was *the niece* who was a communist, she would

¹⁰ Construal distinguishes between *primary* and *non-primary phrases*. The category of primary phrases includes the subjects and main predicates of finite or infinitival clauses and the complements and other obligatory constituents of primary phrases. In other words, a primary phrase is a constituent predictable from the structure already computed (e.g., if an IP has already been constructed, a VP within this IP constitutes a primary relation). Non-primary phrases are all other non-obligatory constituents, including relative clauses of the type being discussed here.

¹¹ Brysbaert & Mitchell (1996) introduce this term to differentiate such possessive constructions from what they aptly name Norman genitives (*the niece of the teacher*).

have said so, using a sentence more like (7) than like (6). Since she didn't utter (7), the perceiver logically assumes the heuristically easier analysis, where Late Closure is not violated, and where the relative clause modifies *the teacher*.

As Brysbaert & Mitchell (1996) and Mitchell & Brysbaert (1998) have pointed out, the Construal account also runs into difficulties dealing with some recent evidence of attachment preferences for Dutch speakers. Dutch has three ways of constructing genitives (Brysbaert & Mitchell, 1996): a Norman genitive, a Saxon genitive, and a construction in which a possessive pronoun follows the genitive.

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|---------------------------------|---------------------|------------------------------------|
| (8) a. <i>de hoed van vader</i> | 'the hat of father' | Norman genitive |
| b. <i>vaders hoed</i> | 'father's hat' | Saxon genitive |
| c. <i>vader zijn hoed</i> | 'father his hat' | antecedent + possessive
pronoun |

Brysbaert & Mitchell note that the Saxon genitive is becoming outdated in Dutch and is used in a very limited set of circumstances (with proper names and family relatives only). According to the Construal hypothesis, the frequency of occurrence of the Saxon genitive should make no difference with respect to listeners' use of Gricean reasoning to determine interpretation of relative clauses in *NP of NP* structures (in Dutch, *NP van NP* sequences). In fact, the mere licensing of the Saxon genitive by the grammar of Dutch should prompt listeners to prefer low attachments in ambiguous structures, as it presumably does in English, by setting the Gricean reasoning into motion. However, it turns out that Dutch speakers prefer high attachments, both off- and on-line (Brysbaert & Mitchell, 1996).

To explain this finding under the Construal account, it could be claimed that Gricean reasoning is only triggered based on the general acceptability of Saxon forms in a language (see Mitchell & Brysbaert, 1998, for a more complete description of this argument). For example, suppose that in English, of all relative clause attachments to possessive constructions, half were to Norman NPs and the other half to Saxon NPs. Brysbaert & Mitchell (1996) note that in Dutch the ratio of such attachments would probably be different, with far more Norman NPs than Saxon NPs, this due to the fact that the Saxon construction is much less frequent in Dutch than it is in English. Such an explanation, however, is almost indistinguishable from claiming that exposure to certain types of constructions is responsible for guiding the choices, which is, in fact, the proposal of the Tuning hypothesis, described in the next section.

Tuning

The Tuning hypothesis (Mitchell & Cuetos, 1991; Cuetos et al., 1996; Brysbaert & Mitchell, 1996; Mitchell et al., 1995; Mitchell, 1994) assumes that the parser's architecture is derivable from the environment of a speaker. This

proposal claims that the processor evaluates the statistical frequency of attachments in unambiguous input and derives its structural preferences, when faced with ambiguity, from the frequencies it has computed. For example, if an individual has been exposed to input with a higher frequency of unambiguous high attachments, then this person's preference when dealing with ambiguous input will be to attach high. After the initial attachment, the Tuning model is assumed to operate much like the Garden Path model (Brysbaert & Mitchell, 1996).

The Tuning hypothesis claims that the relationship between the parser and the corpus of linguistic input it is exposed to is direct. The simplest test of this claim is one which establishes correlations between perceptual and actuarial data. A number of recent studies have focused their efforts on this problem (Gibson & Pearlmutter, 1994; Gibson et al., 1996; Gibson & Schütze, 1996; Mitchell et al., 1995; Igoa, 1996; Mitchell & Brysbaert, 1998). The way frequency data are analyzed could have important consequences in terms of correlating these findings with perceptual data. The question of the grain at which records are kept by the actuarial mechanism is thus an important one, taken up in some detail in Mitchell et al. (1995), where using a coarse-grain in record keeping is advocated. Thus the Tuning processor does not entirely operate in a vacuum without any relationship to the grammar. For example, if the parser keeps coarse-grain records of the input (as Mitchell et al., 1995, suggest), a broad range of syntactic categories must be distinguished and taken account of, including relative clauses, NPs, PPs, APs, etc. Furthermore, syntactic distributions in a given language may affect the frequency counts in interesting ways. As mentioned above, the fact that Saxon forms are less accepted (and therefore less used) in a language like Dutch than in a language like English may in fact reverse the preference from low to high attachment (see Brysbaert & Mitchell, 1996, for further details on this argument).

Contrary to these expectations, Mitchell & Brysbaert (1998) report a statistical analysis of a Dutch corpus where the high attachment preference of Dutch speakers was not matched. Mitchell & Brysbaert analyzed 469 *NP van NP RC* structures found in samples taken from four Dutch newspapers. Of the 469 occurrences of the structure, an unprecedented 325 (almost 70%) were attachments to the lower NP. This mismatch between the perceptual and actuarial data in Dutch presents quite a challenge to the Tuning hypothesis. It is possible that the perceptual data were gathered from a sample of individuals whose primary preferences were affected by external factors (such as, e.g., multilingualism; see discussion below in section 4). Another alternative explanation is that the corpora studied are not representative of the preferences of the population because they were written or edited by atypical speakers following prescriptive norms not followed by the general population. Or it may simply be the case that frequency distributions do not, after all, affect processing routines, at least not as radically as the Tuning hypothesis suggests. (See Mitchell & Brysbaert, 1998, for further possible accounts.)

Prosody

In a new attempt to sort out some of the evidence regarding cross-linguistic variation in sentence processing, Fodor (1998) proposes that many of the controversial facts discussed above can be accounted for by assuming that the language specificity lies in the prosodic segmentation processor, rather than in the parser. Fodor's proposal maintains the universality of the parser and all its operations, including Late Closure, with all constructions, including relative clauses attaching to complex NPs, in all languages, including English and Spanish. This allows for the existence of a fully innate parsing mechanism which any language-specific grammar may be plugged into. In effect, according to Fodor, parsing routines only exist to efficiently implement the competence grammar.

Fodor emphasizes that in languages like Spanish, where Late Closure has reputedly been observed to be violated, the only offending structure found so far is the one represented in (6) (repeated below), where a relative clause modifies a complex NP. In constructions like (5) above (also repeated below), Late Closure holds in Spanish as well as in English, as it does in sentences like (9)–(12), representing a variety of structural ambiguities:¹²

- (6) a. Andrew met the niece of the teacher that belongs to the communist party. (LC ✓?)
- b. Andrés conoció a la sobrina del maestro que está en el partido comunista. (LC ✗)
- (5) a. Rose sold the book that she had published to her friend. (LC ✓)
- b. Rosa vendió el libro que había publicado a su amigo. (LC ✓)
- (9) a. Someone shot the maid of the actress on the balcony. (LC ✓)
- b. Alguien disparó contra la criada de la actriz en el balcón. (LC ✓)
- (10) a. She read the note, the memo, and the letter to Mary. (LC ✓)
- b. Leyó la nota, el memo y la carta a María. (LC ✓)
- (11) a. John said that Tom left yesterday. (LC ✓)
- b. Juan dijo que Tomás se fue ayer. (LC ✓)
- (12) a. A gift to a boy in a box. (LC ✓)
- b. Un regalo para un niño en una caja. (LC ✓)

It seems, then, that Late Closure violations are the exception, not the rule, in both Spanish and English (and Italian, and German—see fn. 12).

Fodor observes that the length (or prosodic weight) of a constituent affects where it will be attached, illustrated by the following contrasting sentences:

¹² Hemforth et al. (1996) provide evidence that with constructions in German of the same structure as that in (9), German speakers attach low, contrasting with the German preference to attach high given structures with relative clauses, like (6) above. De Vincenzi & Job (1993, pp. 190–191) claim that with Italian versions of the sentences in (10)–(12), the preference of Italian speakers is identical to that of English speakers.

(13)a. Someone shot the maid of the actress who was on the balcony with her husband.

b. Someone shot the maid of the actress who cried.

Notice that the shorter relative clause in (13b) seems to be preferably attached low, while the higher one in (13a) could go either way. In Spanish, with sentences equivalent to those in (13), the shorter relative clause would likely also stay low with the longer relative clause raising high. The idea is that the prosody likes to maintain a balance of prosodic weight between attachers and attachees. This means that in (13a), for the relative clause to attach low would mean a great imbalance between the very long attacher (*who was on the balcony with her husband*) and a contrastively puny attachee (*the actress*), therefore the relative clause floats up to the high site, so that its referent is a heavier NP (*the maid of the actress*). In (13b), by contrast, the very short attacher (*who cried*) can easily attach to the comparably brief lower NP (*the actress*). This account thus predicts a shift of preference (in any language) for sentences (5) and (9)-(12) above if the attaching constituent is lengthened, as shown below:

(5) c. Rose sold the book that she had published to her unbelievably intelligent but somewhat peculiar friend.

(9) c. Someone shot the maid of the actress on the recently restored Baroque balcony.

(10)c. She read the note, the memo, and the letter to the assistant secretary of state for Latin American affairs.

(11)c. John said that Tom left the day before yesterday.

(12)c. A gift to a boy in a blue and yellow velvety box.

Whether or not the (a) versions of these sentences differ from the (c) versions as Fodor's account predicts is an empirical question. Lengthening the attaching constituent intuitively has a remarkable effect with sentences like (5), (10) and (12), but fails to work as well with the constructions in (9) and (11).

Data from an experiment reported by Hirose et al. (1997) provide some preliminary support for Fodor's prosody proposal. Japanese speakers have been found to be high attachers (like Spanish speakers, unlike English speakers) given constructions where a complex NP is ambiguously modified by a relative clause (Kamide & Mitchell, 1997).¹³ Hirose et al. measured the reaction times of Japanese speakers with sentences containing complex NPs modified by either a one-word or a two-word AP. The sentences were either

¹³ The structural ambiguity under discussion (complex NP modified by a relative clause or, in the case of the materials used by Hirose et al., an AP) is not equivalent in Japanese and English (or Spanish) at the word-by-word level. Because Japanese is a verb-final left-branching language, the order of the constituents in Japanese is almost the mirror image of the order of the same in English and Spanish. In structurally equivalent Japanese sentences, the modifier (relative clause or AP) comes first, followed by the genitive part of the complex NP (the *of* NP segment), followed by the head of the complex NP. See Kamide & Mitchell (1997) for details.

globally ambiguous (the AP could attach to either site) or disambiguated for low attachment (to the genitive NP site). The interaction of these two factors (AP length by sentence ambiguity type) was significant, with longer reaction times in the forced low attachment, two-word AP condition, wholly in accordance with Fodor's proposal: heavier modifiers float up to higher attachment sites.

To account for the observed differences between English and other languages (including Spanish and Japanese, and a host of others that have been studied to date), Fodor suggests that certain prosodic patterns in English make the language less sensitive to the heaviness of attachers, though just which prosodic patterns yield this characteristic is at the moment unknown (for a similar proposal, see Gilboy & Sopena, 1996).

Summary

Unfortunately, the psycholinguistic literature on relative clause attachment does not yet have a comprehensive theory to explain the cross-linguistic differences in the behavior of monolinguals of languages like Spanish and English. It may turn out that the most valid account of relative clause attachment – indeed, of modifier attachment in general – needs to include a discourse-based factor of the type proposed by the Construal hypothesis, as well as a mechanism for prosodic influences; the operation of either or both of these may further hinge directly on grammatical parameters but not necessarily exclude bias from actuarial records. At this point, we are not in a position to state definitively which is the correct analysis, and only further empirical study will provide more satisfactory answers.

Both Construal and the prosody account of Fodor (1998) eliminate the possibility of language dependent parsing, and predict that differentiation shall not be observed in bilinguals. Under the Tuning hypothesis, language dependent processing routines (in bilinguals) are certainly possible, insofar as a given bilingual is exposed to contrastive distributions of input, each associated with each of her/his languages.

Some recent work (Fernández, 1995; Fernández & Hirose, 1997; Fernández, in progress), has deliberately extended research in relative clause attachment to the domain of bilinguals to determine whether or not parsing in bilinguals is language dependent. While the study of attachment preferences in bilinguals may not be the most ideal way to develop a sound, empirically based explanation of the cross-linguistic variation I have discussed in this section,¹⁴ such an

¹⁴ The psycholinguistic literature has traditionally focused on monolingual processing, if only because bilingual processing raises a great number of difficult and often tangential issues having to do with balance of proficiency, use, etc., which are usually assumed to be negligible when studying monolinguals. Monolinguals, unlike bilinguals, are typically taken to be homogeneous regarding both competence repositories and performance routines.

endeavor may very well contribute in important ways to the development of the ultimate explanation. Study of the variables involved in determining use of strategies in bilinguals may eventually lend evidence to one or another theory. For example, a correlation between language dominance and strategy use may mean that processing strategies are linked closely to grammatical competence. On the other hand, a correlation between language use and strategy use may be used to argue that actuarial records influence processing strategies. Note, however, that both of these two possibilities are not without problems: it may be claimed that language dominance lends support to a Tuning-like account (dominance could imply automatic more exposure to the dominant language), while it may alternatively be claimed that language use supports a grammar-based account, like Construal or Fodor's prosody proposal (since more use typically results in greater dominance). Experimentation with fully crossed variables is therefore very much called for.

Bilinguals and Relative Clause Attachment

We now turn to examining the strategies used by bilinguals to attach relative clauses to complex NPs by surveying the few studies done to date on this topic. Two of these studies were deliberate attempts to obtain data from bilinguals.¹⁵ The other two, to which I turn first, were not.

In one experiment reported by Gibson et al. (1996), Spanish speakers living in the Boston area were tested, and it is a plausible assumption to make that all the subjects in this experiment were Spanish/English bilinguals, though Gibson et al. do not provide any data on their subjects' bilinguality. In a very different study, Brysbaert & Mitchell (1996) examined the behavior of Dutch speakers, tested in Belgium, and were probably all speakers of not only French but also English. Again, Brysbaert & Mitchell do not provide data on their subjects' multilinguality, but Marc Brysbaert (p.c.) points out that very few of the Belgian subjects are really fluent in French and most only started education in that language around age 11. According to Brysbaert, the French influence of the Dutch speakers may be counterforced by English influences: psychology

¹⁵ There is a third such study only recently brought to my attention: Frenc-Mestre (1997) reports on two experiments which examined responses of bilingual subjects given sentences containing the relative clause attachment ambiguity under discussion here. Both experiments tested bilinguals who were "less skilled" in their second language than in their first. The first experiment tested English/French bilinguals, and the second Spanish/English bilinguals (recall that English is a low attaching language; French, like Spanish, is high attaching; Mitchell et al., 1990; Zagar et al., 1997). Frenc-Mestre found evidence of forward transfer having to do with less skill or experience in subjects' second language, with the subjects for whom processing strategies differ between L1 and L2 (the English/French group).

students at the Katholieke Universiteit Leuven, where the testing took place, have to read more texts in English than in French; television programs in Belgium are subtitled and remain in the original language (typically English). A common link between Gibson et al.'s and Brysbaert & Mitchell's data is the individual variation exhibited by their polyglot subjects, which may possibly not be present in a comparable sample of monolinguals of the target languages, Spanish and Dutch. This last assertion, however, is only speculative and requires further investigation.

Gibson et al. do not discuss individual variation in their data, but do provide detailed figures for their Spanish-speaking subjects' results (though, unfortunately, they provide no comparable data for their English monolinguals). Gibson et al. asked subjects to rate the grammaticality of sentence fragments such as the following:

- (14)a. las lámparas cerca de las pinturas de la casa que fue dañada en la inundación
'the lamps near the paintings of the house that was damaged in the flood'
- b. las lámparas cerca de la pintura de las casas que fue dañada en la inundación
'the lamps near the painting of the houses that was damaged in the flood'
- c. la lámpara cerca de las pinturas de las casas que fue dañada en la inundación
'the lamp near the paintings of the houses that was damaged in the flood'

In each of these sentence fragments, the complex NP contains three possible sites for the relative clause to attach to. Only one of the nouns agrees (in number) with the singular verb in the relative clause: in (14a) it is the lowest noun (*la casa*), in (14b) the middle noun (*la pintura*), and in (14c) the highest noun (*la lámpara*). Gibson et al.'s subjects, overall, rated the grammaticality of the materials in this experiment as follows: (14a) was rated as the best (most grammatical), followed by (14c), with (14b) rated as the least grammatical. A close inspection of the distribution of the preferences Gibson et al. provide for the Spanish speakers, though, indicates that only about one third of the 24 subjects follow this pattern, with the remaining 16 subjects following different patterns.¹⁶

¹⁶ In particular, eight subjects followed the pattern L>H>M (the letters are initials referring to the particular site, Low, High, Middle; the expression reads "L was judged most grammatical, H less grammatical than L, M less grammatical than H"). The rest of the subjects pattern as follows: five L>M>H; two L>{H,M}; three H>L>M; three {L,H}>M; two {L,H,M}; one {L,M}>H. (Initials in curly brackets refer to sets of sites which were judged to be equally grammatical.)

Brysbaert & Mitchell, on the other hand, provide a quite detailed analysis of the individual variation among their subjects and conclude that in their subject pool there existed statistically significant individual variation. This they take to be in support of some of the predictions of the Tuning hypothesis, in particular, that individual variation may result from different individuals being exposed to different distributions of structures.

Individual variation has of late received much attention, particularly from proponents of the Tuning hypothesis (see especially Brysbaert & Mitchell, 1996, and Corley, 1995), and with good reason. Tuning predicts that individuals exposed to different distributions will have different preferences than the majority. Corley (1995) reports two experiments, a sentence completion task and a self-paced reading task, in which English speakers (presumably monolinguals) were shown to have individual differences stable over time. In the first experiment, about one quarter of the subjects were found to be consistent high attachers.¹⁷ The attachment preferences of the subjects in Corley's first experiment correlate between the two sessions, separated by two weeks, in which the test was administered. Thus, this experiment suggests that, in monolinguals, individual differences exist and are stable over time. A second on-line experiment provides further support for this idea. Twenty-four subjects from the first experiment were asked to return for a second test, in which they were classified according to the attachment preference they had exhibited in the first experiment. In this second experiment, the 12 high attachers were found to be reliably different from the low attachers when reading sentences with unambiguously attached relative clauses.

Evidently, we want to know more about the high attachers and their language histories, so as to ascertain how they came to be high attachers. Their preference could be exclusively due to exposure to different distributions of unambiguous attachments, as the Tuning hypothesis would explain. However, we cannot rule out the possibility that these dozen high attachers were honor students in, say, French (a language in which the speakers have been found to prefer high attachment; Mitchell et al., 1990; Zagar et al., 1997).

Perhaps one important observable phenomenon to look for is homogeneity in monolingual populations and individual variation (certainly between individuals, as in the case of Corley's subjects, but possibly also within individuals) in bilingual populations. Individual variation thus becomes one crucial target of study in bilingual processing research, and the empirical question is whether the factors that contribute to the individual variation can be isolated.

¹⁷ Though Corley does not provide an exact ratio of high to low attachers, he does plot the results of his first experiment by subjects. In his Figure 5.1 (Corley, 1995, p. 86), approximately 12 of the 52 subjects are plotted in the lower left quadrant, the region representing a high attachment preference.

Spanish/English Bilinguals

In the first study of this nature to specifically look for processing differences between monolingual and bilingual populations (Fernández, 1995), I examined responses to ambiguous sentences in an off-line questionnaire by three groups of speakers of English: 15 monolinguals, 15 Spanish/English bilinguals who learned English before the age of 10 ("early learners"), and 15 Spanish/English bilinguals who learned English after the age of 10 ("late learners"). The average age of acquisition of English for the early learners was 3.38 (for all of them, Spanish was the native language or the language acquired at the same time as English), 19.5 for the late learners. The difference between the bilinguals' knowledge of English and Spanish, as reported by the subjects in self-ratings of their proficiency, was an average of $-.2$ for the early learners, $+.37$ for the late learners.¹⁸ All subjects saw sentences like the following, each followed by a question, which they were to answer by circling the appropriate response, as also shown below:

- (15) a. Roxanne read the review of the play that was written by Dianne's friend.
 What was written by Dianne's friend? the review the play
- b. The crowd cheered for the singer with the guitarist that was awarded a medal.
 Who was awarded a medal? the singer the guitarist
- (16) The neighbor's dog barked at our cat and bit the mailman.
 Who bit the mailman? the dog the cat

The 24 target sentences, 12 like (15a) and 12 like (15b), were ambiguous, and the 48 fillers, like (16), unambiguous (both answers are correct for (15a) and (15b), but only *the dog* is a correct answer for (16)). The results, shown in Figure 1, were analyzed by computing how likely subjects were to attach low.

¹⁸ The negativity in the average ratings for the early learner group indicates that a number of members of this group rated their English as being better than their Spanish, but overall subjects in this group rated their English and Spanish as being equal (proximity to neutral 0). The scores for the early learner averages ranged between $-.5$ and $+.05$. For the late learners, the positivity (and less proximity to neutral 0) indicates that most members stated their Spanish was better than their English. The scores for the late learner averages ranged between $-.05$ and $+.9$.

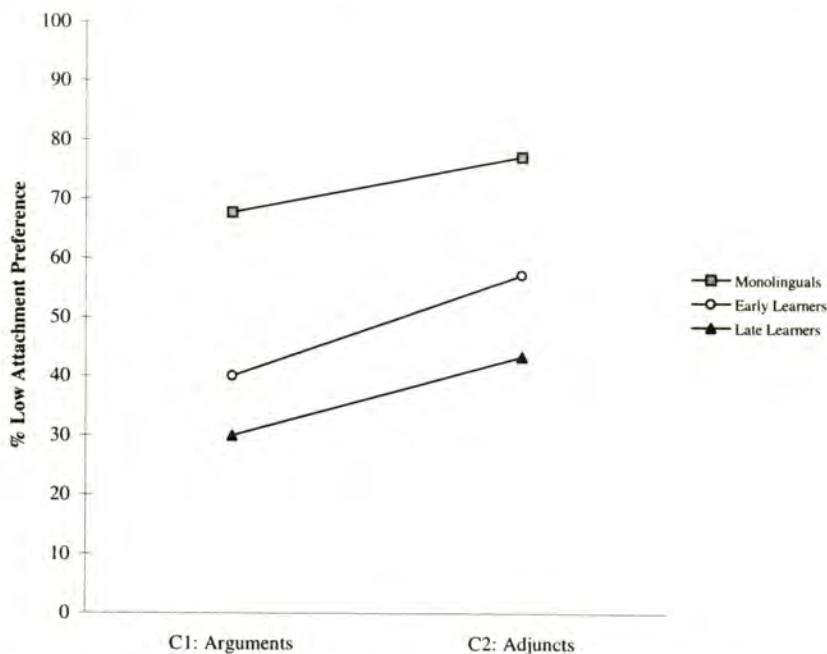


Figure 1. Spanish/English bilingual and English monolingual attachment preferences (after Fernández, 1995).

An omnibus ANOVA was highly significant ($\text{minF}'(2,57) = 9.57, p < .001$): The monolinguals had the strongest preference to attach low (73%),¹⁹ and the late learners the weakest (37%). The early learners fell in between the other two groups (49%), with some individuals tending to be high attachers, others low attachers, and others apparently having no preference. Planned comparisons between the groups indicated a significant difference between the monolinguals and the early learners ($\text{minF}'(1,35) = 7.16, p < .01$), and a tendency to differ between the two groups of bilinguals (marginal in the subjects analysis: $F(1,28) = 2.81, p < .1$; highly significant in the items analysis: $F(1,11) = 15.85, p < .003$).

I will not discuss at length here the difference between the two linguistic conditions in the materials (for details, see Fernández, 1995), but one brief point is worth mentioning. In half of the target sentences, the PP in the complex NP was an argument of that first noun and contained the non-lexical preposition

¹⁹ The results of the late learners are parallel to those reported by Frenck-Mestre (1997, see fn. 15) above for English/French bilinguals, who were found to be influenced by their L1 (English) parsing strategies when processing their second language (French).

of (see (15a)); in the remaining target sentences, the PP was an adjunct to the first noun and contained a lexical preposition like *with* (see (15b)). Responses to the items with argument PPs had a tendency to differ from those to the items with adjuncts: 46% for arguments versus 59% for adjuncts, a difference reliable by subjects ($F(1,42) = 29.1$, $p < .001$) but not by items ($F(1,11) = 2.67$, $p > .1$). This suggests that even the late learners have developed a principled set of strategies for attaching relative clauses to complex NPs. The difference would not hold if the late learners, e.g., were not actually parsing the sentences at all and were just using arbitrary strategies for determining attachment (or for answering the questions in the questionnaire, for that matter).

Overall, the most surprising finding was the amount of individual variation in the early learner sample, not present in the late learner or in the monolingual samples.²⁰ In order to account for this variation, several correlations were carried out on the behavioral data with language history data gathered from the bilingual subjects, to ascertain whether a particular variable (e.g., age of acquisition, use of each language, etc.) could be found to be responsible for the individual variation found in the early learner group. Subjects' average use of Spanish and English, as reported by the subjects themselves, was not significantly correlated with the behavioral data. The age subjects learned English also did not correlate significantly with the behavioral data, but this is hardly a surprising fact, since the relationship between age of acquisition and preference to attach low is not necessarily linear (and the correlation coefficient picks up on linear relationships only). The following figure plots how age of L2 acquisition relates to low attachment preference in L2 (in this case, English) in the bilingual subjects tested.

The chart in Figure 2 illustrates the homogeneity of the late learner sample (all the subjects, with the exception of three, fall below the 50% line for low attachment preference) contrasted with the heterogeneity of the early learner sample (some subjects cluster between 20% and 40%, others between 60% and 75%, one has a preference around 90%, and yet another falls exactly on 50%).

Self-rated proficiency in English versus Spanish (i.e., the difference between the two languages) provides another interesting relationship between the behavioral data and the language history data. The self-ratings (plotted on the abscissa of the chart in Figure 3 below) correlate significantly with subjects' mean responses to items in the argument condition (see (15a)) ($r(29) = -.7$, $p < .05$), with mean responses to items in the adjunct condition (see (15b) above) ($r(29) = -.37$, $p < .05$), and with the average percentages for responses to items in both conditions ($r(29) = -.4$, $p < .05$).

²⁰ The monolinguals' means ranged between 42% and 100% low attachment preference, with one outlier scoring at the 25th percentile.

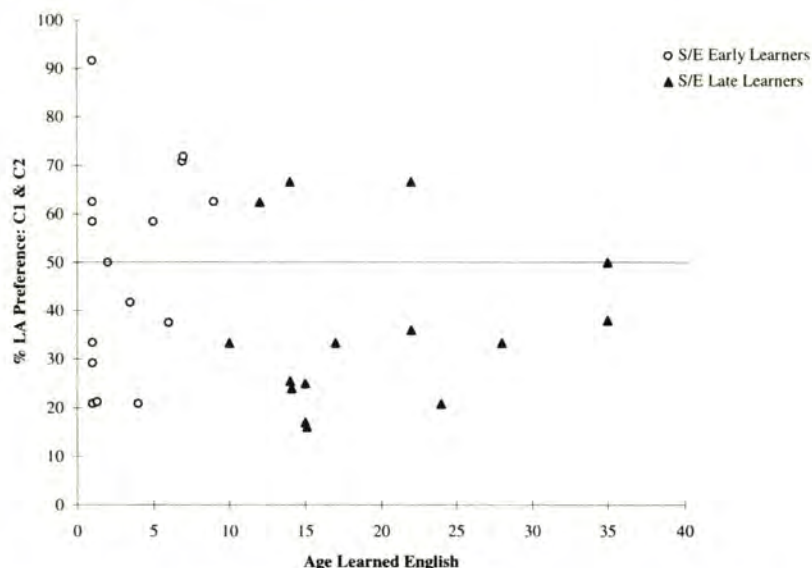


Figure 2. Spanish/English bilinguals: correlation between age English was learned and percent low attachment preference.

The data points in the middle of the chart represent subjects whose self-rated proficiency in Spanish and English are about the same; those to the right, subjects whose Spanish is better; and those to the left, subjects whose English is better. The figure illustrates how subjects for whom Spanish is the dominant language tend to transfer their L1 strategies into their English perceptual routines. On the other hand, those whose English is better tend to be low attachers, like English monolinguals. So it seems that proficiency (balance versus lack thereof) is a more accurate predictor of attachment preferences than is age of acquisition. Yet the subjects in the middle, those who say that their English and Spanish are just as good, those who are also, for the most part, early learners of English, still represent a puzzle. About half of them cluster beneath the 50% line, while the other half of the early learners clearly remains above the 50% line.

Japanese/English Binlinguals

As mentioned above (section 3.3), recent work with Japanese monolinguals (Kamide & Mitchell, 1997) has shown that Japanese speakers prefer attaching to the higher site when given constructions with an equivalent ambiguity as that

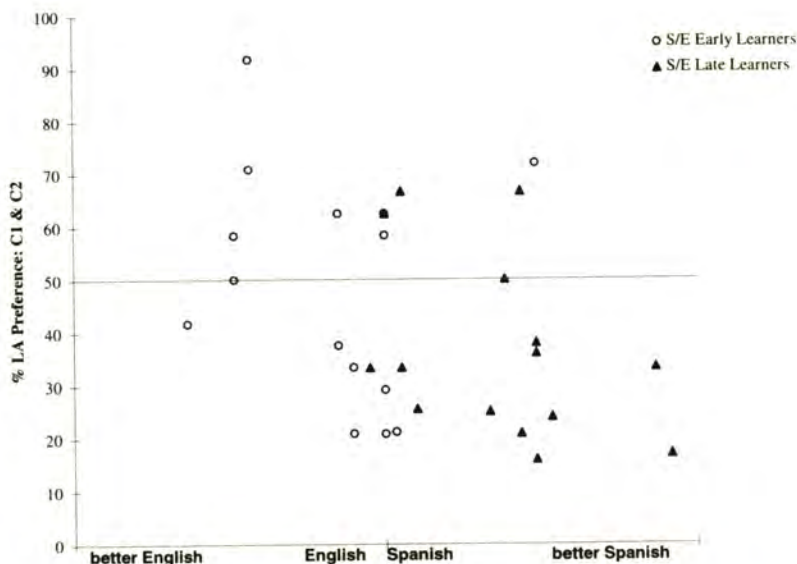


Figure 3. Spanish/English bilinguals: correlation between self-rated proficiency and percent low attachment preference.

in (6). The same questionnaire given to subjects in the Fernández (1995) study was used to analyze the behavioral responses of Japanese/English bilinguals (Fernández & Hirose, 1997).²¹ This bilingual population differed somewhat from the Spanish/English bilingual group, in particular in that the age of L2 acquisition is somewhat younger overall (6 for the Japanese/English early learners, 12.33 for the Japanese/English late learners), although the self-rated proficiency is overwhelmingly in the Japanese-better-than-English side (+.23 for the early learner group, +.67 for the late learners).²²

The results of this questionnaire with Japanese/English bilinguals, compared to those of the English monolinguals tested in Fernández (1995) are shown in Figure 4.

²¹ A few minor changes were made to the materials. In the original study, all target sentences contained the relative pronoun *that* (equivalent to *que* in Spanish, used with both animate and inanimate referents). However, it is prescriptively ungrammatical for Japanese learners of English to use *that* for animate referents; thus all the sentences with animate nouns in the complex NP (six in each condition) were changed such that the relative pronoun was *who*. The Japanese/English bilinguals' responses to *that* versus *who* items did not differ reliably ($F < 1$).

²² For early learners to be so dominant in L1 is somewhat counter-intuitive. It should be pointed out, however, that while these learners have ultimately moved to the United States, where they now live, they first began learning English in Japan, unlike the native Spanish early learners of English.

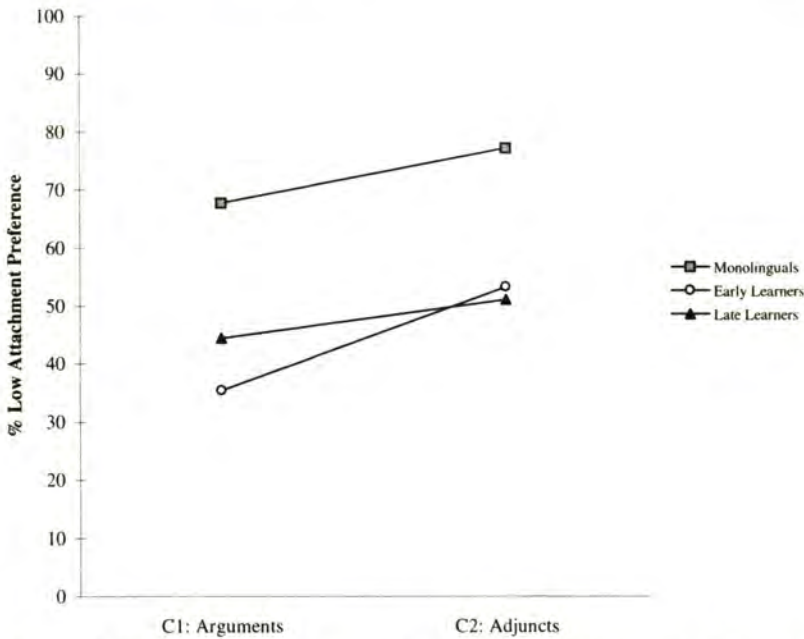


Figure 4. Japanese/English bilingual and English monolingual attachment preferences (after Fernández & Hirose 1997).

An omnibus ANOVA showed significant differences among the three groups ($\text{minF}'(2,27) = 4.41$, $p < .02$). Planned comparisons indicated that the monolinguals (73%) low attachment preference differed from both the early learners (44%) ($\text{minF}'(1,47) = 8.47$, $p < .006$) and the late learners (48%) ($\text{minF}'(1,47) = 5.1$, $p < .03$). However, the two bilingual groups did not differ from each other ($F < 1$ for both subjects and items analyses).²³

As mentioned above, the mean age of acquisition for the Japanese/English group (9.17 average for both early and late learners) was markedly lower than for the Spanish/English group (11.44 average for both early and late learners), this being due to the fact that the late learners in the Japanese/English sample acquired English much younger, and in a completely different setting, than the late learners in the Spanish/English group. This could lead us to claim that the

²³ In the omnibus ANOVA, responses to arguments (49.2% low attachment preference) differed from responses to adjuncts (60.6%) ($\text{minF}'(1,50) = 4.06$, $p < .05$) but this difference did not interact with the language history factor ($F1(2,42) = 1.69$, $p > .1$; $F2 < 1$). This again shows that all subjects are exhibiting principled behavior, and, in particular, that the Japanese/English bilinguals are not guessing haphazardly.

cut-off age of 10 for determining which group bilinguals belong to (early versus late) is too inaccurate or arbitrary. Our statistical analysis tells us that the two Japanese/English bilingual groups are indistinguishable, and this could be because the late learners learned their L2 too young.

But that hardly seems like a valid interpretation of the data. Also, notice that if we were to go in that direction (saying that our 30 Japanese/English bilingual subjects were in fact early learners), then we would need to explain why learning English early is so different when one's L1 is Spanish from when it is Japanese. In particular, we would have to justify why Japanese early learners of English have more forward transfer while Spanish (early) learners of English are a rather heterogeneous group (some show evidence of forward transfer, others seem to use a compromised set of strategies, and others still use English-monolingual-like strategies). And then we would find ourselves in a difficult position trying to account as to why Spanish/English bilinguality differs from Japanese/English bilinguality, at least with regard to processing strategies. While this might be easy to explain under other frameworks,²⁴ recall that we are dealing with the operation of the syntactic processor, which we are assuming to be a module separate from other aspects of cognition, and which therefore should not necessarily vary alongside factors not intrinsically related to it (like the grammar or the prosodic processor, for example, or like actuarial records maintained only for the parser's sake).

Consider the following figure, which plots the average self-rating scores for the Japanese/English bilinguals compared to their attachment preference.

The Japanese/English bilinguals (both the early *and* the late learners) turn out to be not much of a heterogeneous group. Most subject means fall beneath 50%, like those of the Spanish late learners, probably because their proficiency is unbalanced toward the Japanese side. (Notice that the only person who claimed to speak English better than Japanese is much like the average monolingual English speaker, scoring at around 75%. The average score for English monolinguals in this questionnaire was 73% preference to attach low.) It turns out that the Japanese subjects all learned English in school in Japan, rather than in an English-based environment (like, say, a school in the United States with a majority of monolingual English-speaking students). Thus the distinction between the two groups of bilinguals (Spanish/English and Japanese/English) is invalid. In future follow-ups to this study, more accurate screening of subjects must take place, particularly in studies where populations of bilinguals of different linguistic backgrounds are to be compared.

²⁴ Under CM, for example, the highly interactive nature of sentence processing predicts that a person's bilinguality will differ from another's based on a great number of variables, including whether one's L1 is Spanish or Japanese; see discussion in section 2.

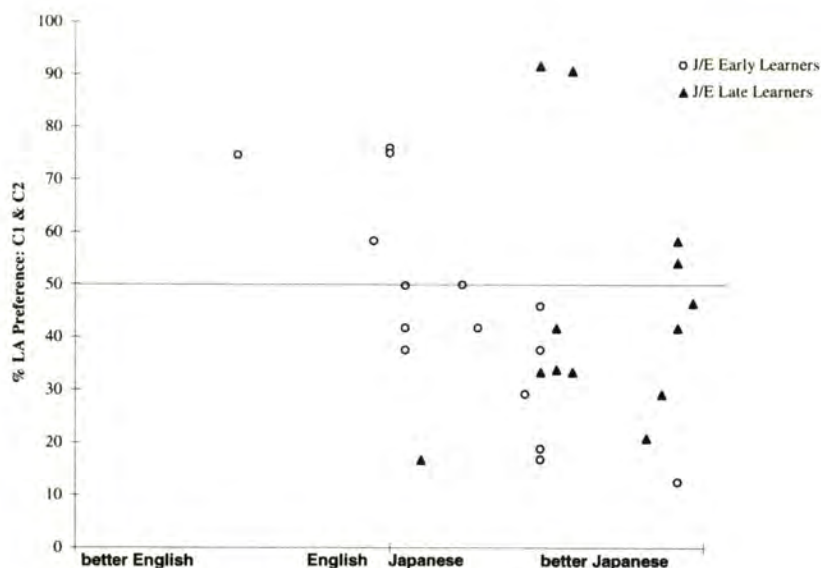


Figure 5. Japanese/English bilinguals: correlation between self-rated proficiency and percent low attachment preference.

Summary

Throughout this section, we have witnessed the importance of L1 and the influence it exerts in parsing in L2, not only in the case of the late learners as well as in the case of the polyglots in the Brysbaert & Mitchell (1996) and Gibson et al. (1996) studies, but also in the case of some of the early learners tested in the Fernández (1995) study. We have also explored the interesting issue of individual variation in sentence processing and I have suggested that it may be a characteristic of bilingual and not so much of purely monolingual populations. This idea needs to be supported with further testing, but the results of the various studies discussed in this section seem to point to its accuracy.

The work discussed in sections 4.2 and 4.3 shows evidence of *forward transfer* for late learners of English whose L1 is Spanish or Japanese. This means that these speakers are using their L1 routines when processing L2 input. (The Spanish/English results are more robust than the Japanese/English ones, but this generalization is still valid.) This research also suggests that some bilinguals *amalgamate* strategies from both of their languages into one set of language-independent strategies. This suggestion (not undebatable) comes primarily from the data of the Spanish early learners of English who scored on

or about 50% in this questionnaire. To establish more accurately what these early learners are doing, further testing is required. In particular, we need to isolate the factor or factors responsible for the individual variation exhibited by the two early learner populations sampled.

The data presented in this section are difficult to reconcile with the Construal hypothesis (section 3.1), unless we are willing to assume that the bilinguals who fail to have preferences like the monolinguals have different underlying grammars for English, which result in a different application of discourse principles. One could postulate, for example, that the bilinguals whose Spanish or Japanese is better than their English have developed a grammar of English based mostly on the grammar of their L1. We might further speculate that, in contrast, the bilinguals whose English is better than their L1 have an English grammar very similar, if not identical, to that of English monolinguals. This would account for the bilinguals on the two extremes of the charts in Figure 3 and Figure 5, whose processing preferences reflect those of monolinguals of their better, or dominant, language: low attachment for those with better English, high attachment for those with better Spanish or Japanese. However, this leaves us with no good explanation for the behavior of the subjects in the middle. For these "in between" subjects, neither of their languages is much more dominant than the other, yet some have high attachment preferences, others have low attachment preferences, and others still have no apparent preferences with these types of constructions.

A similar puzzle arises from attempting to account for the bilingual data under Fodor's (1998) prosody account (section 3.3). We would have to assume differential knowledge of prosody in English for the different groups. This may, in fact, prove somewhat easier to investigate than investigating grammatical representations of the same language between populations of different linguistic backgrounds. The prediction is that bilinguals with English-monolingual-like prosody in both of their languages should parse English as monolinguals do, while bilinguals with Spanish- or Japanese-monolingual-like prosody in both of their languages should parse as Spanish or Japanese monolinguals do. However, there are a couple of problems with this idea. First, as we know nothing about the prosody of the subjects tested in the Fernández (1995) and Fernández & Hirose (1997) studies, it would be mere speculation to assume that the differences found between the bilinguals and the monolinguals have to do with the subjects' prosody rather than with their parsing strategies or their knowledge of English. In fact, these experiments were not designed to test the prosody variable (see Fernández, *in progress*). Secondly, like we saw with the Construal explanation, the prosody account would run into interesting difficulties in trying to account for bilinguals who may have no dominant prosody, those whose prosodic machinery actually differs from L1 to L2 but who still exhibit preferences to attach one way or the other. Finally, it is still unclear what exactly

about the prosody of languages like English differs from the prosody of languages like Spanish and Japanese. It is thus at the moment unclear how one would go about distinguishing bilingual subjects regarding the prosody variable (though a number of ideas are currently being pursued in Fernández, *in progress*).

The bilingual data are most easily dealt with under the Tuning hypothesis (section 3.2), under which it would be noted that the parsing differences are due to the different language histories of the particular groups. Under this framework, the assumption is that bilinguals develop different parsing strategies based on their linguistic history (which hinges on a number of variables: acquisition age, acquisition sequence, amount of use, language dominance, etc.). The question is whether one of these variables plays a more important role than another, and if so, why that should be the case. Furthermore, we need to determine as clearly as possible that the factor responsible for behavioral differences among speakers is actually the parser's language-specific routines, and not the routines of a prosodic processor, or the grammar licensing particular constructions in the language or languages of the speaker.

Finally, we want to know if certain types of bilinguals actually differentiate between the two languages they speak—if they use language-dependent strategies when processing input—or if instead a low attacher in English is always a low attacher and thus exhibits language-independent behavior in parsing. Recall that the Construal and the prosody account predict that bilinguals will not differentiate between strategies in L1 and L2, and that all bilingual processing will be language independent, while the Tuning hypothesis allows for either possibility: language dependent or language independent parsing. The data presented in this section do not provide enough information to answer that question, since to do so we would need to test bilinguals in both of their languages (precisely the aim of the work in Fernández, *in progress*).

Conclusions

A great amount of research in bilingual sentence processing remains to be done. This paper has provided only a glimpse at some of the questions that need to be answered in order to develop a comprehensive picture of bilingual sentence processing. First, we need to determine under what conditions parsing in bilinguals is language dependent or language independent. We have also seen how individual variation should become a key focus of study. I have provided some evidence that monolingual and bilingual populations may differ in terms of whether or not there is homogeneity in processing behavior. While further empirical support of this idea is very much needed, most of the preliminary evidence suggests that this may just be the case.

An underlying theme of this paper has been how the study of bilingual processing can enhance our understanding of human sentence processing in general. For one, it seems now more important to gather specific information on subjects' language histories, be they monolingual or bilingual, when undertaking any type of experimental work. Studying language dependency in bilingual sentence processing may also provide some crucial evidence in our understanding of how sentence processing operates in general.

On a final note, understanding sentence processing in bilinguals is crucial also from an acquisition point of view. If L2 acquirers parse the target language in a way unlike that of monolinguals of the target language, this may have interesting effects on their acquisition of the L2. The input to the language acquisition device is, after all, the output of the parser—and if these representations in L2 learners differ in crucial ways from those of L1 (child) learners, the acquisition process could appear to be different, while in effect it isn't (for further discussion see Fernández, 1995).

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