

# Examining Second Language Reading: An On-Line Look

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## Abstract

The results of several eye-movement experiments, which examined adult non-native readers' performance on-line whilst they read single sentences in their second language, are discussed. Reading performance was investigated in subjects of varying second language ability, and for a variety of linguistic structures. Bilingual subjects' immediate sensitivity to the inconsistency of lexical and/or syntactic constraints across their two languages was demonstrated. This sensitivity provoked longer reading times specifically in the second language and specifically at the region of the sentence where the inconsistency occurred. Moreover, we provide evidence that bilinguals are sensitive to lexical constraints within their second language and use this information when reading potentially ambiguous structures. Transfer effects from the native to the second language were seen to influence syntactic processing, however the amount and effect of transfer varied considerably both as a function of the level of non-native speaker and syntactic ambiguity.

## Introduction

What distinguishes non-native from native readers? Do non-native readers engage in qualitatively different processes than native readers when performing a syntactic analysis on second language sentences, or do they perform in similar fashion, only slower? Where do non-native readers show first language transfer, and when, if ever, does the non-native reader become immune to such influences from his/her native language when reading in the second language? The present paper attempts to shed some light on these questions.

## Experiment 1

Only a handful of studies have examined second language reading on-line, in contrast to a large number of off-line studies (cf. Durgunoglu & Hancin, 1992; Koda, 1993; Odlin, 1989).

In a recent study, we ourselves examined the on-line reading performance of non-native subjects by means of eye-movement recordings (Frenck-Mestre & Pynte, 1997). Therein, we looked at syntactic ambiguity resolution in two experiments. In the first of these, the ambiguity concerned the role of the NP following the subordinate verb, whereby this NP could be either a direct object or the subject of  $S_2$  (e.g. "Whenever the dog obeyed the little girl smiled."). Monolingual research has shown that readers typically prefer the direct object analysis (cf

Frazier, 1987; Mitchell, 1987 for reviews)<sup>1</sup>. We found that skilled non-native readers (whose native language was French) performed the same analysis as native readers of English, that is, they preferred to assign the direct object role to the postverbal NP in cases where the subordinate verb could be used transitively. This was revealed by longer overall reading times and a greater number of refixations originating from the disambiguating region of the sentence in the instance that the postverbal NP was in fact the subject of  $S_2$ . However, a transitory influence of the native language was observed, specifically at the subordinate verb. The non-native readers initially paused at the subordinate verb in the instance that it could not be used transitively in their native language. In other words, they showed a moment's hesitation, due to opposing lexical constraints between the native and second language. Subsequently, however, they adopted the direct object analysis of the postverbal NP and found themselves "garden-pathed" upon the reading of the main verb, akin to native speakers of the language. In conjunction, the results obtained for these skilled bilinguals show transitory transfer

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<sup>1</sup> Note that this has been found even in cases where the subordinate verb should normally preclude the direct object analysis (cf. Ferreira & Henderson, 1990, but also Frenck-Mestre & Pynte, 1995), thus implying that subcategorisation information does not influence initial parsing strategies (but see MacDonald et al., 1994).

effects but overall native-like performance when faced with syntac-tically ambiguous sentences in the second language.

## Experiment 2

In the second experiment of our study (Frenck-Mestre & Pynte, 1997), we examined the performance of non-native readers for another type of syntactic ambiguity, namely PP attachment. We found, in like manner to previous monolingual studies (Clifton, Speer & Abney, 1991; Rayner, Carlson & Frazier, 1983; but see Altmann & Steedman, 1988; Taraban & McClelland, 1988), that non-native readers preferred to attach the ambiguous PP to the preceding VP rather than to the preceding NP (e.g. "Ils accusent l'ambassadeur d'espionage vs. d'Indonesie"). This preference was revealed by shorter first pass reading times of the PP and fewer regressions originating from this region following VP than NP attachment. However, it is crucial to note that this VP attachment preference was only obtained when the preceding verb was ditransitive. For monotransitive verbs, non-native readers (as well as the native controls) showed a preference for low attachment, to the preceding NP (e.g. "Ils admirent le château de sable vs. loin"). Moreover, the non-native readers showed evidence of particular difficulty in attaching the PP "high", to the VP, when the preceding verb was monotransitive, that is when the verb did not allow the reader to foresee a second argument. This latter result suggests that non-native readers may have a general strategy of attaching incoming elements to the most recently processed constituent, but can modify this recency strategy as a function of extra-structural information, such as lexical constraints.

## Discussion

As an ensemble, the results of the above two experiments show that skilled non-native readers resolve syntactic ambiguities on-line in similar fashion to native readers of the language, although there is some evidence of performance specific to the non-native group. Both experiments revealed an immediate influence of lexical information. The fact that lexical constraints influenced syntactic parsing on-line is of interest both to the monolingual and second language literature.

## Experiment 3

In two recent experiments (first presented at the GALA 1997 meeting), we again undertook the question of how non-native readers resolve syntactic ambiguities in the second language. Both experiments recorded subjects' eye movements whilst they read single sentences in their second

language. In these experiments, the subjects were different from those that we had previously studied in that they were considerably less skilled in their second language than were those that partook in our previous experiments. The first experiment examined the performance of English-French beginning bilinguals, whereas the second examined that of beginning Spanish-French bilinguals. In both experiments, the ambiguity involved the attachment of the RC, as illustrated below:

*Jean connaît les filles de la gardienne qui partent...*  
(John knows the girls of the nanny who are leaving)

For sentences of this structure (NP1-Prep-NP2-RC), cross-linguistic research has revealed quite different processing strategies across languages. The seminal study, by Cuetos & Mitchell (1988), revealed a clear preference on the part of Spanish speakers to take N<sub>1</sub> as the subject of the RC, in contrast to English speakers, who showed a trend for an N<sub>2</sub> preference. This study sparked a series of others, in various languages (cf. Cuetos, Mitchell & Corley, 1996, for a recent review). A subsequent study with Spanish and English speakers confirmed the N<sub>1</sub> preference for Spanish, but failed to find a reliable preference for either potential host in English (Carreiras & Clifton, 1993). In like manner to the data for Spanish, but in contrast to English, native French readers prefer to attach the relative clause to N<sub>1</sub> (Zagar, Pynte & Rativeau, 1997). The choice of a given strategy, i.e. N<sub>1</sub> versus N<sub>2</sub> attachment, of the relative, has been attributed to various causes (Frazier & Clifton, 1996; Gibson, Pearlmutter, Canseco-Gonzales & Hickok, 1996; Gilboy, Sopena, Clifton & Frazier, 1995).

To account for the data obtained for this structure in English, Frazier & Clifton (1996) have appealed to the Gricean maxim of clarity. Given that the Saxon genitive form (*John's daughter*) allows the speaker/writer to unambiguously denote the subject of the relative, the choice of the Norman form (*the daughter of John*) would lead the perceiver to pay greater attention to N<sub>2</sub>. This would detract from the proposed general strategy, to take N<sub>1</sub> as the subject of the relative, and in English would result in a null preference. Frazier (1990) indeed proposed the "Relativized Relevance Principle", whereby adjuncts are preferably construed as being relevant to the main assertion of the sentence, to account for the N<sub>1</sub> preference observed for this structure in almost all other languages than English.

Rather than propose a universal strategy, Gibson et al. (1996) account for the differences in the choice of attachment sites across languages for this particular structure in terms of the weight of

two general principles, namely "Predicate Proximity", leading to an  $N_1$  preference, and "Recency", leading to an  $N_2$  preference. The predominance of one or the other of these strategies would depend upon the properties of a given language. Yet another account is forwarded by Mitchell and colleagues (Mitchell, 1994; Cuetos et al., 1996) who assume that the initial choice between two (or more) potential attachment sites is determined by the perceiver's past experience with a given structure, rather than by any general principle. Thus, it would be an "historical accident" that English speakers prefer  $N_2$  over  $N_1$  as the host site for the relative in the NP1-Prep-NP2-RC structure, whereas Spanish and French readers prefer  $N_1$ . Note, in favor of this "linguistic tuning" hypothesis, that there is no clear way to cut the data across language groups; on-line measures have shown an  $N_1$  preference for this structure in Spanish and French, but also in German, whereas an  $N_2$  preference has been shown for Italian and under certain conditions for Spanish, while no clear pattern has been established for English or Dutch. Moreover, the pattern of preferences can vary as a function of the measurement, i.e. whether on or off-line (cf. Cuetos et al., 1996; Frazier & Clifton, 1996)

While there is a lack of consensus regarding the explanation of these effects, there are quite clearly cross-linguistic differences. Given the difference observed across English and French for this structure, it appeared a prime candidate for the on-line study of syntactic transfer effects. In a first experiment, sentences of this structure (NP1-Prep-NP2-RC) were mixed with a series of other structures, and were presented in French to English-French beginning bilinguals, who were uninformed of the ambiguous nature of the test sentences. The question of interest was which of two possible analyses these non-native readers would adopt.

Our results for the beginning English-French bilinguals differ markedly from those obtained for the control group of native French readers. Whereas the native readers showed the  $N_1$  preference typical for French, the English-French bilinguals showed no reliable preference for either NP when reading in French, although there was a slight trend for an  $N_2$  preference. These preferences were revealed by differences in reading times (mean first pass gaze duration) at the subordinate verb: French natives were significantly slower to read the verb when the RC was attached to  $N_2$  than to  $N_1$  (423 vs. 367 ms), while the opposite pattern was found for the English-French bilinguals (492 vs. 447 ms for  $N_1$  and  $N_2$  attachment, respectively). As can be seen in Figure 1, while non-native readers were overall slower

than native readers, differences between the two groups in terms of syntactic processing were visible at the disambiguating verb region only.

The performance of the English-French bilinguals may be accounted for in various ways. It is possible that, when reading in their second

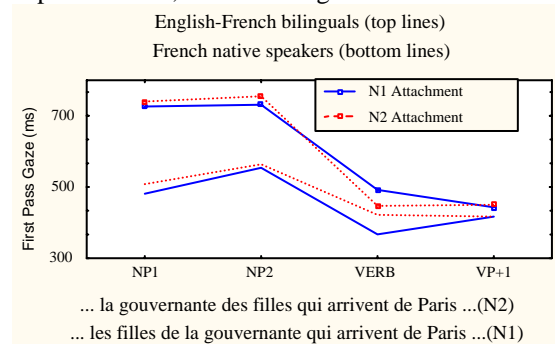


Figure 1. Mean first pass gaze durations for native and non-native readers of French as a function of sentence region and type of attachment of the RC.

language, non-native readers prefer to attach new elements to the most recently processed constituent (cf. Frenck-Mestre & Pynte, 1997), due to a principle such as Right association (Kimball, 1973). It is also plausible that these novice English-French bilinguals were influenced by syntactic processing strategies derived from their native language, English. Indeed, the results for these subjects in French are highly similar to those obtained in previous studies for English. Moreover, various off-line studies have shown evidence of transfer from the native to second language, at both the lexical and syntactic level (cf. Koda, 1993).

#### Experiment 4

To determine which of the above hypotheses best accounts for the data, it is necessary to examine the second language performance of readers whose own native language has been shown to produce an  $N_1$  preference when faced with the NP1-Prep-NP2-RC ambiguity. One possibility would be to run the mirror-image of our first study. That is, examine the performance of French-English bilinguals for this structure in English. If attachment preferences in the second language are determined by a Recency preference, then these French readers should drop the  $N_1$  strategy that they exhibit in French and display an  $N_2$  preference when reading in English. This solution would involve changing both subject pools and linguistic materials, however, which may not be optimal. Indeed, given the strong variations observed across languages and even within the same language, any change in linguistic materials could be a potential source for divergent results.

We thus chose to run a second study using the exact same materials as in the first, but with a group of non-native speakers whose performance in the native language has shown a clear  $N_1$  preference, namely Spanish-French bilinguals.

The  $N_1$  preference observed in Spanish by Cuetos & Mitchell (1988) for the NP1-Prep-NP2-RC ambiguity has since been replicated and qualified (Carreiras & Clifton, 1990; Gibson, et al., 1996; Gilboy, et al. 1995; Gilboy & Sopena, 1996). By examining Spanish-French beginning bilinguals, whose level in their second language, French, was similar to that of the English-French bilinguals who participated in the first study, we could determine which hypothesis best explained our data. An  $N_2$  preference for the Spanish-French bilinguals would support the hypothesis of a general recency preference linked to second language processing. An  $N_1$  preference for the Spanish-French bilinguals would invalidate the recency hypothesis and support the hypothesis that performance on this particular structure is highly influenced by native language strategies, at least in relatively inexperienced non-native speakers.

The results of the second study were straightforward. Spanish-French bilinguals clearly preferred the first NP as subject of the relative clause. These subjects were overall slower to read the sentence than native French speakers, however the pattern of results in the two groups was identical, as can be seen in Figure 2. Both groups showed faster first pass gaze durations at the subordinate verb when it was attached to the first NP than to the second (Spanish-French bilinguals: 425 vs. 502 ms, and French native speakers: 367 vs. 423 ms, for  $N_1$  and  $N_2$  attachment, respectively).

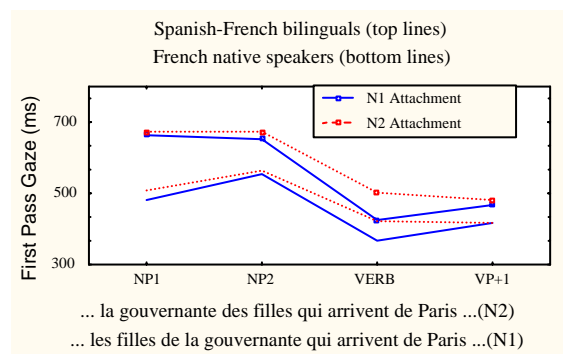


Figure 2. Mean first pass gaze durations for native and non-native readers as a function of sentence region and attachment of the relative clause.

Hence, these data do not support the hypothesis that non-native readers show a general recency preference for this structure, but point to the involvement of native language strategies. The latter hypothesis, of native language transfer, is indeed the only one which can account for the entire data set, i.e. from both the English-French and Spanish-French bilinguals.

## General Discussion

What, one may query, leads to the large influence of the native language in the latter two studies, whereas the first two experiments revealed highly skilled second language processing which was only minimally influenced by the readers' native language? The simplest answer would be experience with the second language. The participants of the two experiments involving the NP1-Prep-NP2-RC structure were as yet rather inexperienced with their second language compared to those that took part in the first two experiments that we report. Another factor may well be the cross-linguistic differences as concerns the ambiguous structures that we examined, however. In all four experiments, the structures that we examined existed in both the readers' native and second languages. However, whereas the first two experiments examined the role of lexical information on syntactic ambiguity resolution and the possible interference from the second language, the latter two examined the influence of preferences in syntactic ambiguity resolution which, for the structure under question, are not necessarily structurally determined (cf. Cuetos et al., 1996; Frazier & Clifton, 1996). It is indeed plausible that native language preferences may be more difficult to overcome than is incompatible lexical information from the native language, and that even highly skilled second language readers would show transfer effects. We are currently running studies to address this question.

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