Syntactic Processing by Skilled Bilinguals

Michael L. Hoover and Veena D. Dwivedi
McGill University

Recent advances in cross-language psycholinguistics provide reading researchers with both the models and the tools needed to investigate the syntactic processing of second language (L2) readers. In our study, 48 L1 (first language) and 48 highly fluent L2 French readers read sentences containing constructions that do not exist in English, the L1 of the L2 readers: pre-verbal pronominalization (clitics) and the faire+infinitive causative construction. The L2 readers exhibited the same processing as L1 French readers; however, slower (but equally fluent) L2 readers also employed a compensatory processing for sentences with clitics. These results build on previous findings that faster L2 readers are more efficient in their use of lower-level information by demonstrating that they are also more efficient at higher-level syntactic processing. Results are discussed in terms of implications for theories of L2 reading and recent models of cross-language syntactic processing.

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L2 Versus L1 Reading

Research has long noted that second language (L2) reading is slower than first language (L1) reading (see Segalowitz & Hébert, 1990 for discussion). Slower reading by L2 learners results from imperfect knowledge of the L2 (see Alderson, 1984). The present study, however, is concerned with the sentence processing of highly fluent L2 readers, who can be assumed to have achieved L2 competence.

Segalowitz and his colleagues (Favreau & Segalowitz, 1983; Segalowitz, 1986; Segalowitz & Hébert, 1990) have attributed this slower L2 reading to relatively less efficient use of low-level (e.g., phonological) information by the L2 reader. For example, Segalowitz and Hébert (1990) compared the reading of two kinds of highly fluent L2 readers: those who read at the same rate in both languages (Equal Reading Rate) versus those who read more slowly in their L2 (Unequal Reading Rate). Using a sentence verification task, they found that for the Unequal Reading Rate group, L2 presents a heavier processing load in working memory. This was manifested as greater difficulty (more errors) with phonological codes while reading sentences (Segalowitz & Hébert, 1990, p. 533). Specifically, the Unequal Reading Rate group made more errors judging sentences that contained phonologically ambiguous words (e.g., “The weather was fair” vs. “The weather was nice,” and “The weather was fare” vs. “The weather was hair”). These results are consistent with Segalowitz’s (1986) claim that L2 reading difficulty is due to “certain basic cognitive mechanisms underlying reading, not directly related to higher order syntactic, ... linguistic knowledge” (pp. 3–4).

The present study explores one example of higher order (i.e., syntactic) knowledge that might affect the difficulty that L2 readers encounter as they process sentences. Specifically, we will examine whether there are differences in the efficiency with which L2 readers use syntactic information compared to L1 readers.

Posner and Snyder’s (1975) dual-process model of reading proposed two independent types of processes. One, automatic, is
fast, does not use attention capacity and is not inhibitory. The second, a conscious-attention mechanism, is slow, does use attentional capacity and can be either facilitatory or inhibitory. For example, studies of word recognition have found that the time required to recognize words in isolation decreases as reading ability increases (Perfetti, Finger & Hogaboam, 1978; Perfetti & Hogaboam, 1975). That is, the process of word recognition becomes more automatic as reading ability improves. (See Favreau & Segalowitz, 1983, for operational definitions of automaticity in a bilingual context that go beyond speed of processing.)

In a refinement of the Posner and Snyder (1975) model, Stanovich and his colleagues (Stanovich, 1980; Stanovich & West, 1979; Stanovich, West & Feeman, 1981) proposed an interactive model of reading that allows for compensatory processes. In their model, one level of processing can compensate for deficiencies at another level. They found that skilled readers have faster word recognition skills, and that less-skilled readers rely more heavily on contextual information in word recognition. They have argued that word recognition is not as automatic for the less-skilled readers as for the skilled readers; as a result, the formers' conscious-attention mechanism takes effect, which requires more processing and therefore more time. Less-skilled readers thus compensate for their less automatic word recognition skills by relying on context-level information.

To determine how L2 readers are using syntactic information as they process sentences, it is necessary to employ an on-line methodology and make use of models that have been developed for L1 syntactic processing. Although there is a long history of studies of L2 reading, there have been relatively few studies of the processing of L2 syntactic information (for exceptions, see Bates & MacWhinney, 1987) and even fewer that study L2 sentence processing on-line (for an important exception, see Juffs & Harrington, 1996). In fact, most studies of L2 reading have employed off-line comprehension or verification methodologies. Although these off-line studies have provided much information about the kinds of sentences that are problematic for L2 readers, only an
on-line methodology can provide a reasonably direct measure of how L2 readers are using syntactic information while processing sentences.

Models of Syntactic Processing

Relatively little work has been done on syntactic processing in L2 reading, undoubtedly because models of syntactic processing had until recently only described processing in English (e.g., Bever, 1970; Ford, Bresnan, & Kaplan, 1982; Frazier & Fodor, 1978; Just & Carpenter, 1980, 1992). Several recent psycholinguistic models, however, do address syntactic processing in different languages. These cross-linguistic models fall into two general categories: modular and experience-based. In the modular models (e.g., De Vincenzi, 1991; Frazier & Fodor, 1978; Frazier & Clifton, 1996), sentence processing (parsing) follows from principles that appeal to linguistic structure. In contrast, experience-based models (Bates & MacWhinney, 1987; Bever, 1970; Hoover & Berdugo-Oviedo, 1996) appeal to general principles of cognitive processing (see Cueto, Mitchell & Corley, 1996 for an overview). In experience-based models, L2 readers’ experience in processing their L1 influences their processing of the L2, parallel to Lado’s (1957) contrastive analysis hypothesis for L2 acquisition.

Distinguishing between these two classes of models is beyond the scope of this paper. However, we will outline the common assumptions underlying both classes of models. First, both assume a limited working memory, so that extra processing will be delayed until working memory is freed up. Therefore, ceteris paribus, longer reading times reflect greater processing load. Second, both assume that sentence processing is generally a highly automatic process. Therefore, any effects of syntax on processing will only be observed in relatively complex sentences. An example of such a syntactically (and semantically) complex sentence is the clitic/causative construction in French.
Clitic/Causative Constructions

The present study applies the methods used in these psycholinguistic studies to the study of L2 syntactic processing. To ensure that we are looking at L2 syntactic processing rather than L1 processing transferred to the L2, we examined the processing of constructions not present in the L1 and thus to which the L2 reader cannot successfully apply L1 processing.

Clitics, unstressed pre-verbal pronouns, are prevalent in Romance languages but do not occur in English. Both English and French exhibit Subject-Verb-Object word order when the object is a noun ("John prefers elephants," Jean préfère les éléphants). However, when the object "elephants" is pronominalized, English retains the same word order, but the clitic pronoun in French appears before the verb ("John prefers them" vs. Jean les préfère).

The causative construction is particularly interesting, both because it has been shown to be a more difficult construction in L1 acquisition in English and in Romance languages than in languages in which it is unambiguously marked (like Turkish or Serbo-Croat; Ammon & Slobin, 1979) and because it invokes the unique syntax of clitics. Below is an example of this construction with a full direct object NP:

(1) Jean fait entrainer les éléphants (à Sara).
John make train-Inf. the elephants to Sara
"John made the elephants be trained (by Sara)/John made Sara train the elephants."

When the object les éléphants is pronominalized, it is not left adjacent to entrainer “train” but rather is left adjacent to fait “made”:

(2) Jean les fait entrainer (à Sara).
John them make train-Inf. (to Sara)
"John made them be trained (by Sara)/John made Sara train them."

This is not the standard situation with direct object clitics of infinitives. Compare (2) with (4), where the clitic is a part of a regular infinitival construction:
(3) \textit{Jean veut entrainer les elephants.}
John wants train-Inf. the.pl elephants
"John wants to train the elephants."

(4) \textit{Jean veut les entraîner.}
John wants them train-Inf.
"John wants to train them."

In (4) the object clitic is adjacent to the verb of which it is an argument.

Dwivedi and Hoover (1996) examined the L1 processing of these French clitic/causative structures. They assumed a modular model of sentence processing (Frazier 1987; Frazier & Fodor, 1978), based on De Vincenzi’s (1991) Minimal Chain Principle (MCP). As predicted by the MCP, they found that reading times (RTs) for the second verb in causative constructions were longer following a clitic, indicating that the reader had incorrectly construed the clitic as an object of \textit{faire}, and hence on reaching the second verb had to reanalyze the construction. In the non-clitic case, no reanalysis was necessary, so RTs were shorter. They also found an increase in reading time at the beginning of the infinitival clause in the non-causative constructions.

\textit{The Present Study}

Our study examines how highly fluent L2 French readers (L1 English) process French clitics in causative and non-causative sentences. We studied two groups of equally fluent L2 French speakers, one group of faster French readers, and the other slower, as defined below. We compared their processing to L1 French readers’ processing of the same clitic/causative sentences.

Specifically, we compared the syntactic processing of Dwivedi and Hoover’s (1996) French L1 readers to fast and slow highly fluent French L2 (FSL) readers reading the same stimuli sentences. If the differences between L1 and L2 reading speed are due to lower-level processing (e.g., Segalowitz, 1986) and not due to syntactic processing, then there should be no differences in
the syntactic processing of fast and slow L2 readers. On the other hand, if one of the causes for slower L2 reading is less efficient syntactic processing, then there should be a difference in the pattern of reading times between fast and slow L2 readers (as opposed to across-the-board longer reading times for slow L2 readers). Specifically, fast FSL readers should process sentences like L1 French readers, whereas slow FSL readers should exhibit compensatory processing, parallel to Stanovich’s (1980) findings. For example, rather than relying solely on syntactic information, slow FSL readers might appeal to semantic or contextual information, once the sentence has been read. If this is the case, then we should expect longer RTs at the end of the sentence.

The present study employs a reader-paced word-by-word reading task (see Aaronson & Ferres, 1984). This methodology assumes that, ceteris paribus, the amount of time spent reading any word in the sentence indicates how much processing the reader is doing at that point in the sentence. This methodology has shown itself to be sensitive to syntactic processing (e.g., De Vincenzi & Job, 1993, 1995; Dwivedi & Hoover, 1996; Hoover, 1992).

Specifically, if our hypothesis about the less efficient use of syntactic information by slow, but not fast, L2 readers is correct, then we should see:

1. Similar patterns of reading times across the different target sentences for fast FSL readers and French L1 readers;
2. Different patterns of reading times across the different target sentences for fast versus slow FSL readers;
3. Slow FSL readers should demonstrate longer reading times at the end of the sentences they find difficult.

Method

Participants

Forty-eight native francophone students at the Université de Montréal served as paid participants for the L1 French group.
Fifty-three L1 English students at McGill University in Montreal, who considered themselves highly fluent in FSL, were recruited from degree programs that operate in French for lectures, readings, and assignments. We excluded from the analysis 3 FSL participants who did not meet the criteria for L1 English speaker (a parent spoke a language other than English at home) and a fourth who failed to meet the criterion for fluency (as measured by the reading comprehension section of the University of Wisconsin College-Level Placement Test). We also dropped a fifth FSL participant who did not follow instructions. Thus, 48 L1 French and 48 FSL participants were included in the analysis.

**Stimuli**

We used the same stimuli as in Dwivedi and Hoover (1996) in the present study. Participants read 24 target sentence pairs embedded within 72 filler sentence pairs. Each sentence pair contained a context sentence and a target or filler sentence. All verbs and nouns in the target sentences were controlled for frequency, using Baudot’s (1992) word count for Québec French. Six target sentences contained a causative (*faire*+verb) construction with a direct object noun phrase, 6 a causative construction and a clitic direct object, 6 a non-causative double-verb construction with a direct object noun phrase, and 6 a non-causative double verb construction with a clitic direct object. In target sentences where the direct object noun was pronominalized as a clitic, an extra word was added to the sentence to control for sentence length. This extra word was matched with the noun both for frequency and number of characters.

The target sentences were constructed in sets of four so that, across participants, the same sentence (with the manipulated verb and clitic) appeared in all four conditions. An example set of target sentences is presented in Table 1 (for the complete set, see Appendix). To avoid the sentence run-on effect that can occur with word-by-word reading time tasks, in which the reader does not realize the sentence is over until several words into the next
Table 1

Example Target Sentences

context sentence:
   Serge s'achetait fréquemment un bon vin rouge.
   Serge would often buy a good red wine.

target: causative, no clitic
   Il faisait tranquillement goûter le vin avec son fromage préféré.
   He had the wine be tasted quietly with his favourite cheese.

target: causative with clitic
   Il le faisait tranquillement goûter avec son fromage doux préféré.
   He had it be tasted quietly with his favourite mild cheese.

target: non-causative, no clitic
   Il aimait tranquillement goûter le vin avec son fromage préféré.
   He loved to taste the wine quietly with his favourite cheese.

target: non-causative with clitic
   Il aimait tranquillement le goûter avec son fromage doux préféré.
   He loved to taste it quietly with his favourite mild cheese.

sentence, we marked the end of each sentence (EOS) with a set of
asterisks (****) rather than with a period, which can be difficult
to see on the computer screen.

To avoid the participants’ adopting a specific strategy for the
target sentences versus the fillers, we constructed the filler sen-
tences so that (a) use of faire as the main verb “to make” versus a
causative reading was balanced in the fillers; and (b) there were
as many filler sentences with clitics as there were fillers with
direct object noun phrases.

Procedure

   Participants read the sentences word by word on a Macintosh
computer using the Great Presenter software (Renaud, 1996). Par-
participants pressed the space bar to receive the next word in the
sentence. Instructions and a practice task preceded the presentation
of the experimental materials. All instructions were in French, and we (the L1 French-speaking experimenters) answered any questions. Participants received one of 24 random orders of the stimuli sentences, so that 2 participants in each language group received the same random ordering of stimuli. We recorded RTs for each word in the target sentences and the responses to the comprehension questions.

To ensure that readers were reading for comprehension, all sentence pairs were followed by a comprehension task, in which participants had to answer a yes/no question based on the target or context sentence, as in the following example:

(5) a. _L'avocate apportera le document final_
   The lawyer will bring the final document

   b. _Elle fera directement signer le contrat en présence de l'actionnaire_
   She will have the contract be signed directly in the presence of the stockholder

   c. _L'actionnaire apportera le document final, oui ou non?_
   The stockholder will bring the final document, yes or no?

After they had completed the experiment, the FSL participants completed the reading comprehension sections of the University of Wisconsin College-Level Placement Test (Form 901) for French as a Second Language. This test is designed to determine the appropriate level of university French courses for incoming students. The reading comprehension section consists of a series of short texts that the participants read on a computer screen. We used only the 5 most advanced texts, because of the participants' high level of FSL fluency.

We instructed participants to read as quickly as they could, but told them that there would be a series of questions following each text. When they had finished reading, they pressed the space bar and the text was replaced with the first of 3 questions. All participants read 5 texts and answered 15 multiple-choice com-
prehension questions. We recorded both the participants’ responses and the time they took to complete the test.

Before any analyses were performed, we divided the FSL participants into two groups, each with 24 participants, based on the speed with which they read the texts in the comprehension test. Because there can be individual differences in test-taking strategies based on factors other than linguistic competence, question-answering time was not included in the participant’s test-reading time. The fast group took a mean of 375.19 seconds ($SD = 51.99$ seconds) to read the 5 texts; the slow group spent a mean of 538.78 seconds ($SD = 74.32$ seconds) to read the same texts. A $t$-test showed that the fast and slow readers did not differ significantly on their comprehension scores: slow $M = 91.67\%$, $SD = 7.9\%$, fast $M = 89.17\%$, $SD = 7.3\%$; $t_{(46)} = 1.17$, $p = .26$—providing no evidence for a speed/accuracy trade-off.\(^1\)

Results

Analyses

Analyses of the responses to the comprehension questions revealed no significant effects or interactions, either between-groups or within-participants. Because we had included these questions solely to ensure that these highly fluent FSL participants were reading for comprehension, this lack of results was not surprising.

We first screened the reading time data for outliers. We eliminated any reading time more than 3 standard deviations above the mean RT for all words in the experiment for that participant from the analysis and replaced it with the mean reading time for that participant for that word in that condition. We excluded fewer than 2% of the data as outliers. We did 2 series of repeated-measures analyses of variance (ANOVAs), reported below. The first set compared L1 and FSL processing of the sentences. The second compared the fast versus the slow FSL
readers. In both sets, we ran ANOVAs on the processing times for the critical points in the sentences: the clitic or direct object, the adverb, the second verb, the last word, and the end of sentence (EOS) marker. We also ran analyses for the time to answer the comprehension questions, and number correct on the comprehension questions. All analyses were by participant and by items (see Clark, 1973) for the following within-participant (or within-items) factors: ±clitic (whether there was a clitic or a direct object noun in the target sentence), ±causative (whether the double-verb construction was a faire+infinitive causative construction or a double-verb infinitival clause construction), and order of presentation (participants tended to read sentences more slowly near the beginning of the experiment and gradually speed up—i.e., a practice effect). This order of presentation (or practice) effect was significant both by participants and by items in all analyses of reading times, but is not relevant to the questions at hand, so will not be discussed further.

**French L1 vs. FSL Readers**

L1 French reading times were significantly faster than FSL reading times in all analyses, consistent with previous findings with L2 reading. We found no other significant effects or interactions for any variable except for reading times for clitic and the second verb.

Although L1 French readers were significantly faster in reading the second verb—$F_{(1,94)} = 20.50, p < .001$; $F_{(1,23)} = 175.76, p < .001$ (see Table 2)—as indeed they were in reading all words, there were no interactions of language group and any other factor, indicating that both the L1 French and the FSL participants showed the same pattern of reading times for the second verb. There was a significant interaction of ±clitic and ±causative, $F_{(1,94)} = 15.95, p < .001$; $F_{(1,23)} = 12.70, p = .002$. These results are presented in Table 2.

Both groups spent longer on the second verb in causative sentences with a clitic than in causative sentences without a clitic,
Table 2

Mean Reading Times (and Standard Deviations) in msecs for the Second Verb

<table>
<thead>
<tr>
<th></th>
<th>causative sentences</th>
<th>non-causative sentences</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>w/clitic  w/object noun</td>
<td>w/clitic  w/object noun</td>
</tr>
<tr>
<td>L1 French</td>
<td>343  326 (144) 126 (126)</td>
<td>325  353 (119) 150 (150)</td>
</tr>
<tr>
<td>L2 French</td>
<td>497  460 (193) 141 (192)</td>
<td>449  474 (166)</td>
</tr>
</tbody>
</table>

but both groups spent longer on the second verb in non-causative sentences without a clitic (i.e., with a direct object noun phrase) than in non-causative sentences with a clitic. These results from the FSL group are thus consistent with the results reported by Dwivedi and Hoover (1996) for L1 French readers.

For clitic reading times, there was a significant difference for group, $F_{s(1.94)} = 9.489, p = .003; F_{i(1.23)} = 239.87, p < .001$; French L1 readers read more quickly than FSL readers, as was true for all words. There was a significant effect for ±clitic, $F_{s(1.94)} = 7.39, p = .008; F_{i(1.23)} = 9.35, p = .006$; this indicated that all participants spent significantly more time reading nouns versus clitics. There was also a significant ±clitic by ±causative interaction, $F_{s(1.94)} = 21.56, p < .001; F_{i(1.23)} = 9.53, p = .005$. As can be seen in Table 3, this interaction was due, for both L1 and FSL readers, to faster clitic reading times in causative sentences.

This pattern of reading times for the FSL readers was thus the same as for the French L1 readers. To ensure that lack of difference in pattern between groups was not due to failure to find differences, we reran the results for both groups separately, with the same pattern resulting in both groups. Both showed the same pattern of processing reported for Dwivedi and Hoover’s (1996) French L1 readers: (a) evidence of reanalysis of the clitic in causative sentences when the second verb is read and the reader
Table 3

<table>
<thead>
<tr>
<th></th>
<th>causative sentences</th>
<th>non-causative sentences</th>
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<tbody>
<tr>
<td></td>
<td>clitic</td>
<td>object noun</td>
</tr>
<tr>
<td>L1 French</td>
<td>298</td>
<td>323</td>
</tr>
<tr>
<td></td>
<td>(116)</td>
<td>(115)</td>
</tr>
<tr>
<td>L2 French</td>
<td>360</td>
<td>411</td>
</tr>
<tr>
<td></td>
<td>(108)</td>
<td>(133)</td>
</tr>
</tbody>
</table>

realizes that faire is marking the causative rather than being the matrix verb in the sentence; and (b) increased processing at the beginning of the infinitival clause (at the clitic or at the second verb in sentences without clitics) in the non-causative double-verb constructions.

Fast vs. Slow FSL Readers

The only significant difference between the slow and fast FSL readers was in End of Sentence (EOS, marked by the asterisks) processing time, in which there was a significant interaction of group (fast vs. slow) by clitic: $F_{\text{adj}}(1, 46) = 4.62, p = .037; F_{\text{adj}}(1, 23) = 2.99, p < .10$\(^2\). As can be seen in Table 4, there were no differences in EOS response times for the fast readers (as was the case for the L1 French), but the slow FSL readers spent longer at the end of sentences in which there had been a clitic than after sentences in which there was none.

Discussion

The three experimental hypotheses were confirmed:

1. We found similar patterns of reading times across the target sentences for fast FSL readers and French L1 readers.
Table 4

Mean End-of-Sentence (EOS) Reading Times (and Standard Deviations) in ms for Fast and Slow Readers

<table>
<thead>
<tr>
<th></th>
<th>Causative sentences</th>
<th>Non-causative sentences</th>
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<tbody>
<tr>
<td></td>
<td>Clitic</td>
<td>Object noun</td>
</tr>
<tr>
<td>Fast L1 readers</td>
<td>241</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>(69)</td>
<td>(86)</td>
</tr>
<tr>
<td>Slow L1 readers</td>
<td>435</td>
<td>419</td>
</tr>
<tr>
<td></td>
<td>(85)</td>
<td>(87)</td>
</tr>
<tr>
<td>Fast L2 readers</td>
<td>436</td>
<td>441</td>
</tr>
<tr>
<td></td>
<td>(150)</td>
<td>(152)</td>
</tr>
<tr>
<td>Slow L2 readers</td>
<td>539</td>
<td>501</td>
</tr>
<tr>
<td></td>
<td>(206)</td>
<td>(203)</td>
</tr>
</tbody>
</table>

Note. The criterion for fast vs. slow readers is slightly different for the L1 and L2 groups (see text and note 4).

2. We found different patterns of reading times across the different target sentences for fast versus slow FSL readers.

3. Slow FSL readers demonstrated longer reading times at the end of the sentences they found difficult: sentences with clitics.

These results clearly indicate that highly fluent FSL readers for the most part exhibit L2-like syntactic processing when processing an L2 construction not found in their L1. That is, all of the FSL readers in this study showed the same pattern of reading times across the sentences as did the L1 French readers: lengthened RTs at the second verb in causative constructions with a clitic, but not in causative constructions without a clitic (as predicted by De Vincenzi’s, 1991, Minimal Chain Principle), and lengthened RTs at the beginning of the infinitival clause in non-causative constructions. (Dwivedi & Hoover, 1996, attributed this to either the extra effort involved in processing PRO, the empty
subject of the infinitival clause, or to the extra syntactic structure required for infinitival complements.)

Although the slow FSL readers, defined as such a priori in terms of the speed with which they read the texts in the University of Wisconsin College-Level Placement Test (but who were equally fluent based on the comprehension scores from the same test), exhibited French L1-like processing times, they also exhibited compensatory processing with sentences with clitics. This compensatory processing consisted of an increase in processing time at the end of the sentence (the EOS effect), which may indicate that when faced with a complex syntactic construction they adopted a strategy of checking to see if the semantics of the sentence were congruent with the context. This is consistent with previous findings for L1 English readers, such as Bever and Townsend’s (1995) recent model of sentence processing or Frazier and Rayner’s (1982) finding of delayed processing under ambiguity.

Our results indicate that automaticity effects (assuming that is what our results are) can indeed be found in higher-order linguistic (i.e., syntactic) processing, cf. Segalowitz (1986; pp. 3–4), who suggested that certain lower-order processes affect L2 reading. Our slow FSL readers were making less efficient use of syntactic information while reading the sentence in these clitic constructions, and thus may have relied more on contextual information, which is presumably more available after the end of the clause or sentence (EOS). The fast FSL readers, on the other hand, were making efficient use of this information while they were processing the sentence—like the L1 French readers, and therefore had no need for extra processing at the EOS.

A possible alternative explanation for this result might be that some lower-level process, such as word recognition, was confounded with our conditions, and thus really caused these effects. However, the target sentences were the same across conditions, except for the high-frequency auxiliary verb (faire vs. aimer, vouloir, etc.), and the word added to equate the sentences for length when a clitic replaced the direct object, which was matched for frequency and length. It is therefore unlikely that any
differences in the words used across conditions caused these effects. Although the slow FSL students read more slowly than the fast FSL participants, the interaction effects cannot be explained by a general appeal to speed of word recognition.

The slow FSL readers' reliance on compensatory EOS processing with French clitics (vs. object nouns) but not with French causatives (vs. non-causatives) cannot be explained by any model that assumes difficulty due to structural differences in FSL versus their L1, because French structurally differs from English both in terms of clitics and in the syntax of the causative construction (see Dwivedi & Hoover, 1996, for details). However, experience-based models (e.g., Bates & MacWhinney, 1987; Bever, 1970; Hoover & Berdugo-Oviedo, 1996) can easily account for this pattern of results. Clitics signal grammatical function completely differently from English, by marking object information not just in a different syntactic position but also with a different kind of marker. In fact, a number of syntactic analyses claim that clitics are not even pronouns but rather verbal affixes (see Auger, 1994, for a review of the syntactic literature on clitics). Given this difference in the surface form that signals the grammatical function, an experience-based model would predict that L1 English speakers would have more difficulty with clitics, since these represent a signaling device foreign to their L1.

On the other hand, the causative is signaled in the same way in both languages, by the use of a periphrastic construction using the verb faire, "make," although syntactic specifics (e.g., argument structure) differ between the two languages. This is consistent with Ammon and Slobin's (1979) findings for child L1 speakers of English and Italian, in which the causative is marked with a periphrastic construction (as it is in French), who showed a different pattern of acquisition than Serbo-Croat or Turkish-speaking children, for whom the causative is unambiguously marked. Given this parallel signaling of the causative construction in both languages, experience-based models would predict that L1 English readers should be able to transfer their L1 processing of causatives
to FSL. Therefore, the French causative construction should present little difficulty for L1 English readers.

If the hypothesis that FSL readers have greater difficulty with clitics is correct, then slow FSL readers should have more difficulty with (and thus exhibit longer EOS processing times for) all sentences with clitics, not just double-verb constructions like the target sentences here. Although we did not construct our single-verb filler sentences specifically for this comparison, they can be used as a first-pass test of this hypothesis. In a post hoc test, we compared the EOS processing times for filler sentences with one direct object clitic with those for filler sentences with direct object nouns, which we matched as much as possible for frequency and length. We also found the same increase in EOS processing time following sentences with clitics versus object nouns in the single-verb filler sentences: $F_{s(1,46)} = 12.43, p < .001; F_{1(1,18)} = 9.55, p = .006$. Thus, the increase in slow FSL EOS processing time following sentences with clitics occurred both in the double-verb target sentences and in the single-verb filler sentences.

To determine whether this increase in EOS processing time results from transfer of L1 processing or is a pattern typical of less efficient readers of both languages, we performed a second post hoc analysis to determine whether less efficient French L1 readers also showed the same EOS effect following sentences that contained clitics. Because the French L1 readers had not taken the French Proficiency test, we divided them into 2 groups based on their total reading time for the experimental task. Neither the slower nor the faster French L1 readers exhibited any EOS effect for ±clitic for the target sentences or filler sentences.

The L1 French readers did, however, show a significant EOS effect for ±causative once they were divided into fast versus slow readers, with the slower readers spending significantly more time at the EOS than faster readers—$F_{s(1,46)} = 67.24, p < .001; F_{1(1,23)} = 24.84, p < .001$—and significantly more time at the EOS following non-causatives than causatives—$F_{s(1,46)} = 9.947, p = .003$, suggesting that for slow L1 French readers, but not for slow FSL
readers, non-causative double verb constructions create more difficulty than the *faire*+infinitive constructions. Because this post hoc analysis used total experimental reading time to divide the L1 participants into fast versus slow groups and used target sentence reading times as the dependent measure, a certain circularity is involved; hence this analysis must be interpreted with care.

Nonetheless, these EOS results for fast versus slow French L1 readers, as well as for the fast versus slow FSL readers, suggest that longer EOS processing time is a compensatory processing used by both slow L2 and slow L1 readers. However, the two groups of slow readers employed this compensatory processing under different conditions: the slower French L1 readers for infinitival-clause double-verb constructions versus causative constructions, whereas the slow FSL readers employed it following sentences with clitics, as predicted by experience-based models (see Table 4).

These findings are consistent with Dwivedi and Hoover's (1996) that the non-causative infinitival clause construction led to an increase in on-line processing time by French L1 readers when compared to the causative *faire*+infinitive construction. Taking a structural approach, Dwivedi and Hoover suggested that the presence of the empty subject (PRO) in the non-causative construction induces longer processing times due to the effort required in linking (co-indexing) PRO with its antecedent. They discussed another possible explanation: The increase in processing time was due to the extra clausal structure required for the non-causative infinitival construction (i.e., a Complementizer Phrase is required for the non-causative construction, whereas only a Small Clause is required for the causative). Further research is needed to distinguish these alternate proposals.

**Implications**

Our results suggest that L2 readers—at least those who have become highly fluent in L2—exhibited no differences in their
syntactic processing compared to L1 readers when faced with constructions that do not appear in the bilingual’s L1.

Our comparison between fast and slow FSL readers indicates that there may be a decrease in the automaticity of syntactic processing associated with decreased FSL reading skill, parallel to the reduction in dependency on phonological recoding among slower readers found by Segalowitz (1986) and Segalowitz and Hébert (1990). These results strongly suggest that L2 reading is a complex set of skills, and that expertise in L2 reading includes both lower-level (e.g., phonological) automaticity of processing and higher-level (e.g., syntactic) automaticity of processing.

They also indicate that slow (but equally fluent) L2 readers employ compensatory processing with some syntactic structures, but not with others. In particular, our slow FSL readers exhibited less automaticity where experience-based models (e.g., Bates & MacWhinney, 1987; Bever, 1970; Hoover & Berdugo-Oviedo, 1996) would predict: with FSL sentences containing clitics—which signal grammatical function differently than their L1—but not with FSL causative sentences—which signal grammatical function in the same way as their L1.

Furthermore, we also found the same compensatory EOS processing with slower L1 French readers, suggesting that it is a general pattern for less efficient readers across languages (or at least of slow L1 English and slower L1 French readers). However, the slow French L1 readers used compensatory EOS processing for sentences in which there was an infinitival clause, and the slow FSL readers used it for sentences in which the direct object appeared as a pre-verbal clitic pronoun.

Finally, these psycholinguistic models—and especially experience-based models—give the L2 acquisition researcher a way of determining and measuring which surface forms will present the greatest difficulty for L2 learners from a given L1.

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Notes

1 An argument could be made that these high scores represent a ceiling effect which would mask any differences in comprehension between the two groups (and therefore any speed/accuracy trade-off). Although the scores are high, they still leave sufficient room for differences to emerge. For example, a difference of 4.5% between the groups would have been significant given the moderately large size of the sample.

2 This by-item analysis required averaging across order of presentation, which accounted for much of the variance in the data. Therefore this is a less powerful test than the by-subjects analysis, and so a criterion of two-tailed alpha = .10 was used (equivalent to a one-tailed alpha of .05).

3 Because we had not designed the study with this post hoc test in mind, the only by-items analysis available forced the averaging of different numbers of reading times across order of presentation, as well as across subjects, two of the factors which account for much of the variance in this study. Therefore there was no appropriate error term with which to test the by-item analysis. The null result, $F_{(1,23)} = 1.02, p = .36$, resulting from this averaging is therefore uninterpretable.

4 Because we used different criteria for dividing the L1 and L2 readers into fast versus slow—L1 readers based on time to complete the experimental task and L2 readers based on time to complete a reading comprehension test not given to the L1 speakers—it is possible that the different groupings are responsible for the differences between slow L1 and slow L2 readers. Therefore, we ran a second post hoc analysis in which the L2 participants were divided using the same criterion as the L1 participants (time to complete the experimental task). This second analysis produced the same pattern of results as the original analysis.

References


Appendix: Context and Target Sentences

Direct objects which are replaced by clitics are in **bold**.
Extra words matched for frequency and length in clitic conditions are in parentheses.
Clitic site for non-causative conditions are marked with _.
Clitic site for causative (faire) conditions are marked with —.

context:  *Murielle a deux grands sapins devant sa maison.*
          Muriel has two tall pine trees in front of her house.

**target**  *Elle doit / — fait inévitablement _ décorer les arbres pour les (belles) festivités de Noël.*

non-caus  she must inevitably decorate **the trees** for the (beautiful) Christmas festivities.

causative  she inevitably has **the trees** decorated for the (beautiful) Christmas festivities.

context:  *La fermière n’a jamais eu beaucoup de succès avec la betterave.*
          the farmer(f) never had much success with beets.

**target**  *Elle ose / — fait soigneusement _ cultiver la plante en gardant un (maigre) espoir.*

non-caus  she tries to carefully grow **the plant** while maintaining a (faint) hope.

causative  she has **the plant** carefully grown while maintaining a (faint) hope.

context:  *Hélène a toujours gardé toutes ses lettres.*
          Helen always kept her letters.

**target**  *Elle ose / — fait souvent _ lire les lettres lors de réunions d’amies (d’enfance).*

non-caus  she frequently ventures to read **the letters** during the reunion of (childhood) friends.

causative  she frequently has **the letters** read during the reunion of (childhood) friends.

context:  *La fille du riche excentrique prenait note de son testament.*
          the daughter of the rich eccentric noticed the new will.

**target**  *Elle osera / — fera discrètement _ rédiger le texte à son (unique) avantage.*
non-caus  she will discreetly dare to edit the text to her (sole) advantage.
causative she will discreetly have the text edited to her (sole) advantage.

context:  Sophie avait planté des chrysanthèmes sur la tombe.
Sophie had planted chrysanthemums on the grave.
target  Elle pourra / — fera annuellement _ entretenir les fleurs
en mémoire de sa (vieille) mère.
non-caus  she could tend to the flowers annually in memory of her (aged) mother.
causative she will have the flowers tended annually in memory of her (aged) mother.

context:  L’avocate apportera le document final.
the lawyer will bring the last document.
target  Elle pourra / — fera directement _ signer le contrat en
présence de l’actionnaire (principal).
non-caus  she could sign the contract directly in the presence of the (major) stockholder.
causative she will have the contract signed directly in the presence of the (major) stockholder.

context:  Tante Adèle prenait grand soin de ses deux voitures.
Aunt Adele took good care of her two cars.
target  Elle préférerait / — faisait régulièrement _ vérifier les véhicules depuis la collision (tragique).
non-caus  she preferred to inspect the vehicles regularly since the (tragic) accident.
causative she had the vehicles inspected regularly since the (tragic) accident.

context:  Céline envoie une peinture par mois à la galerie d’art.
Celine sends a picture a month to the art gallery.
target  Elle préfère / — fait habituellement _ poster la toile dans une boîte en bois (solide).
non-caus  she usually prefers to hang the painting in a (solid) wood frame.
causative she usually has the painting hung in a (solid) wood frame.
context:  La bicyclette de Denise avait une crevaison.
Denise’s bike was in an accident.

target  Elle savait / — faisait aisément _ réparer la bicyclette
avec l'aide du voisin (mécanicien).

non-caus  she knew (how) to easily repair the bike with the help
of her (mechanic) neighbour.
causative  she had the bike easily repaired with the help of her
(mechanic) neighbour.

current:  La couturière avait reçu une commande spéciale pour

the dressmaker had received a special order for a dress.

target  Elle voulait / — faisait minutieusement _ mesurer la robe
après la (longue) journée de travail.

non-caus  she wanted to minutely measure the dress after the
(long) workday.
causative  she had the dress minutely measured after the (long)
workday.

current:  Serge s’achetait fréquemment un bon vin rouge.
Serge often bought a good red wine.

target  Il aimait / — faisait tranquillement _ goûter le vin avec
son fromage (doux) préféré.

non-caus  he liked to quietly taste the wine with his favourite
(mild) cheese.
causative  he had the wine quietly tasted with his favourite
(mild) cheese.

context:  Le restaurateur connaît bien les habitudes de la dame.
the restauranteur knows the lady’s habits well.

target  Il désire / — fait gentiment _ servir la cliente à sa table
(préférée).

non-caus  he wants to gracefully serve the client at her
(favourite) table.
causative  he has the client gracefully served at her (favourite)
table.

context:  Le fermier adorait son nouveau-né.
the farmer adored his newborn (baby).

target  Il devait / — faisait doucement _ bercer le bébé dans son
mignon berceau (rose).
non-caus  he should have gently rocked the baby in his pretty (pink) cradle.
causative he had the baby gently rocked in his pretty (pink) cradle.

target  Il devra / — fera malheureusement _ soigner le patient sans anesthésie (locale).
non-caus  unfortunately, he will have to treat the patient without (local) anesthetic.
causative unfortunately, he will have the patient treated without (local) anesthetic.

target  Il devra / — fera rapidement _ dénoncer les employés au retour de l'inspecteur (principal).
non-caus  he will have to quickly denounce the employees on the return of the (head) inspector.
causative he will have the employees quickly denounced on the return of the (head) inspector.

target  Il devra / — fera sûrement _ cacher le texte durant le (court) procès.
non-caus  he will surely have to hide the text during the (short) trial.
causative he surely will have the text hidden during the (short) trial.

target  Il doit / — fait immédiatement _ retourner les véhicules aux propriétaires (respectifs).
non-caus  he must return the vehicles immediately to their (respective) owners.
causative he has the vehicles returned immediately to their (respective) owners.

target Il pourra / — fera facilement _ repeindre la chaise après la (courte) saison des pluies.

non-caus he could easily repaint the chair after the (brief) rainy season.

causative he will have the chair repainted easily after the (brief) rainy season.

classification: Bernard désire protéger ses vitres contre l'ouragan.

Bernard wants to protect his (window)panes against the hurricane.

target Il va / — fait solidement _ recouvrir les fenêtres avant que la (terrible) tempête que s'amène.

non-caus he is going to firmly cover the windows before the (terrible) storm that is threatening.

causative he has the windows firmly covered before the (terrible) storm that is threatening.

classification: L'entraîneur prenait grand soin de sa nouvelle athlète. the coach took great care with his new athlete (f).

target Il voulait / — faisait étroitement _ surveiller la fillette durant les (fréquentes) pratiques.

non-caus he wanted to strictly supervise the girl during the (frequent) practices.

causative he had the girl strictly supervised during the (frequent) practices.

classification: Jean-Claude s'était acheté une ancienne maison.

Jean-Claude had bought an old house.

target Il voulait / — faisait progressivement _ réparer la demeure pour y passer l'hiver (prochain).

non-caus he wanted to repair the dwelling bit by bit in order to spend the (upcoming) winter there.

causative he had the dwelling repaired bit by bit in order to spend the (upcoming) winter there.
context: \( \textit{Les juges manquaient de preuve pour condamner le mafioso.} \)
The judges lacked the proof to find the mafioso guilty.

\begin{itemize}
\item target \( \textit{Ils devront / — feront obligatoirement _ libérer le détenu puisque la loi (civile) l'oblige.} \)
\item non-caus they will have to obligatorily release \textbf{the prisoner} because the (civil) law requires it.
\item causative they will have \textbf{the prisoner} obligatorily released because the (civil) law requires it.
\end{itemize}

context: \( \textit{Le jeune criminel a de nouveau échappé aux policiers.} \)
the young criminal escaped again from the police.

\begin{itemize}
\item target \( \textit{Ils voudront / — feront assurément _ punir le coupable dès sa (prochaine) capture.} \)
\item non-caus they will surely want to punish \textbf{the guilty} party on his (upcoming) capture.
\item causative they will surely have \textbf{the guilty} party punished on his (upcoming) capture.
\end{itemize}

context: \( \textit{Jacqueline prend bien soin du dressage de ses chiots.} \)
Jaqueline is very careful about the training of her puppies.

\begin{itemize}
\item target \( \textit{Elle veut / — fait définitivement _ dompter les mâles pour plaire aux (futurs) acheteurs.} \)
\item non-caus she definitely wants to tame \textbf{the males} for the (future) buyers.
\item causative she definitely has \textbf{the males} tamed for the (future) buyers.
\end{itemize}