"Good-Enough" Use of Structural Information in French: Prosodic and Verb-Bias Cues

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1. Introduction

It is well established that second/foreign language (L2) learners do not always interpret sentences as native speakers do, especially if the L2 was learned around or after the onset of puberty. Sentences that contain temporary syntactic ambiguities, in particular, have been shown to pose parsing difficulties for late L2 learners, especially when L2 learners' initial interpretation must be revised upon disambiguation of the sentence. The present study investigates the extent to which two types of cues—prosodic cues and verb-bias cues—modulate mid-to-high-level L2 learners' ultimate interpretation of temporarily ambiguous sentences. Prosodic boundaries, instantiated by lengthening, by pauses, and in some languages by accenting, tend to be aligned with syntactic boundaries (e.g., Selkirk, 1986; Truckenbrodt, 1999); this prosodic information is thus encoded alongside syntactic information and independently from lexical information. Verb bias, on the other hand, is the probability that a particular verb will take a specific type of syntactic structure as its complement; it also provides a cue to structural information, but unlike prosodic information, it is encoded lexically. By comparing these two types of cues, this study sheds further light on L2 learners' relative reliance on prosodic vs. lexical information in sentence comprehension and whether this reliance is modulated by individual variables such as L2 learners' proficiency.

The paper is organized as follows: in Sections 2 and 3, we review previous research on native and non-native listeners' "good-enough" processing and on their use of prosodic and verb-bias cues to structural information in sentence comprehension; in Section 4, we describe the method used in the present study; in Section 5, we present the results; and in Section 6, we discuss these results in light of the theories summarized below and conclude the paper.

2. Good-Enough Processing

Studies examining the comprehension of temporarily ambiguous sentences have demonstrated that native speakers sometimes do not always compute complete syntactic analyses of sentences and instead show evidence of "good-enough" processing. This results in native speakers relying more on lexical and semantic information than on syntactic information. For example, Ferreira, Christianson, and Hollingworth (2001) showed that upon encountering a temporary syntactic ambiguity in "late-closure" sentences (Frazier & Fodor, 1978; Frazier & Rayner, 1982) such as *While Bill hunted the deer ran into the woods*, native speakers initially interpreted *the deer* as being the object of the embedded verb *hunted*; upon encountering the main verb *ran*, they revised their initial interpretation to understand that the deer ran into the woods, but the initial interpretation that Bill hunted the deer lingered. Speakers were thus likely to interpret *the deer* as the object of the verb *hunted* even after they recovered from the garden path. Christianson, Hollingworth, Halliwel, and Ferreira (2001) reported that initial (syntactically incorrect) interpretations were more likely to linger if the ambiguous region of the sentence was longer (e.g., *While Bill hunted the deer that was brown and graceful ran into the woods*) and if the correct syntactic analysis led to an implausible interpretation (e.g., *While Bill hunted the deer paced in the zoo*). Initial syntactic interpretations were shown to linger even with reflexive

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absolute transitive verbs (e.g., *While Anna dressed the baby spit up on the bed*), which do not require an overt object and where the temporarily ambiguous noun cannot be simultaneously the object of the embedded verb and the subject of the main verb. On the basis of results like these, Ferreira, Christianson, and colleagues (see also Ferreira, 2003; Ferreira, Ferraro, & Bailey, 2002; Ferreira & Patson, 2007) propose that sentence reanalysis operates according to Frazier and Clifton's (1998) "Minimal Revision Principle," with any revisions maintaining as much of the initially assigned syntactic structure and interpretation as possible. Revision mechanisms such as Fodor and Inoue's (1998) "Adjust" mechanism in turn fail to apply exhaustively.

L2 learners have also been claimed to process the target language in a good-enough manner, thus relying more on lexical and semantic information than on syntactic information. Clahsen and Felser's (2006) Shallow Structure Hypothesis stipulates that L2 learners not only compute shallower syntactic representations than native speakers do, but are *restricted* to this shallow processing. Accordingly, adult L2 learners have been proposed not to use the syntactic parsing routines that native speakers use, and they have been claimed not to transfer syntactic parsing routines from the native language (L1) into the L2. Much of the evidence in support of this hypothesis comes from studies on relative-clause attachment preferences (e.g., Felser, Roberts, Marinis, & Gross, 2003; Papadopoulou & Clahsen, 2003) and on the processing filler-gap dependencies (e.g., Felser, Cunnings, Betterham, & Clahsen, in press; Felser & Roberts, 2007; Marinis, Roberts, Felser, & Clahsen, 2005). For example, Felser et al. (2003) reported that native speakers of Greek and German at advanced proficiencies in English did not show high- or low-attachment preferences in their processing of sentences such as *The dean liked the secretary of the professors who was/were reading a letter*. In this sentence, the verb *was* forces the attachment of the relative clause to the first noun in the noun phrase (here, *secretary*; i.e., "high-attachment"), whereas the verb *were* forces the attachment of the relative clause to the second noun in the noun phrase (here, *professors*; i.e., "low-attachment"). Thus, unlike native speakers, these L2 learners did not read *was* more slowly than *were*. Furthermore, they did not read *were* more slowly than *was*, even if the L1 of these participants would have favored a high-attachment interpretation. Papadopoulou and Clahsen (2003) found similar null results for native speakers of Spanish, German, and Russian at advanced proficiencies in Greek (but for different results, see Dussias, 2003; Fernández, 2002).

Although many studies have examined L2 learners' use of syntactic information in sentence processing, few have looked at whether the initial syntactic interpretation that L2 learners assign to sentences linger like it does for native speakers. The only study (to our knowledge) that has done this is that of Lim (2011). Using translation tasks in which Korean L2 learners of English translated semantically plausible and semantically implausible active and passive English sentences (e.g., *The cat/mouse chased/was chased by the mouse/cat*) into Korean, Lim found that L2 learners' translation accuracy was affected by both the voice and the plausibility of the sentence, but the two factors interacted such that L2 learners showed a larger effect of plausibility for passive sentences than for active sentences, suggesting that plausibility information plays a more important role in more difficult syntactic structures. Similar results had been obtained by Ferreira (2003) in a different experiment using similar sentences with native English speakers. Lim also conducted a similar experiment where other Korean L2 learners of English translated the sentences from Korean to English. Her results showed that the L2 learners' translation accuracy was significantly affected by voice but only marginally affected by plausibility, with no interaction between the two factors. Her results overall suggest that L2 learners are capable of using structural information in the L2, contra the Shallow Structure Hypothesis, but they may be more sensitive to plausibility information when parsing the L2 (i.e., in the English-to-Korean translation task) than when parsing the L1 (i.e., in the Korean-to-English translation task), perhaps because structural information is less stable in the L2.

3. Prosodic and Verb-Bias Cues to Structural Information

One type of cue to structural information that has not received much attention in L2 processing research is prosody. Prosody can guide listeners' structural interpretation of sentences by helping them avoid garden path that could otherwise take place or by helping them recover from those garden paths. Using three different types of listening tasks (a judgment task, a sentence comprehension task, and a cross-modal priming task) where prosodic boundaries coincided or did not coincide with a syntactic boundary, Kjelgaard and Speer (1999) reported that native English speakers showed faster responses

when they heard sentences with facilitating prosody (e.g., *When Roger leaves] [the house is dark*) than when they heard sentences with ambiguous or conflicting prosodies (e.g., respectively, *When Roger leaves the house is dark* and *When Roger leaves the house] [is dark*), and more so for early-closure sentences than for late-closure sentences (e.g., *When Roger leaves the house it's dark*). In a sentence continuation task where the accented word coincided or did not coincide with a syntactic boundary, Schafer, Speer, Warren, and White (2000) similarly showed that native English speakers were better at selecting the correct sentence continuation (e.g., *will encounter a cookie*, not *it should land in a good spot*) if they heard an early sentence fragment that contained facilitating prosody (e.g., *When that MOVES the square*) than if they heard an early sentence fragment that contained ambiguous or conflicting prosodies (e.g., respectively, *When that moves the squares* and *When that moves the SQUARE*). These studies suggest that the comprehension system performs a detailed analysis of the prosodic structure of an utterance and makes use of this detail when assigning syntactic structure to it.

Research has shown that prosody also affects the parsing decisions of L2 learners, especially those at higher proficiencies. In a listening comprehension task, Dekydtspotter, Donaldson, Edmonds, Liljestrand, and Petrush (2008) reported that roughly a third of the English L2 learners of French in their study showed sensitivity to prosodic boundaries in their interpretation of sentences with relative-clause attachment ambiguities, with these learners giving a high-attachment interpretation for sentences where a prosodic boundary was inserted between the second noun and the relative clause (e.g., *Nous adorons le secrétaire du psychologue] [qui se promène au centre-ville* 'We adore the secretary of the psychologist who is walking around downtown') and a low-attachment interpretation for sentences where a prosodic boundary was inserted after the first noun (e.g., *Nous adorons le secrétaire] [du psychologue qui se promène au centre-ville*). These results suggest that these L2 learners' syntactic interpretations were guided by prosodic information. Note, however, that roughly two thirds of their L2 learners did not show sensitivity to prosodic information, and proficiency (as established by the numbers of semesters of French) was not a good predictor of L2 learners' ability to use prosodic information in sentence comprehension. By contrast, in a partial replication of Schafer et al. (2000), Hwang and Schafer (2006) found a significant effect of L2 proficiency in the use of prosodic information for syntactic disambiguation by Korean L2 learners of English. This indicates that L2 learners can use prosodic information in sentence comprehension, but the circumstances under which they do so requires further investigation.

Another type of cue to structural information, but one that is lexical in nature, is verb-bias information. Verb-bias information has been shown to modulate the extent to which native speakers garden path in temporarily ambiguous sentences. For example, in self-paced reading and eye-tracking experiments, Garnsey, Pearlmutter, Myers, and Lotocky (1997) found that native English speakers were more likely to garden path in sentences where the main verb was more likely to take a direct object than a sentential complement (e.g., *The talented photographer accepted the money could not be spent yet*) than when it was more likely to take a sentential complement than a direct object (e.g., *The ticket agent admitted the mistake had been careless and stupid*). These results suggest that verb-bias information guides the parser's syntactic decisions (see also Ferreira & Henderson, 1990; Hare, McRae, & Elman, 2003; Mitchell, 1989; Trueswell, Tanenhaus, & Kello, 1993; Wilson & Garnsey, 2009). The immediate use of verb-bias information in online sentence processing has been used to argue for interactive constrained-based models (e.g., MacDonald, Pearlmutter, & Seidenberg, 1994; Trueswell & Tanenhaus, 1994; Trueswell, Tanenhaus, & Garnsey, 1994) and against serial garden-path models (e.g., Frazier & Fodor, 1978, 1980; Frazier, 1990).

Research has shown that L2 learners have little difficulty in using verb-bias information, including verb subcategorization information, in sentence comprehension. For example, Frenck-Mestre and Pynte (1997) found that English L2 learners of French interpreted temporarily ambiguous prepositional phrases as a function of whether the verb preceding them should take one or two complements; thus, with ditransitive verbs, they showed faster reading times at *danger* than at *village* in the sentence *Elle protège les enfants du danger/village*… 'She protects the children from the danger/village…,' but they did not show this difference with sentences containing monotransitive verbs such as *Il rate le train de nuit/peu*… 'he misses the night train…/he almost misses the train…'. Similarly, Dussias and Scaltz (2008) reported that Spanish L2 learners of English showed the same sensitivity to verb-bias information as native English speakers in sentences like *The CIA director confirmed the rumor could mean a security leak* vs. *The ticket agent admitted the mistake might not have been caught*. These studies suggest that lexical information such as verb bias guides L2 learners' syntactic interpretation of

sentences. These findings highlight the apparent asymmetry between L2 learners' use of prosodic information , which may or may not be successful, and L2 learners' use of lexical information, which poses little difficulty (see also Ullman, 2001).

The present study examines L2 learners' use of prosodic and verb-bias cues to structural information, with the goal of establishing their relative importance for constraining L2 learners' sentence comprehension. More specifically, it investigates whether these two types of cues modulate the extent to which initial (syntactically incorrect) analyses linger in final sentence interpretation. To do so, this study focuses on the interpretation of late-closure sentences by native English speakers at various proficiencies in French and native French speakers. French differs from English in that the last word of the Accentual Phrase (and, thus, of the Intonational Phrase) is typically accented on its last non-reduced syllable (e.g., Jun & Fougeron, 2000, 2002; Welby, 2006). Yet, French and English work similarly in the use of prosodic cues to syntactic disambiguation, in that inserting an Intonational Phrase boundary after the embedded verb of late-closure sentences (e.g., *Quand Marie écriVAIT]$_{IP}$ [sa longue lettre s'est effacée de son bureau par accident* 'When Marie wrote her long letter was erased from her computer accidentally') should help listeners not interpret the following noun as the direct object of the verb; conversely, inserting an Intonational Phrase boundary after the temporarily ambiguous noun (e.g., *Quand Marie écrivait sa longue LEttre]$_{IP}$ [s'est effacée de son bureau par accident*) should mislead listeners into interpreting this noun as the direct object of the verb. In our study, the main cues to these Intonational Phrase boundaries were higher fundamental frequency (from both the accented word and the boundary tone) and increased duration. The role of verb-bias information, which was obtained via a norming study with native French speakers, will be examined alongside the role of prosodic information.

Given previous research, we predict that L2 learners will rely more on lexical cues such as verb-bias information than on prosodic cues. Given that L2 learners' syntactic representations have been proposed to be shallower than those of native speakers (e.g., Clahsen & Felser, 2006), we might also predict that L2 learners' (incorrect) initial syntactic analysis will linger more than that of native speakers.

4. Method

4.1. Participants

The participants were 23 English L2 learners of French (mean age: 24.4; range: 18–41) and 38 native French speakers (mean age: 22.2; range: 18–29). The L2 learners were undergraduate and graduate students at a Midwestern American university and they were all late L2 learners. The native French speakers were graduate students at a Midwestern American university and undergraduate students at a university in France.

The participants completed a language background questionnaire. L2 learners provided information such as their age of first exposure to French, their number of years of instruction in French, their number of months of residence in a French-speaking environment, and their percent weekly use of French. The L2 learners also completed a cloze test that assessed their global proficiency in French. The particular test that was used had independently been shown to provide valid and reliable estimates of global L2 proficiency in French (e.g., Tremblay, 2011; Tremblay & Garrison, 2010). The L2 learners' language background information and their cloze test scores are provided in Table 1. Note that the cloze test scores provided in Table 1 represent 22 rather than 23 L2 learners, as one participant did not complete the cloze test.

As can be seen from the information from Table 1, the L2 learners were quite heterogeneous in their experience with and proficiency in French. This variability will be considered in the analysis of the results.

Table 1. *L2 Learners' Language Background Information*

	First exposure to French (age)	Instruction on French (years)	Residence in French-speaking environment (months)	Weekly use of French (percent)	Cloze test scores (/45)
Mean	13.3	9.3	13.6	7.8	26.2
SD	4.2	4.9	6.9	11.4	10.6
Range	5-22	2-22	0-38	5-30	8-42

Note. SD = Standard Deviation

4.2. Materials

The participants completed a listening comprehension task. Our experimental sentences included three prosodic conditions, summarized in Table 2. In the condition with facilitating prosody, the sentences contained an Intonational Phrase boundary between the embedded verb (*écrivait*) and the following noun (*sa longue lettre)*, thus making it more difficult for that noun to be interpreted as the direct object of the verb. In the condition with ambiguous prosody, the sentences did not contain an Intonational Phrase boundary after the embedded verb or after the following noun, thus making it possible for that noun to be interpreted as the direct object of the verb. Finally, in the condition with conflicting prosody, the sentences contained an Intonational Phrase boundary after the noun following the embedded verb, thus making it more likely that this noun will be interpreted as the direct object of the embedded verb. Each sentence was followed by a true or false comprehension question (e.g., *Marie écrivait sa longue lettre* 'Marie wrote her long letter'). For the experimental items, the correct answer to the comprehension question was always false. The experiment included 36 experimental sentences, and the three prosodic conditions were counterbalanced in three lists so that no participant would hear the same experimental sentence in more than one prosodic condition. These sentences were interspersed with 72 distracter sentences, and all the sentences were randomized across participants. Half of the sentences in the entire experiment had "false" as correct answer, and half had "true" as correct answer.

Table 2. *Experimental Conditions and Examples*

Prosody	Example
Facilitating	*Quand Marie écriVAIT]$_{IP}$ [sa longue lettre s'est effacée de son bureau par accident.*
Ambiguous	*Quand Marie écrivait sa longue lettre s'est effacée de son bureau par accident.*
Conflicting	*Quand Marie écrivait sa longue LEttre]$_{IP}$ [s'est effacée de son bureau par accident.*
	'While Marie wrote her long letter was erased from her computer accidentally.'

French does not have reflexive absolute transitive verbs where the direct object is not expressed overtly. In French, a sentence such as *While Anna dressed the baby spit up on the bed* requires a reflexive verb, which would then be accompanied by an overt reflexive pronoun: *Quand Anna s'est habillée le bébé a régurgité sur le lit*, where the noun following the embedded verb cannot be interpreted as the direct object of the sentence. Hence, this study only used optionally transitive verbs that could potentially have a direct object, but semantically the noun was always plausible as direct object of the embedded verb, even after syntactic disambiguation. The complete list of verbs used in the experimental sentences can be found in the appendix.

For each verb used in the experiment, verb-bias information was assessed via norming data collected from native French speakers living in France, none of whom completed the listening comprehension task. Twenty-four speakers took part in a sentence-completion task where they provided a plausible continuation for sentences truncated after the embedded verb such as *Quand Marie écrivait* _____. The norming task included the 36 experimental sentences and 72 distracter sentences from the listening comprehension task. For the experimental sentences, their responses were coded as 0 if the speakers provided a direct object continuation and as 1 if they provided a new clause continuation. Our 36 experimental verbs received an average norming score of 0.64 (SD = 0.3), thus showing a wide distribution but being slightly more likely to be followed by a new clause than by a direct object. The norming scores for each critical verb are provided in the appendix. These scores will be incorporated in the analysis of our results.

The experimental sentences were recorded by a native French speaker from Bordeaux, France. Two types of sentences were recorded: sentences with a temporary late-closure ambiguity such as *Quand Marie écriVAIT]$_{IP}$ [sa longue lettre s'est effacée de son bureau par accident*, and sentences with forced late closure such as *Quand Marie écrivait sa longue LEttre]$_{IP}$ [sa longue lettre s'est effacée de son bureau*. The sentences with facilitating prosody were recorded as such; the sentences with ambiguous prosody were created by cross-splicing *Quand Marie écrivait* from the forced late-closure sentence with *[sa longue lettre s'est effacée de son bureau* from the temporary late-closure-

ambiguity sentence; and the sentences with conflicting prosody were created by cross-splicing *Quand Marie écrivait sa longue LEttre]* from the forced late-closure sentences with *s'est effacée de son bureau* from the temporary late-closure-ambiguity sentences. In other words, the three sentence types had distinct prosodies up until the temporarily ambiguous nouns, and were prosodically identical thereafter.

4.3. Procedure

The L2 learners were tested on desktop computers in a quiet research laboratory at a Midwestern American university. The native speakers were tested on a laptop computer at a Midwestern American university or on desktop computers at a university in France. The listening comprehension task (approx. 30 minutes) was administered with the software E-Prime (Psychology Software Tools; Schneider, Eschmann, & Zuccolotto, 2002). In each trial, the participants heard the sentence under headphone, read the true-or-false comprehension question on the computer screen, and entered "v" for *vrai* 'true' or "f" for *faux* 'false'. Their accuracy rates and reaction times were recorded. A practice session of 10 trials preceded the main session. The participants were told whether their responses were correct during the practice session, but not during the main session. After the listening comprehension task, the participants completed the language background questionnaire, and the L2 learners completed the cloze test.

4.4. Data Analysis

The participants' accuracy rates and reaction times were analyzed with logit and linear mixed-effects models using the lme4 package in R (for discussion of this method, see Baayen, 2008). Mixed-effects models are an advantageous data-analysis method, in that they take into account random-effect variance such as that of the participants and of the test items, thus forfeiting the need to conduct both by-subject and by-item analyses (see, for example, Fraundorf, Watson, & Benjamin, 2010). These models also make it possible to include as predictors continuous variables such as verb-bias information and L2 proficiency.

Due to the uneven number of participants in each group, we conducted our models separately on the native speakers' and L2 learners' data. For each group, the fixed variables were prosody (facilitating, ambiguous, conflicting, with facilitating prosody serving as baseline), verb-bias information (0-1, see the appendix), and the interaction between prosody and verb-bias information; the random variables were participants and test items. The final models did not include the fixed variables that did not have significant main or interaction effects. For L2 learners, we added proficiency (i.e., cloze test scores) to the final models to determine whether L2 learners' use of prosody and/or verb-bias information was modulated by their proficiency in French. Note that the degrees of freedom are smaller in this analysis, because one L2 learner did not complete the cloze test and thus did not have a proficiency score.

5. Results

Table 3 shows the mean accuracy rates (percentage) and reaction times (in milliseconds) that native speakers and L2 learners obtained on the three prosodic conditions in the listening comprehension task.

Table 3. *Mean Accuracy Rates and Reaction Times (Standard Error) on Listening Task*

	Prosody	Accuracy (%)	Reaction times (ms)	
			All responses	Correct responses
Native speakers	Facilitating	82.5 (2.9)	2753 (208)	2666 (203)
	Ambiguous	82.2 (3.3)	2706 (196)	2592 (223)
	Conflicting	73.5 (4.4)	2887 (207)	2864 (210)
L2 Learners	Facilitating	72.1 (5.9)	3344 (241)	3334 (248)
	Ambiguous	63.8 (6.7)	3505 (229)	3414 (292)
	Conflicting	60.1 (5.5)	3534 (235)	3564 (255)

A logit mixed-effects model performed on native speakers' accuracy rates revealed a marginally significant effect of prosody for sentences with conflicting prosody as compared to sentences with facilitating prosody (i.e., the baseline condition), $z(1365)= –1.8$, $p<.073$, but not for sentences with ambiguous prosody (as compared to the same baseline), $z<|1|$; this model did not reveal any effect of verb-bias information, $z(1365)= –1.1$, $p<.287$, nor did it reveal any interaction between prosody and verb-bias information, $z<|1|$. We therefore removed verb bias and its interactions with the two prosodic conditions from the model. This subsequent model revealed a significant effect of prosody for sentences with conflicting prosody, $z(1367)= –4.5$, $p<.001$, but again not for sentences with ambiguous prosody, $z<|1|$. These results suggest that only the conflicting prosody had a significant negative effect on the native speakers' accurate sentence comprehension.

A linear mixed-effects model performed on native speakers' reaction times for all responses did not reveal significant effects of prosody (ambiguous prosody: $t<|1|$; conflicting prosody: $t(1365)=1.208$, $p<.227$) or verb-bias information, $t<|1|$, nor did it reveal significant interactions between prosody and verb bias information, $t<|1|$. Removing verb bias from the model did not result in significant effects of prosody (ambiguous prosody: $t<|1|$; conflicting prosody: $t(1367)=1.2$, $p<.233$). Another linear mixed-effects model conducted on native speakers' reaction times for only correct responses revealed a significant effect of prosody for sentences with conflicting prosody ($t(1083)=2.1$, $p< .04$), but not for sentences with ambiguous prosody, $t<|1|$; this model did not reveal an effect of verb bias, $t<|1|$, or did it yield significant interactions between prosody and verb-bias information (ambiguous prosody: $t<|1|$; conflicting prosody: $t(1083)= –1.3$, $p<.211$). Removing verb bias and its interactions with prosody from the model did not change the results substantially (ambiguous prosody: $t<|1|$; conflicting prosody: $t(1085)=2.2$, $p<.027$). The native speakers' reaction times for accurate responses thus mirror their overall accuracy rates, with only conflicting prosody affecting their listening comprehension.

A logit mixed-effects model performed on L2 learners' accuracy rates revealed a significant effect of prosody for sentences with conflicting prosody, $z(825)= –2.24$, $p<.026$, but not for sentences with ambiguous prosody, $z<|1|$; this model did not reveal any effect of verb-bias information, $z(825)=1.3$, $p<.184$, nor did it reveal any interaction between prosody and verb-bias information, $z<|1|$. We therefore removed verb-bias and its interactions with the two prosodic conditions from the model. This subsequent model revealed a significant effect of prosody for sentences with ambiguous prosody, $z(827)= –2.7$, $p<007$, and for sentences with conflicting prosody, $z(827)= –3.7$, $p<.001$. Thus, whereas native speakers' accurate comprehension is affected by the conflicting prosody condition and otherwise unaffected by prosody, L2 learners' accurate comprehension is affected by both the absence of prosodic cues and conflicting prosodic cues.

Adding proficiency (i.e., cloze test scores) and its interactions with the two prosodic conditions to the previous model did not result in a significant effect of prosody (ambiguous prosody: $z(825)= –1.3$, $p<.188$; conflicting prosody: $z(825)=1.2$, $p<.220$), but it yielded a significant effect of proficiency, $z(789)=4.7$, $p<.001$, and a significant interaction between proficiency and prosody for sentences with conflicting prosody, $z(789)= –2.7$, $p<.006$, though not for sentences with ambiguous prosody, $z<|1|$. This interaction, represented in Figure 1, indicates that the effect of conflicting prosody affected listening comprehension more for higher-proficiency L2 learners than for lower-proficiency L2 learners. In other words, with increasing proficiency in French, L2 learners showed a pattern of accuracy that is more similar to that of native speakers.

A linear mixed-effects model performed on L2 learners' reaction times for all responses did not reveal significant effects of prosody (ambiguous prosody: $t(825)=1.1$, $p<.302$; conflicting prosody: $t(825)=1.6$, $p<.109$) or verb-bias information, $t<|1|$, nor did it reveal significant interactions between the two, $t<|1|$. Removing verb bias from the model did not result in significant effects of prosody (ambiguous prosody: $t(827)=1.1$, $p<.268$; conflicting prosody: $t(827)=1.3$, $p<.192$). Adding proficiency to this last model yielded no effect of prosody, $t<|1|$, no effect of proficiency, $t(789)= –1.1$, $p<.252$, and no interaction between proficiency and prosody for sentences with ambiguous prosody, $t<|1|$, but it yielded a marginally significant effect of prosody and a significant interaction between proficiency and prosody for sentences with conflicting prosody (respectively: $t(789)=1.9$, $p<.062$; $t(789)=2.5$, $p<.009$). This interaction, shown in Figure 2, indicates that the effect of prosody as a function of proficiency is different for sentences with conflicting prosody as compared to sentences with facilitating or ambiguous prosody: as L2 learners' cloze test scores in French increase, they respond more slowly to sentences with conflicting prosodies; it is also the case that lower-proficiency

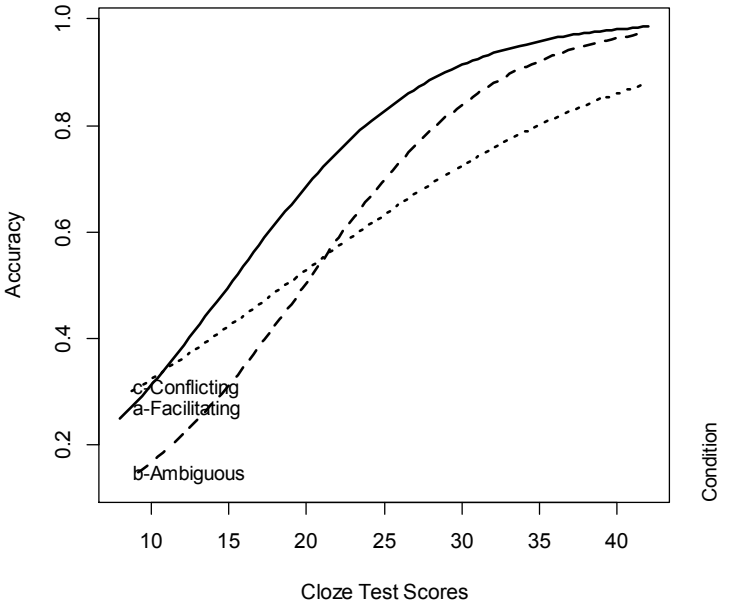

Figure 1. Relationship between L2 learners' accuracy on each prosodic condition and their proficiency

L2 learners respond more rapidly to sentences with conflicting prosody than to sentences with facilitating and ambiguous prosodies. This may potentially be due to L2 learners' inaccurate responses on some of the test items, which are more numerous for lower-level L2 learners than for higher-level ones.

Another linear mixed-effects model on L2 learners' reaction times for only accurate responses did not reveal significant effects of prosody (ambiguous prosody: $t(538)=1.1$, $p<.273$; conflicting prosody: $t(538)=1.3$, $p<.183$) or verb bias, $t<|1|$, nor did it yield a significant interaction between the two, $t<|1|$. Removing verb-bias information from the model did not result in significant effects of prosody (ambiguous prosody: $t(540)=1.1$, $p<.289$; conflicting prosody: $t(540)=1.4$, $p<.173$), nor did adding

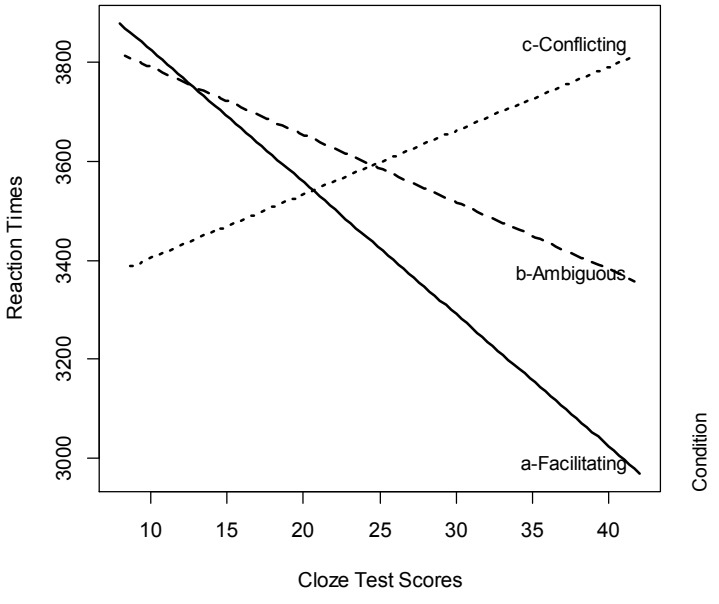

Figure 2. Relationship between L2 learners' reaction times on each prosodic condition and their proficiency

proficiency to this last model (ambiguous and conflicting prosodies: $t<|1|$; proficiency: $t(507)= -1.3$, $p<..200$; proficiency × ambiguous prosody: $t(507)=1.0$, $p<.313$; proficiency × conflicting prosody: $t<|1|$). Hence, we may conclude that the effects of prosody and the interactions between prosody and proficiency observed in L2 learners' reaction times were partly due to the test items to which they responded incorrectly.

6. Discussion and Conclusion

Our results show that both L2 learners and native speakers use prosodic cues to structural information in sentence comprehension. On the one hand, native speakers' final interpretation of late-closure sentences is affected by prosodic cues only when these cues conflict with structural information. This was evidenced in native speakers' accuracy rates as well as in their reaction times for correct responses. On the other hand, L2 learners as a group appear to be affected by both the absence of prosodic cues and by conflicting prosodic cues; this was evidenced in L2 learners' accuracy rates. When proficiency is considered, higher-level L2 learners show a pattern of results that more closely resembles that of native speakers, with their final interpretation being more negatively affected by conflicting prosodic cues; this was evidenced in L2 learners' accuracy rates as well as in their reaction times for all responses.

These results suggest that prosodic information guides both L2 learners' and native speakers' final interpretations of late-closure sentences, but in slightly different ways. L2 learners may be more affected by the absence of prosodic cues than native speakers are (cf. Dekydtspotter et al., 2008), because their syntactic representations are less stable than those of native speakers. The relationship between L2 learners' responses on sentences with conflicting prosody and their proficiency suggests that their ability to assign the correct syntactic interpretation to late-closure sentences improves as they become more proficient in French, thus resulting in a greater effect of prosody when that information conflicts with the structurally correct interpretation. One limitation of our experimental design is that the sentences with facilitating prosody differed from those with ambiguous and conflicting prosodies in that they were not cross-spliced. It is therefore possible that the effect of prosody that we observe was due in part to the acoustic manipulation in sentences with ambiguous and conflicting prosodies. Note, however, that our participants did not treat sentences with ambiguous prosody and sentences with conflicting prosody in the same manner: native speakers' responses were not affected by ambiguous prosody, and L2 learners did not show a relationship between their responses on sentences with ambiguous prosody and their proficiency. We can thus attribute the effects that we find to the prosodic cues themselves and not to the cross-splicing manipulation.

Importantly, our results show no effect of verb-bias information on L2 learners' and native speakers' final sentence interpretation, suggesting that the likelihood that different verbs take a direct object in French, which is encoded lexically, does not influence the extent to which L2 learners and native speakers assign a correct final interpretation to late-closure sentences, even if our verbs showed a wide distribution of norming scores. There are a few caveats associated with our measurement of verb-bias information, however. One of them is that native speakers, not L2 learners, provided the norming data that constituted the basis for assessing the role of verb-bias information. Given the different exposure to French that our L2 learners (all of which were in a Midwestern American university) and native speakers might have, these norming data may not be appropriate for investigating the role of verb-bias information in L2 processing. A second caveat is that we used verbs along a continuum of norming scores rather than two sets of verbs with values at each end of the continuum. The latter manipulation might perhaps have better captured the effect of verb-bias information. Finally, a third possibility is that although verb-bias information has been shown to guide online sentence processing (e.g., Dussias & Scaltz, 2008; Ferreira & Henderson, 1990; Frenck-Mestre & Pynte, 1997; Garnsey et al., 1997; Hare, McRae, & Elman, 2003; Mitchell, 1989; Trueswell et al., 1993; Wilson & Garnsey, 2009), this information may not be strong enough to influence listeners' final interpretation of garden-path sentences. Further research providing a more robust manipulation of verb-bias information is necessary to determine whether the present results can be replicated.

Finally, our accuracy results, which were numerically lower for L2 learners than for native speakers, suggest that L2 learners have more difficulty avoiding incorrect syntactic parses or

recovering from them than native speakers do. In other words, the initial interpretation assigned to late-closure sentences lingers more for L2 learners than for native speakers. These results are compatible with theories that suggest that L2 processing may rely more on good-enough syntactic structures as compared to native processing (e.g., Lim, 2011), but by no means do they entail that L2 learners are restricted to such structures (cf. Clahsen & Felser, 2006): our L2 learners may simply not have been sufficiently proficient to obtain higher accuracy rates. What is unclear from our listening task is whether L2 learners' correct syntactic interpretation was their initial interpretation or their revised interpretation. In other words, we do not know whether prosodic cues helped L2 learners avoid garden paths or whether they helped them recover from garden paths. More sensitive experimental methods such as eye tracking will shed further light on this question.

Overall, our findings suggest that L2 learners can learn to use cues to structural information that are not encoded lexically, namely prosodic cues, and they may not rely heavily on cues to structural information that are encoded lexically, namely verb-bias cues.

Appendix

Table 4. *Verb Bias Information*

French Verb	English Translation	Norming (*n*=24)	French Verb	English Translation	Norming (*n*=24)
attendre	'to wait'	0.13	*Fumer*	'to smoke'	0.81
balayer	'to sweep'	0.50	*Grignoter*	'to munch'	0.71
boire	'to drink'	0.88	*Jouer*	'to play'	0.13
broder	'to embroider'	0.88	*Lire*	'to read'	0.63
chanter	'to sing'	0.75	*Manger*	'to eat'	0.38
chauffer	'to heat'	0.14	*Marcher*	'to walk'	1.00
chuchoter	'to whisper'	0.88	*Nettoyer*	'to clean'	0.38
composer	'to compose'	0.75	*Parler*	'to talk/to speak'	0.75
conduire	'to drive'	0.88	*Pêcher*	'to fish'	0.88
copier	'to copy'	1.00	*Peindre*	'to paint'	0.75
coudre	'to sew'	0.88	*Photographier*	'to photograph'	0.50
cuisiner	'to cook'	0.90	*Présenter*	'to present'	0.13
danser	'to dance'	0.88	*Ranger*	'to arrange'	0.36
dessiner	'to sketch'	0.86	*Regarder*	'to see/ to watch'	0.14
discuter	'to discuss'	0.57	*Respirer*	'to breathe'	0.88
écrire	'to write'	0.38	*Sculpter*	'to sculpt'	0.88
enseigner	'to teach'	0.38	*Tourner*	'to turn'	0.13
étudier	'to study'	1.00	*Tricoter*	'to knit'	1.00

Note. 0 = Direct object, 1=New Clause

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