THE PROCESSING AND PRODUCTION OF PROSODIC FOCUS IN FRENCH BY NATIVE AND NON-NATIVE SPEAKERS

BY

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DISSERTATION

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ABSTRACT

The present research examines whether adults who learn a second language (L2) mainly in a classroom setting can develop linguistic representations that are qualitatively similar to those of native speakers for linguistic content that is not explicitly taught in the classroom. It does so by focusing on the domains of speech processing and speech production in L2 learners. Specifically, this dissertation investigates the processing and production of prosodic focus, a characteristic of the French language not taught in the classroom. This research examines whether French learners can, in the absence of explicit instruction on prosodic focus, learn the correct mapping between the form of prosodic focus in French and what it entails at the discourse level, both in speech processing and in speech production.

Prosodic focus has similar discourse entailments in both French and English. However, French and English differ in both the extent to which focus is expressed only phonologically and how prosodic focus is realized. The specific nature of the similarities and differences between French and English prosody creates an interesting learning problem for L2 learners, who must learn both the phonetic and phonological characteristics of focus in French and use this information to infer the status of specific referents in the discourse.

Experiments 1a and 1b of this dissertation use the visual-world eye-tracking paradigm to examine whether native French speakers and English-speaking L2 learners of French used prosodic focus (in the form of pitch accents) in online sentence interpretation. Experiment 1a revealed that native speakers' interpretation of sentences in French was constrained by whether or not the referent in the sentence was prosodically focused. Experiment 1b showed that L2 learners were sensitive to the presence of prosodic focus, but unlike native speakers, their

interpretation of sentences was not constrained by this information. Thus, despite similarities between the discourse implications of prosodic focus in the native and target languages, L2 learners appeared not to map the form of prosodic focus in French to its discourse implications.

Experiments 2a and 2b are interactive production experiments similar to those used in the Visual-World Eye-Tracking paradigm in Experiments 1a and 1b. They examine whether native French speakers and English-speaking L2 learners produce prosodic focus in the absence of syntactic cues to focus. The results show that neither group of participants produced prosodic focus where it was appropriate. Although questions are raised as to whether L2 learners can produce prosodic focus when the discourse context allows it, ultimately the results of both groups are attributed to potential methodological limitations of the production task.

These results suggest that while the L2 learners in this study may be sensitive to prosodic focus, their mapping of prosodic focus to its meaning in the discourse may not be complete at this point in their linguistic development, suggesting that L2 learners' representations may be qualitatively different from those of native speakers.

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Chapter 1

Introduction

It is well known that individuals learning a language after the ages of 10-12 do not acquire the language with the same ease as children do, nor are they ultimately as successful at acquiring the language (for discussion, see Bley-Vroman, 1989). In general, language acquisition becomes increasingly difficult with age. Adult second/foreign language (L2) acquisition—the process of learning a new language in adulthood—differs in a number of ways from both first language (L1) and child L2 acquisition (e.g., Grondin & White, 1996; Schwartz, 1992; Unsworth, 2007). Children typically acquire their native language successfully, and are also quite successful at acquiring an L2 after an L1 (though perhaps to a lesser degree than children acquiring their L1) (e.g., Dulay & Burt, 1974; Hulk & Cornips, 2006; Schwartz, 1992; Unsworth, 2005, 2007). Adults, although not unable to learn an L2, seldom achieve the complete success seen in children and tend to "fossilize" without reaching native-like competence (e.g., Qiang, 2000; Rong, 2005; Selinker, 1972; Selinker & Lakshmanan, 1992). Furthermore, tremendous individual variability is observed in the degrees of success in L2 acquisition as compared to L1 acquisition, which shows comparatively little variability (e.g., Dörnyei, 2005; Dörnyei & Skehan, 2003; Moyer, 1999; Skehan, 1989). A third important difference that sets adult language acquisition apart from child language acquisition is the degree of success in different aspects of language (e.g., Scovel, 1988; Seliger, 1978). It is interesting to note that many adults who achieve near-native ability in reading, writing, and listening skills still do not attain native-like oral production and are perceived to have a "foreign accent" (e.g., Flege, Munro, & Mackay, 1995; Flege et al., 2006). This observation also contrasts with language learning in children, which more often reaches native-likeness in oral production.

Clearly, age has an important effect on the ability to learn a new language and potentially on the process of learning. This leads to the question of whether or not adults who have begun learning an L2 after childhood can develop linguistic representations that are qualitatively similar to those of native speakers, and if not, what causes this inability. As human beings age, neurological changes take place in the brain, making it more difficult to learn new languages. Some theories claim that after a certain age, successful language learning is no longer possible due to a qualitative change in the brain associated with loss of plasticity (e.g., Abrahamson & Hyltenstam, 2009; Bley-Vroman, 1989; Clahsen & Felser, 2006; DeKeyser, 2000; Hyltenstam & Abrahamson, 2003; Johnson & Newport, 1989; Long, 1990; Scovel, 1988). Studies on different aspects of language acquisition claim that this critical period could be different for different aspects of language. For example, some studies claim that the critical period for learning phonology may end as early as 6-9 months (e.g., Long, 1990; Dupoux & Peperkamp, 2002), whereas the critical period for learning morphosyntax is generally considered to end around the onset of puberty. Others claim that there is no such qualitative change in the brain, and that the observed difference between L1 and L2 acquisition is quantitative, largely due to the entrenchment of the L1, limited access to cognitive resources in the L2, and general age-related decline in cognitive capacities leading to a steady decline over time instead of a sharp decline at a particular age (e.g., Bialystok, 2002; Bialystok & Hakuta 1999; Bialystok & Miller, 1999; Birdsong & Molis, 2001; Bongaerts, 1999; Flege, Yeni-Komshian, & Liu, 1999; Hakuta, Bialystok & Wiley 2003; Hopp, 2006, 2010; McDonald, 2000, 2006; Wiley, Bialystok & Hakuta, 2005).

The present research examines whether adults who learn an L2 mainly in a classroom setting can develop linguistic representations that are qualitatively similar to those of native

speakers for linguistic content that is not explicitly taught in the classroom. It does so by focusing on the domains of speech processing and speech production in L2 learners. Specifically, this dissertation investigates the processing and production of prosodic focus, a characteristic of the French language not taught in the classroom. This research examines whether French learners can, in the absence of explicit instruction on prosodic focus, learn the correct mapping between the form of prosodic focus in French and what it entails at the discourse level, both in speech processing and in speech production. Ultimately, the goal of this research is to establish whether native and non-native listeners' representations of focus are qualitatively similar. At a theoretical level, answering this question will shed light on whether adult L2 learners in a classroom setting, who receive limited exposure to the target language and who receive no explicit instruction on prosodic focus, can develop linguistic representations that are qualitatively similar to those of native speakers. At a practical (pedagogical) level, this research will have implications for whether prosodic focus should perhaps be explicitly taught in adult French language classes.

L2 linguistic representations are deemed to be qualitatively similar to those of native speakers if the linguistic system that L2 learners develop constrains their speech processing and production in a similar way as it does for native speakers. Complete nativelikeness in L2 speech processing and production is extremely difficult to reach. L2 processing is known to be more cognitively demanding than L1 processing (e.g., Coughlin & Tremblay, 2013; Hoover & Dwivedi, 1998; Hopp, 2010; Kilborn, 1992; McDonald, 2006; Segalowitz, 2003; Service et al., 2002). Research suggests that even if L2 learners are sensitive to L2 cues, they may not use them predictively in sentence comprehension (Dussias, Valdés Kroff, Guzzardo Tamargo, & Gerfen, 2013; Grüter, Lew-Williams & Fernald, 2012; Grüter & Rohde, 2013; Hopp, 2013; Kaan, 2014; Lew-Williams & Fernald, 2010; Martin et al., 2013). According to Kaan (2014), this does not

imply a qualitative difference between native and non-native linguistic representations; she instead attributes these differences to factors such as difficulty of tasks, access to lexical information being slower, or parsing routines being less automatic (i.e., general resource deficits). Likewise, L2 speech production requires learners to master specific articulatory commands and actively put them into use as they produce the form that results from their coordination of linguistic representations at various levels (phonological, lexical, syntactic, semantic, etc.). The high cognitive demands of L2 speech production might cause L2 learners to produce speech that, on the surface, sounds different from that of native speakers. These differences do not necessarily entail that L2 learners' linguistic system differs fundamentally from that of native speakers, at least if L2 learners' speech production *pattern* similarly to that of native speakers (for discussion, see Rasier & Hilligsmann, 2007; Trofimovich & Baker, 2006).

The present study sheds further light on these questions by examining native French and native English speakers' processing and production of prosodic focus in French. Prosodic focus has similar discourse entailments in both French and English. However, French and English differ in both the extent to which focus is expressed only phonologically and how prosodic focus is realized. There are two different types of focus: broad focus, which focuses an entire constituent in which all its parts receive equal prominence, and narrow focus, which tends to apply to words and may be used to signals contrast or emphasis (e.g., Ladd, 1980). Broad focus tends to signal new information, whereas narrow focus tends to signal contrastive information. The way in which French and English signal broad and narrow focus differ substantially (cf. Chapter 3). The specific nature of the similarities and differences between French and English prosody creates an interesting learning problem for L2 learners, who must learn both the phonetic and phonological characteristics of focus in French and use this information to infer the

status of specific referents in the discourse. If L2 learners have developed linguistic representations that are qualitatively similar to those of native speakers, they should map the form of prosodic focus in French to the discourse implications it entails in at least one of the two speech domains investigated (processing or production), even if L2 learners' surface realization or comprehension of prosodic focus differs quantitatively from that of native speakers. If L2 learners do not show any evidence of such mapping, it can be concluded that L2 learners have not developed linguistic representations that are qualitatively similar to those of native speakers. If, by contrast, L2 learners show evidence of a mapping that differs significantly from that of native speakers, it can be concluded that L2 learners have developed a linguistic system that differs qualitatively from that of native speakers.

This dissertation is organized as follows: Chapter 2 discusses previous research on L2 learners' processing and production of prosody. Chapter 3 describes the prosodic structure of French and reviews two studies that examine the role of focus in French. Chapter 4 describes the prosodic structure of English and discusses studies on the comprehension and production of prosodic focus in English. Chapter 5 outlines the differences between French and English, to establish the goals of this dissertation, followed by a description of the first two experiments, undertaken to study the role of focus on speech comprehension in French. In Chapters 6 and 7, Experiments 1a and 1b study native speakers' and L2 learners' processing of focus in French, respectively. In Chapters 8 and 9, Experiments 2a and 2b focus on the production of focus in French by native speakers and L2 learners, respectively. Chapter 10 discusses the implications of this research for the questions of whether or not native and non-native speakers process and produce the target language in a qualitatively similar manner, and the potential pedagogical implications of this research for the teaching of French as a foreign language.

Chapter 2

Prosody in Second Language Speech Production and Processing

It is widely accepted that adult L2 acquisition differs at least in some ways from child L1 acquisition, in that the types of information that children and adults receive (e.g., input, instruction, feedback) are very different. An important question is thus whether L2 learners develop similar or different linguistic representations from those of native speakers. The existing evidence suggests that although the final outcome is different for the two groups, it is unclear whether this difference is qualitative (i.e., whether the representations are different in nature) or quantitative (i.e., whether the representations are similar, but not used as efficiently in the L2 due to increased processing load in L2 learners). Current theories of L2 speech processing and production primarily focus on the segmental level of spoken language (e.g., Best, 1995; Flege, 1995, Long, 1990; Scovel, 1988, among others). Relatively little has been studied about higher-level suprasegmental cues in speech, specifically how L2 learners use these cues in L2 processing and whether they produce them accurately. This chapter will highlight the importance of prosody in native speech production and comprehension, and it will discuss previous research on the L2 comprehension and production of prosody.

Prosody includes rhythm, duration, stress, and intonation. As Walker (1984) explains, "prosody is considered to include anything not specifically involved in the articulation of individual segments. Thus, aspects of syllable structure, rhythm, duration, stress, tone, intonation, speech rate, and even pauses have all been considered as prosodic at one time or another" (p. 103). Native speakers routinely depend on prosody when producing and comprehending language. However, unlike other components of language such as the lexicon, morphosyntax, segmental phonology, and so on, prosody is rarely the object of explicit

instruction in the foreign language classroom (at least in French). Therefore, L2 learners, whether in an immersion environment or in a foreign language classroom, must implicitly learn to use prosody. This can be particularly challenging, especially in a foreign language environment where the target language is not spoken on a regular basis.

Prosody is an important characteristic of spoken language: In speech production, native speakers produce prosodic cues to word boundaries, syntactic constituents, and discourse structure (e.g., Pierrehumbert, 1980; Pierrehumbert & Hirschberg, 1990; Ito, Speer & Beckman, 2004; Jun & Fougeron, 2002; Welby, 2006; Bell, Brenier, Gregory, Girand, & Jurafsky, 2009; Lam & Watson, 2010). In speech comprehension, prosody can thus potentially serve as an important cue to break down the speech signal into words, locate syntactic constituents in the sentence, and infer discourse structure. Research indeed shows that native listeners use prosody to understand words, sentences, and the discourse in general. At the word level, in a study on native French speakers, Christophe, Peperkamp, Pallier, Block, and Mehler (2004) showed that lexical competitors spanning a phonological phrase boundary (e.g., *chagrin* 'chagrin' in *le chat grimpait* 'the cat was climbing') do not delay lexical access as compared to lexical competitors that do not span such a boundary (e.g., *chagrin* in *le chat grincheux* 'the cranky cat') (see also Welby, 2007). Native French speakers are thus able to use suprasegmental information to recognize words in speech (for evidence in English, see Cooper, Cutler, & Wales, 2002; cf. Cutler, 1986). Christophe et al. further argue that since phonological phrase boundaries tend to coincide with syntactic boundaries, native French speakers could use phonological phrase boundaries to restrict their syntactic analysis online. Research has effectively shown that French listeners also use prosodic boundaries to break down sentences into syntactic constituents (e.g., Grosjean, 1996; Namjoshi, Gaillard, & Tremblay, 2013; for evidence in English, see

Carlson, Clifton, & Frazier, 2009; Kjelgaard & Speer, 1999; Schafer, Speer, Warren, & White, 2000). Finally, native French listeners have been shown to use pitch accents to infer discourse structure (e.g., Féry, 2001, Magne, Astésano, Lacheret-Dujour, Morel, Alter, & Besson, 2005; for evidence in English, see Birch & Garnsey, 1995; Ito & Speer, 2008; Lee & Watson, 2011; Schafer, Carter, Clifton, & Frazier 1996).

Given the importance of prosody in native language processing, if it is not used successfully in L2 sentence comprehension, at best it may result in inefficient processing, and at worst it may result in failure to recognize words and to understand sentences and discourse structure. L2 learners have been shown to be relatively successful in their use of prosody in speech comprehension (at least as compared to speech production, discussed next), but their likelihood of success appears to depend on the linguistic unit (word, syntactic constituent, and discourse structure) that prosody signals. At the word level, studies on the use of prosody in L2 processing suggest that the L1 plays an important role in determining how words are recognized in the L2. The case of "stress deafness" of French monolinguals has been well documented (e.g., Dupoux & Peperkamp, 2002; Dupoux, Pallier, Sebastian, & Mehler, 1997; Dupoux, Peperkamp, & Sebastián-Gallés, 2010; Dupoux, Sebastián-Gallés, Navarette, & Peperkamp, 2008). Dupoux and colleagues (1997) demonstrated that in discrimination tasks involving nonword stimuli that differed solely in lexical stress (e.g., *bópelo, bopélo, bopeló*), French monolinguals, whose L1 does not have lexical stress, were impaired in their ability to use lexical stress for word discrimination as compared to Spanish listeners, whose L1 has lexical stress. In a follow-up study using a lexical decision task and a sequence recall task that imposes a high memory load, Dupoux and colleagues (2008) found that even in the presence of metalinguistic instructions about stress and training to recognize stress, French L2 learners of Spanish were just

as “stress-deaf” as monolingual French listeners. Dupoux and colleagues attribute these results to the L1 of the participants. They argued that the French listeners who are able to use stress accurately in discrimination experiments use acoustic representations of stress rather than abstract phonological representations of stress, and that these acoustic representations cannot be used in tasks that impose a high memory load (which require the use of abstract phonological representations). Other studies have shown similar L1 effects in the processing of L2 stress (e.g., Lin, Wang, Idsardi, & Xu, 2014; Tremblay, 2008, 2009). However, in a study on simultaneous French-Spanish bilinguals, Dupoux, Peperkamp and Sebastian-Galles (2010) found that simultaneous bilinguals’ performance was in between that of native Spanish listeners and late L1-French L2-Spanish bilinguals, suggesting a possible interference from French in the encoding of Spanish stress even if both languages were learned from birth.

Effects of the dominant language have also been observed in bilingual listeners’ use of rhythmic cues in speech segmentation. Cutler, Mehler, Norris, and Segui (1992) tested French-dominant and English-dominant simultaneous bilinguals’ ability to locate word boundaries in English and French speech. In their experiments, participants were asked to detect written syllables whose boundaries matched or did not match the syllable boundaries in the auditory word (e.g., *bal-* vs. *ba-* in French *balcon* and English balcony or in French *ballon* and English *ball*). They found that the French-dominant group’s word recognition in French was facilitated when the onset and offset of the written syllable matched that in the auditory word (cf. Content, Kearns, & Frauenfelder, 2001; Dumay, Frauenfelder, & Content, 2002), whereas the English-dominant group did not show this effect in either language. The authors suggest that some procedures, such as syllabic segmentation, develop to segment the dominant language efficiently and can be switched off where they are not efficient. This would be the case with their French-

dominant individuals. The English-dominant individuals, on the other hand, do not develop syllabic segmentation at all, since the cues to speech segmentation in their dominant language are not at the level of syllables, and the routine is thus not efficient for their dominant language. The routine that is efficient for English is locating word boundaries at the beginning of strong syllables, and this is the routine that English-dominant individuals develop and use (e.g., Cutler, & Butterfield, 1992; Cutler & Norris, 1988; McQueen, Norris, & Cutler, 1994). Cutler et al. (1992) argue that at the level of speech segmentation, bilingualism cannot be perfect—it is efficient for the bilingual individual to have only one segmentation routine (see also Golato, 2002; for further discussion, see Cutler, 2012). Such an explanation could also account for the findings of Dupoux et al (2010) on the stress-deafness of simultaneous French-Spanish bilinguals.

Tremblay, Coughlin, Bahler, and Gaillard (2012) further show that the L1 plays an important role in determining whether or not L2 learners can learn to use prosodic cues in speech segmentation. They examined the use of prosodic information in speech segmentation by native French speakers and English-speaking L2 learners of French. Materials included target words created at the phonemic level between a monosyllabic word and the first syllable of the following adjective (e.g., *chalet* 'cabin' in *chat lépreux* 'leprous cat'). In the "within-AP" condition, the noun and adjective were part of the same Accentual Phrase (AP), whereas in the "across-AP" condition, there was an AP boundary between the two words. Participants saw the target word, heard a sentence, and immediately pressed a key if they thought they heard the target word in the sentence, under time pressure. The authors found that while L2 learners were able to use greater intensity and lengthening as cues to locate word-final boundaries in French, they did not rely on pitch rise as cue to word-final boundaries. The authors explain that the lack

of use of this pitch cue may be attributed to its different use in the L1 (pitch rise in English tends to signal word-initial boundaries), its co-occurrence with lengthening in the L2, and its use to mark both word-initial and word-final boundaries in the L2 (for details on the prosodic structure of French, see Chapter 3). Overall, their study shows that L2 learners can use some prosodic cues for speech segmentation like native speakers do, but only the cues that work similarly in the L1 and in the L2.

At the word level, it can thus be concluded that the L1 plays an important role in determining which prosodic information can be learned and used in the L2 and how easily it can be learned. By contrast, at the sentence level, several studies indicate that L2 learners can in fact use prosodic cues similarly to native speakers when comprehending speech. For example, Hwang and Schafer (2006) examined the effect of prosodic boundaries in the parsing of "early closure" and "late closure" sentences by native English speakers and Korean L2 learners of English. In a forced-choice continuation selection task, participants heard partial sentences that were syntactically ambiguous. The prosody of the stimuli was varied. Participants were asked to then choose one of two visually presented disambiguating options (e.g., after hearing *When that moves the square*, they would choose either *will encounter a cookie* ("early closure": *the square* is not the object of the embedded verb *moves*) or *it will encounter a cookie* ("late closure": *the square* is the object of the embedded verb *moves*)). The authors found that cooperating prosodic boundaries helped L2 learners disambiguate the sentences, indicating that these L2 learners could use prosodic boundaries similarly to native speakers in sentence comprehension.

Dekydtspotter, Donaldson, Edmonds, Fultz, and Petrush (2008) similarly examined the interaction of prosody and syntax in the context of relative-clause attachment preferences. Native French speakers and English-speaking L2 learners of French were asked to interpret sentences

like that in (1), in which two different interpretations are possible depending on whether the relative clause attaches to the first noun (high attachment) or the second noun (low attachment).

(1) *Nous adorons le secrétaire du psychologue qui se promène au centre-ville.*

'We adore the secretary of the psychologist who takes a walk downtown'

The authors manipulated the attachment preferences by varying whether the prosodic break was placed after the first or second noun. The sentences were presented aurally and participants answered comprehension questions such as (2).

(2) *Qui se promène au centre-ville?*

'Who takes a walk downtown?'

The results showed that about a third of the L2 learners had their attachment preferences influenced by the placement of prosodic boundaries, and thus were in fact sensitive to prosodic boundaries in language processing. The authors explained that the lack of effect for some L2 learners may be due to these L2 learners having difficulty integrating different types of information (phonological, syntactic, and semantic) when processing fast connected speech. They argue that intonation may not affect interpretation unless all types of information are successfully integrated.

Namjoshi, Gaillard, and Tremblay (2013) also examined the influence of prosody on the processing of temporarily ambiguous "late-closure" sentences in French (e.g., *Quand Marie écrivait sa longue lettre s'est effacé de son bureau par accident.* 'While Marie wrote her long

letter was erased from her computer accidentally'). They found that while native French speakers and English L2 learners of French both use prosodic information in sentence processing, their reliance on this information differ: L2 learners appeared to be more affected by the absence of prosodic cues than native speakers (i.e., L2 learners' comprehension of sentences without such cues was much poorer than their comprehension of sentences with such cues), and prosody conflicting with syntactic information was more misleading to learners as their proficiency improved, suggesting that they became increasingly sensitive to how prosody signals syntactic boundaries in French with more experience in French. The L2 learners' greater reliance on prosodic information was attributed to their less stable syntactic representations as compared to those of native speakers.

Overall, these findings suggest that L2 learners can use prosodic information in sentence processing, and that native-like use of prosodic information may accompany high language proficiency. L2 learners' greater success in using prosodic information at the sentence level than at the word level could be due to the fact that prosodic cues to syntactic information differ less across languages than prosodic cues to lexical identity and to word boundaries, though of course it is difficult to provide a direct comparison of the research that focuses on the sentence level and the research that focuses on the word level (e.g., different native and target languages, different proficiencies, different methods). L2 learners' difficulty in using prosodic cues in word recognition has also been attributed to their over-reliance on lexical information (e.g., White, Melhorn & Mattys, 2010).

Relatively few studies have investigated L2 learners' production of prosodic information. The studies that have done so suggest that L2 learners' production of this information is generally not very successful. At the word level, studies on the L2 production of suprasegmental

information show that there is tremendous variability among L2 learners in their production accuracy, both across individuals and within individuals, for different suprasegmental characteristics of speech (e.g., Archibald, 1993; Guion, Harada, & Clark, 2004; Pater, 1997; Tremblay & Owens, 2010). One of the suprasegmental characteristics that is difficult for L2 learners to produce is stress. Languages differ in whether or not they have lexical stress (e.g., English vs. French) and in the generalizations (if any) that underlie stress placement (e.g., English vs. Spanish). In the domain of speech production, studies have shown effects of the L1 on the production of L2 stress (e.g., Anani, 1989; Archibald, 1993, 1994; Juffs, 1989; Mairs, 1989), as well as overgeneralization of stress placement based on statistical regularities (e.g., Pater, 1997; Tremblay, 2008; Tremblay & Owens, 2010). In many of these studies, L2 learners appeared to have developed L2 representations of stress that differed from those of native speakers (i.e., the stress patterns they produced differed from those of native speakers; e.g., Tremblay, 2008; Tremblay & Owens, 2010).

At the sentence level, L2 learners' production of suprasegmentals tends not to be phonetically accurate either. Mennen (2004) examined the production of tonal peaks in Greek and Dutch by Dutch L2 learners of Greek. Dutch and Greek tonal peaks are similar but differ on two levels: the Dutch peak is earlier than the Greek one, and the phonological vowel length of the accented syllable affects the peak in Dutch but not in Greek. Results showed that the subjects produced non-native-like peaks in Greek, but that at the same time their L1 Dutch peaks did not remain native-like either (four of five speakers partially neutralized the peak timing differences between sentences with accented syllables containing long and short vowels). This indicates that there is a bidirectional effect of the phonetic realization of the tonal alignment in the two languages.

Trofimovich and Baker (2006) investigated the learning of suprasegmental information in relation to L2 exposure. Specifically, they examined whether suprasegmental learning occurs in the same way as segmental learning in adult L2 learners. Adult Korean L2 learners of English had their production of English declarative sentences assessed for five suprasegmental characteristics: stress timing and tonal peak alignment, which characterize speech melody; and speech rate, pause frequency, and duration, which characterize speech fluency. They found that even at high levels of exposure, the Korean speakers were not native-like in their production of suprasegmental characteristics of speech, thus retaining some degree of a foreign accent. The authors also found that the learning of suprasegmental information, like that of segmental information, depended to some extent on the amount of L2 exposure that the L2 learners had received, and that some suprasegmental characteristics of speech (e.g., stress placement) required lesser exposure to learn than others (e.g., speech rate or native-like placement of tonal peaks). Interestingly, native-like stress timing was related to degree of exposure, whereas speech rate, pause duration, and pause frequency were related to the age of exposure to the L2. The data from the tonal peaks and stress timing suggest that, with increased exposure, the L2 learners in Trofimovich and Baker's (2006) study may have been able to acquire some qualitative suprasegmental aspects of L2 speech production (e.g., stress placement). The differences in pause duration and pause frequency can be considered more quantitative in nature, in that they relate to fluency, which can easily be influenced by cognitive load.

At the discourse level, some research has also examined L2 learners' production of prosodic focus. In one such study, Nava and Zubizarreta (2008) examined the production of narrow and broad focus in the English speech of native Spanish speakers. In English sentences with broad focus, the nuclear pitch accent can fall on the object in transitive structures (e.g.,

Mary watches the <u>*birds*</u>) and on the subject in intransitive structures that do not contain an adverb (e.g., *The* <u>*magician*</u> *disappeared*); in intransitive structures that contain an adverb, the nuclear accent can fall on the intransitive verb (e.g., *A dog mysteriously* <u>*disappeared*</u>) (e.g., Gussenhoven, 1984). English also shows deaccenting of the material following the nuclear pitch accent (post-nuclear anaphoric deaccenting) by deletion of the pitch accent associated with a previous mentioned (i.e., anaphoric) constituent (Ladd, 1980, 1996). For example, in (3) from Nava and Zubizarreta (2009, p. 179), the word *collect* bears nuclear stress and *stamps* is deaccented (i.e., without a pitch accent).

(3) *Why are you buying that old stamp?*

Because I <u>*collect*</u> *stamps.*

By contrast, in Spanish sentences with broad focus, the main phrasal prominence is aligned with the last word of the Intonational Phrase, independently of the category of the phrase-final word (e.g., Sosa, 1999; Zubizarreta, 1998). In contrast to English, Spanish does not exhibit post-nuclear anaphoric deaccenting (e.g., Cruttenden, 1997; Ladd 1996; Zubizarreta, 1998). For example, in (4) from Nava and Zubizarreta (2009, p. 179), the anaphoric constituent receives main sentence stress.

(4) *¿Por qué compras ese sello tan viejo?*

'Why are you buying that old stamp?'

Porque colecciono <u>*sellos*</u>*.*

'Because I collect stamps.'

Nava and Zubizarreta's (2008) first experiment had a question-and-answer format and was intended to specify L2 learners' use of the intonation patterns associated with common sentence types in English. The results showed that L2 learners produced nuclear accenting as they would in the L1 rather than as they should in the L2. In other words, they incorrectly placed a nuclear pitch accent on the right-most word of the sentence instead of assigning an English-like nuclear pitch accent (e.g., in a subject-object-verb sentence, 93% of native speakers of English placed a nuclear pitch accent on the verb, but the learners only did so only 40% of the time, instead placing the pitch accent on the object). However, some L2 learners were capable of successful anaphoric deaccenting. Analyses also suggest a proficiency effect, with highly proficient L2 learners showing both anaphoric deaccenting and English-like nuclear accenting and intermediate learners showing deaccenting but incorrect nuclear accenting. The authors' second experiment measured vowel durations in readings of "The North Wind and the Sun". Results suggest that L2 learners might show negative transfer of the nuclear pitch accent from the L1 to the L2. The authors found the learners lost this transfer effect as their proficiency increased and eventually learned the correct L2 nuclear pitch accent. These results suggest that these learners acquired deaccenting before nuclear accenting. Note, however, that of their ten L2 learners, six showed neither target-like accenting nor deaccenting, only two showed evidence of target-like anaphoric deaccenting without having acquired target-like nuclear accenting, and the remaining two had acquired both.

The above L2 studies suggest that it is generally difficult for L2 learners to comprehend and (especially) produce suprasegmental information accurately. This difficulty seems to stem in large part from the phonetic and phonological differences between the L2 and the L1. However,

since little research exists on the learning of prosodic focus, it is unclear whether L2 learners in a classroom setting, who receive limited exposure to the target language and who receive no explicit instruction on prosodic focus, can develop linguistic representations that are qualitatively similar to those of native speakers. The present study sheds light on this question by examining L2 learners' processing and production of prosodic focus in French. Specifically, it will determine whether L2 learners can map the form of prosodic focus in French to the discourse structure it entails. We now turn to a discussion of prosody and focus in French.

Chapter 3

Prosody and Focus in French

The models that have sought to explain prosodic focus in French are general intonation models that attempt to explain a variety of intonational patterns in French. These models, and two specific studies on prosodic focus in French, are reviewed in this chapter.

Jun and Fougeron (2000) put forth an autosegmental metrical model of intonation for French, in which they proposed two intonational units in French: The Accentual Phrase (henceforth, AP) and the Intonational Phrase (henceforth, IP). They described the tonal patterns of the abovementioned phrases and explained that non-lexical prominence in French is at the level of the AP. The AP is associated with four tones: LHiLH* where only the final H* is obligatory. The realization of the other tones is not obligatory. The type of realization may depend on the number of syllables in the phrase, speech rate, speech style, phrase location, and type of adjacent tones. This prominence is the only obligatory tone to be realized, and it is a pitch accent. Hi tends to be realized on the first syllable of the AP-initial lexical word, but can be realized differently. It is not considered a pitch accent, but can be realized as one if the word is being focused; when it is not a pitch accent, it is weaker than H* in duration and pitch. The first L is not always realized; when realized, it is usually on AP-initial function words or as a plateau between two syllables. The second L is usually on the AP-penultimate syllable, but on AP-final full syllable if AP is short or if it is the last AP of the sentence.

Jun and Fougeron (2002) give the example of sentence (5) which contains one IP and two APs. The first AP has all four tones, LHiLH*: L on *le*, Hi on *co-*, L on *gar-* and H* on *–çon*.

L Hi L H*

(5) {[*Le coléreux garçon*]$_{AP}$ [*ment à sa mère.*]$_{AP}$}

'The angry boy lies to his mother.'

The slope of the early rise (LH) is variable within speakers (Welby 2006). The late H is accompanied by syllable lengthening, whereas the early H is not, making it "weaker". Jun and Fougeron (2002) refer to LHi as a phrasal accent or AP-initial rise, and LH* as the pitch accent or AP-final rise. When there are four syllables in the AP, each tone can be realized on its own syllable, but when there are more than four syllables, the first two tones are associated with the first two syllables and the last two tones with the last two syllables. When there are less than four syllables, various realizations are possible, with the final H* pitch accent always being realized. Jun and Fougeron (2002) also suggest that having H tones on adjacent syllables is avoided. In Welby's (2006) study on the intonational structure of French, Hi and H* were found to be structurally different, as claimed by Jun and Fougeron. The first L was found to be edge-seeking, being part of an early rise associated with the left boundary. The second L, while unstable, was claimed to be independent of the two Hs from the observation of LLH* structures (there can be two consecutive Ls without an H in between). Thus, Welby's study also provides support for Jun and Fougeron's (2000, 2002) model.

In this model, the IP is a major continuation rise or a major final fall. The IP-final syllable is significantly longer than AP-final syllable; and the AP final syllable is significantly longer than unaccented syllables. As per the Strict Layer Hypothesis (Selkirk, 1986), the AP, which is a smaller unit, is entirely contained within the IP, which is the larger unit. Thus, IP boundaries always coincide with AP boundaries, but AP boundaries may or may not coincide

with IP boundaries. As in the above example from Jun and Fougeron (2002), the second AP boundary follows the final syllable of the second AP and coincides with the IP boundary, while the first AP boundary does not. The two APs are thus fully contained in the IP, which is the larger unit.

Rolland and Loevenbruck (2002) carried out a study on the characteristics of the AP in French, with a perception experiment to test whether the lowest level of the hierarchical model was perceived as a single unit. Native French listeners heard sentences read by native French speakers. All sentences consisted of an IP with three APs, but the APs contained different numbers of syllables (3 to 5 in the subject/object APs and 1-5 in the verb APs). Balanced sentences (e.g., 6) contained the same number of syllables (3/4/5) in all three APs and unbalanced sentences (e.g., 7) contained different ones.

(6) *[Mon mari] [ranima] [le marin]*.

'My husband revived the sailor.'

(7) *[Le mauvais marin] [vend] [le rat]*.

'The bad sailor sells the rat.'

Each sentence could be sliced in five different ways (e.g., 8, in which 8e is the correct slicing by AP). Listeners listened to all five choices, up to three times, and were asked select the choice they found most adequate in terms of melodic cues.

(8) a. *(Le long mulot voulait manger le rat marron)*

b. *(Le long mulot voulait manger) (le rat marron)*

c. *(Le long mulot) (voulait manger le rat marron)*

d. *(Le long mulot voulait) (manger le rat marron)*

e. *(Le long mulot) (voulait manger) (le rat marron)*

'The long field mouse wanted to eat the brown rat.'

In a subsequent task, French listeners were presented delexicalized versions of the original sentences in reiterated speech, in which all syllables were replaced by "ma". A correct score indicated choosing the version with the correct APs (above, e). They found that French listeners were indeed able to use prosody to segment both the lexicalized corpus and the delexicalized corpus into accentual phrases (i.e., they selected the response corresponding to the segmentation in 8e). While the average accuracy for the delexicalized corpus was slightly higher than that for the lexicalized corpus, the difference was not significant, indicating that lexical and syntactic contents were not the primary information being used by the listeners to segment the sentences. Accuracy was also found to be higher when the AP had all four tones [LHiLH*]. The authors claimed that this provides evidence for the Accentual Phrase in French being perceived as a single unit, validating its acoustic, articulatory, and perceptual salience.

It is generally accepted that the two French accents can perform distinct discourse functions. The first is the phrase-final pitch accent, which occurs on the final syllable of the last word in the AP, serves as nuclear pitch accent. There is also a non-obligatory phrase-initial accent, which can occur on the initial syllable of the first lexical word in the AP. The same syllable or the second syllable can serve as the location of the contrastive accent, also called

accent d'insistance (cf. Delattre 1963; Dell, 1984; Post, 2000; Rossi, 1980, among others). In Jun and Fougeron's (2000) model, the location of this contrastive pitch accent in sentences with objective contrastive focus (A, not B) tends to be on the syllable bearing the initial accent (Hi) (e.g., *Le PROfesseur a la clé, pas l'étudiant.* 'The professor has the key, not the student'). The post-focal sequence in French, is deaccented (i.e., without other pitch accents) (Touati, 1987; Di Cristo, 1998; Clech-Darbon, Rebuschi & Rialland, 1997) but not but not dephrased (Jun & Fougeron, 2000).

Furthermore, contrastive accents in French tend to be accompanied by certain syntactic structures (e.g., *C'est le MAcaron que tu dois manger!* 'It's the macaron that you must eat,' with the capitalized syllable representing the accented syllable), where the contrast is signaled by both a left cleft in the sentence and a contrastive accent on *macaron* (i.e., it is the macaron that you must eat, not something else). It is also possible to say *Mange le MAcaron!* ('Eat the macaron!'), in which *macaron* bears a contrastive accent without clefting in the sentence (i.e., the constrative accent is the only feature in the sentence that marks contrastiveness; Féry, 2001). Finally, in a production study by Féry (2001) (discussed in more detail next), subjects were asked to respond to questions targeting a focused constituent in the response, while retaining the syntactic structure. Some participants changed the syntax to include clefting in the response even when the question did not have any clefting. This indicates that it may be more common for native speakers to use clefting to signal focus than accenting alone.

Féry (2001) proposes a model of focus in French under the assumption that French does not have lexical stress. Féry considers the final accent to be either a boundary tone or a mixed tone (half boundary tone, half pitch accent), and proposes that lengthening and tonal movements in French should be analyzed as suprasegmental correlates of phrasing. According to Féry

(2001), while the boundary tone is usually located at the right edge of the phonological phrase (what Jun & Fougeron called the Accentual Phrase), a narrow contrastive focus can be made with a high initial boundary tone. She proposes that there are three ways of achieving focus in French: Fronting (e.g., *Arnim, il a escaladé la montagne* 'Arnim, he has climbed the mountain'), clefting (e.g., *C'est Arnim qui a escaladé la montagne* 'It is Arnim who has climbed the mountain'), and special phrasing (e.g., *ARnim a escaladé la montagne*. 'ARnim has climbed the mountain'). What she calls 'special phrasing' is the prosodic focus investigated in this research.

In an experiment that tested the intonational realization of focus as answers to *wh*-questions by native speakers of French, Féry (2001) found that, barring a few exceptions, participants almost always retained the original syntactic structure of the question. For example, they provided a cleft answer to a cleft question (e.g., *Qui c'est qui caramélise les navets? C'est … qui caramélise les navets* 'Who is it who caramelizes the turnips? It is … who caramelizes the turnips'). In other words, the phrasing of the answers was influenced by the syntactic (focus) structure induced by the question. Results showed that the focused constituent was usually realized as a separate phonological phrase with its own tonal structure. For example, in (9), the verbal phrase was focused, and in (10) the subject was focused. The examples in (11) provide the different possible responses subjects gave.

(9) *Que fait le garcon?*

'What is the boy doing?'

[$_{PhP}$ Le garçon] [$_{PhP}$ peint le garage] [$_{PhP}$ en noir].

[$_{PhP}$ Le garçon] [$_{PhP}$ peint] [$_{PhP}$ le garage] [$_{PhP}$ en noir].

'The boy is painting the garage black'

(10) *Qui peint le garage en noir?*

'Who is painting the garage black?'

[PhP Le garçon] peint le garage en noir.

'The boy is painting the garage black'

(11) *Qui caramélise les navets?*

'Who caramelizes the turnips?'

H L

a. *[Le marmiton] caramélise les navets/les caramélise.*

'The cook caramelizes the turnips/ caramelizes them.'

H L

b. *[Le marmiton] les caramélise*.

H L H

c. *[Le marmiton] les caramélise*.

Féry (2001) also reports individual variability among the participants in the tonal structure they used. For example, in answering the question *Qui caramélise les navets?* ('Who caramelizes the turnips?'), of the people who produced the focused word *marmiton* in the special phrasing answer (e.g., 11), 6 produced it with HL where H was on the second syllable (11a), 3 produced it with HL where H was on the first syllable (11b), and 1 produced it with HLH (11c). Féry argues that the variability in tonal realization indicates that the contrastive accent is not a pitch accent, or else the definition of pitch accent should be less restrictive. Féry's conclusion is

that it is phrasing in French that signals focus, and not the contrastive accent itself. Furthermore, the results indicate that while clefting as a syntactic structure commonly accompanies accenting in focus, some participants do realize focus *in situ*, that is, without clefting or fronting. In such cases, there is a break both before and after the focused word and the post-focus part is dephrased (i.e., it is not a part of the phrasal structure) and is realized as a low/high and flat tone till the end of the sentence. For example, in (11b) and (11c), *les caramélise* ('caramelizes them') would be dephrased. Féry uses the term dephrased to describe strings of sentences without tonal realization and with no phonological phrase structure assigned to them.

Magne et al. (2005) further examined the processing of what they called "pop-out" (i.e., contrastively focused) words in French using the event-related potential (ERP) method. Their materials had two variables: expected contrastiveness of the answer, and the word bearing the focal (contrastive) accent. Crucially, contrastive focus in this study was examined using prosodic cues alone in the absence of syntactic cues. Items consisted of short dialogues composed of a question (e.g., *A-t-il donné une bague ou un bracelet à sa fiancée?* 'Did he give his fiancée a ring or a bracelet?' or *A-t-il donné une bague à sa fiancée ou à sa sœur?* 'Did he give a ring to his fiancée or his sister?') and an answer (e.g., *Il a donné une bague à sa fiancée.* 'He gave a ring to his fiancée'). For each answer, the question was manipulated to induce specific expectations about which word would be accented (*A-t-il donné une bague ou un bracelet à sa fiancée?*/ *A-t-il donné une bague à sa fiancée ou à sa sœur?*). In the first case, the contrastive accent would be expected to fall on the word 'ring', but in the second case, it would be expected to fall on the word 'fiancée'. The two conditions in which the expectation matched the actual location of the accent were felicitous, but two infelicitous conditions were created with a mismatch between the expectation and the actual location of the accent in the sentence.

Participants were asked to judge whether the intonation of the answer was coherent in response to the question in the dialogue (yes/no). ERPS were recorded as the participants heard the sentence. ERP recordings were time locked to the onset of the focal accent rather than the onset of the word for both word-medial and word-final positions. Incongruous patterns (i.e., inappropriate or missing accents) elicited a P300 effect on the medial word (e.g., *bague*), which was interpreted as a surprise effect (p. 751). In sentence-final words (e.g. *fiancée*), both types of incongruous patterns (i.e., inappropriate or missing accents) elicited a negativity resembling the N400 component, interpreted by the authors as potentially reflecting integration difficulties. One limitation of this study was that there was always a focal accent on either the medial word (e.g., *bague*) or the final word (e.g., *fiancée*). Thus, in the context of this study, participants may have come to expect a focal accent in each sentence. This study illustrates that listeners can be sensitive to discourse requirements for contrastive focus even in the absence of syntactic cues, and that they can use prosodic cues to discern new from given information.

In summary, the following can be said about French prosody: (i) nuclear pitch accents occur on the final syllable of the Accentual Phrase in non-utterance-final positions, therefore marking AP-final boundaries; (ii) there may be secondary prominence on the initial syllables of words—this prominence is marked by a pitch rise but it does not instantiate a pitch accent; (iii) French has a contrastive accent (*accent d'insistance*), which may or may not be instantiated with the secondary prominence identified in (ii) (cf. p.5, Féry, 2001 vs. p. 161, Di Cristo, 1999); (iv) the contrastive accent in French implies contrastive focus even in the absence of syntax, and native speakers are sensitive to discourse expectations of contrastive focus.

To our knowledge, relatively few studies have investigated the comprehension and production of prosodic focus in native or non-native French speakers. The present study fills this

gap by examining the processing and production of prosodic focus by native French speakers and L2 learners of French. The L1 of the L2 learners being English, it is important to note the differences between the two languages. The next chapter therefore describes the prosody of English and discusses the role of prosodic focus in English speech comprehension and production.

Chapter 4

Prosody and Focus in English

The prosody of English differs substantially from that of French. The domain of prominence in English is the word. Accented syllables are marked by an F0 rise, increased amplitude, and increased duration (e.g., Beckman, 1986). Statistically, words in English tend to be stressed on the initial syllable (e.g., Clopper, 2002; Cutler & Carter, 1987), and native English listeners use this tendency to identify word-initial boundaries in continuous speech (e.g., Cutler & Norris, 1988; McQueen, Norris & Cutler, 2004).

Spoken language has been proposed to be divided into a hierarchy of structures such that one structure is entirely contained within the next, as stipulated by the Strict Layer Hypothesis (McCarthy, 1986; Nespor & Vogel, 1986; Selkirk, 1984). In English, these constituents, going from largest to smallest, have been proposed to be the intonational phrase (IP), the intermediate phrase (iP), the phonological phrase (PhP) and the prosodic word (PWd). A higher structure called the "utterance" has also been postulated (Beckman & Pierrehumbert, 1986). Based on the Strict Layer Hypothesis, each intonational phrase (IP) must contain at least one intermediate phrase (iP) with a pitch accent. Beckman and Pierrehumbert (1986) give the example of an intonational phrase with one or two intermediate phrases in Figure 1.

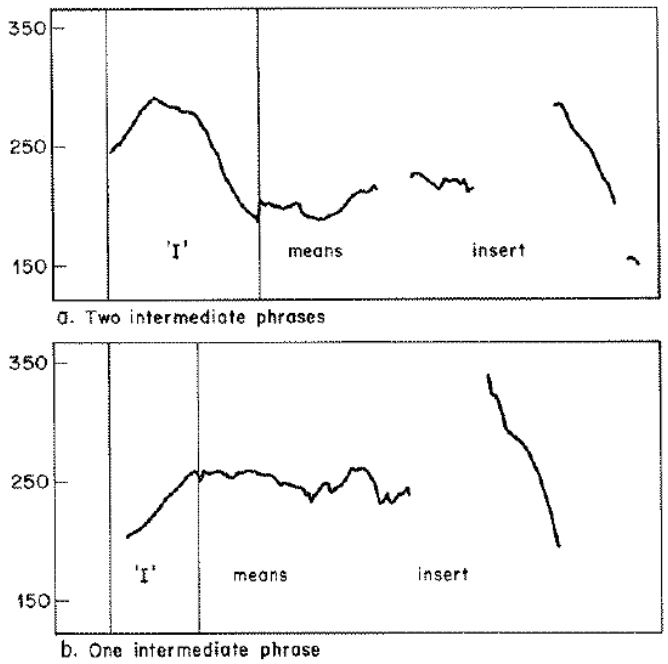

Figure 1. Intermediate phrases (Beckman & Pierrehumbert, 1986, p. 189)

The top panel of Figure 1 shows an utterance with an intermediate phrase break after 'I' and the bottom panel of the figure shows the utterance without a phrase break. Among these, the intermediate phrase is associated with a phrase accent, preceded by at least one pitch accent. The intonational phrase must have a boundary associated with a boundary tone. These boundaries are also realized with increased duration (Pierrehumbert, 1980). One intonational phrase can have several nuclear pitch accents associated with intermediate phrases. For example, the word *constitution* in English can be produced with two pitch accents—one on the first syllable and another on the third, as illustrated in example (12) from Beckman and Pierrehumbert (1986).

(12) *constitution*

H* H* L L%

Intonation in English is conveyed with the help of these pitch accents. The locus of the pitch accent in the word—that is, the syllable on which the starred tone of the accent can occur in the word—are lexically specified (Beckman & Pierrehumbert, 1986).

In comparison to French, there is little definitive evidence for the existence of an Accentual Phrase (AP) in English. Beckman and Pierrehumbert (1986) postulate the possible existence of an AP in English based on two criteria in the framework of Prince's (1983) and Halle and Vergnaud's (1985) version of metrical theory. The first is based on the fact that pitch accents constitute a local tonal prominence, explained under the above theories either as a designated terminal element of a prosodic domain (here, the potential AP) or by rhythmic alternation. Since rhythmic alternation does not explain the presence of a single strong element in a domain, pitch accents are better explained as designated terminal elements, which are compatible with a potential AP. The second criterion is the ease of production of longer strings of unaccented syllables utterance-finally rather than utterance-initially. For example, *constitutional amendment* can be produced with a nuclear pitch accent on the third syllable of *constitutional,* but not with a nuclear accent on *amendment* in the absence of a prenuclear accent on *constitutional*. In the first case, prenuclear syllables can be analyzed as a single extra-metrical stress foot at the level of the AP, but in the second case, there would be two stress feet without an accent, which is anomalous. Therefore, pitch accents in English may be compatible with the presence of an Accentual Phrase. However, according to the Strict Layer Hypothesis, any prosodic element (here, a potential AP) should be a grouping of immediately inferior elements (McCarthy, 1986; Nespor & Vogel, 1986; Selkirk, 1984). This is not evident for a postulated AP in English (i.e., a potential AP cannot be broken down into specific immediately inferior elements). Beckman and Pierrehumbert (1986) also state that it would not be clear whether the

AP should be interpreted as a grouping of stress feet or of prosodic words. Therefore, it cannot be said that English has an AP comparable to that of French.

In English, according to the ToBI system of notation (Beckman & Ayers, 1997), there are five types of pitch accents: H*, L*, L*+H, L+H*, and H+!H*. Of these, H* is a nuclear pitch accent and L+H* is a contrastive pitch accent. In (13), the word *mother* bears a nuclear pitch accent (H*) and the second instance of the word *Mary's* bears a contrastive pitch accent (L+H*).

(13) *Who's it for? Mary's mother. It's for Mary's mother.*

H* L+H*

According to Beckman and Ayers (1997), the two accents are similar in that they have high fundamental frequency targets timed to occur on the accented syllable. The actual timing of the F0 peak can also change depending on the length of the syllable and on neighboring tones for both accents. However, the difference between their realizations is the L tone: In the contrastive accent, the L tone is a fundamental frequency value low in the pitch range, not an L* pitch accent on the preceding syllable or an L– phrase accent or L% boundary tone at a preceding phrase boundary. The H* accent can have low tones surrounding it, such as the L* pitch accent.

At the level of the discourse, pitch accents are associated with newness and givenness of information (e.g., Bolinger, 1961, 1986; Chafe, 1974; Chafe & Li, 1976). Words bearing contrastive accents are perceived as signaling information contrastive to other information. L+H*, signaling contrast on a word, constrains the possibilities available for newness and givenness in the upcoming part of the sentence: L+H* is more likely to occur in a contrastive context, such as in the case of corrective focus on the word *Helsinki* in (14) (Gussenhoven, 2007,

example 23, p. 11). Furthermore, a contrastive accent highlights the existence of multiple referents, one of which is focused (Magne et al, 2005; Birch & Clifton, 1995).

(14) *A: The capital of Finland is OSlo.*

B: (NO.) The capital of Finland is HELsinki. .

L+H*

In this study, we will focus on the nuclear pitch accent and the contrastive pitch accent. Nuclear pitch accents tend to appear at the level of the iP. Contrastive accents can appear anywhere to focus a constituent, and the post-focus part is usually deaccented (i.e., without other pitch accents). This means that in English, pitch accents do not necessarily coincide with boundary tones. In this respect, English is different from French, as will be highlighted further below. Pitch accents in English tend to be associated with increased amplitude, duration, and hyper-articulation of the segments, and they are aligned with the lexically stressed syllable of a word in English (Beckman, 1986).

Several studies have examined the role of prosodic focus in language processing in English. In a sentence recognition study, Speer, Crowder, and Thomas (1993) conducted two experiments using sentences with different prosodic realizations. Experiment 1 included three types of sentences. The first type included "syntactic change" sentences such as the "boundary change" sentences in (15), the "pronoun antecedent change" sentences in (16), the "noun projection/verb projection" sentences in (17), and the "conjoined noun phrase" sentences in (18). In sentences (15) and (18), the pound sign (#) represents a prosodic break.

(15) *The dog may attack Gwen* vs. *The dog may attack #Gwen.*

(16) *The neighbor called your mother, and she called your dad* vs. *The neighbor called your mother and she called your dad.*

(17) *They are FRYING chickens* vs. *They are frying CHICKENS.*

(18) *Either Sam# or Susan and Lara# will come to babysit* vs. *Either Sam or Susan# and Lara # will come to babysit.*

The second type of sentences was "focus change" sentences in which exchanging prosodies created a subtler change in meaning, as illustrated in (19). In this example, the first sentence places emphasis on both the mother and father being called, while the second sentence places emphasis on the order in which they were called.

(19) *The neighbor called your mother, AND then called your dad.* vs *The neighbor called your mother and THEN called your dad.*

The third type of sentences was declarative sentences produced with interrogative prosody to form yes/no questions, as shown in (20).

(20) *Mary went to the movies with Peter?*

Participants were asked to choose the better paraphrase of two to best indicate what they thought the sentence meant. A difference score between hits and false alarms was created for each word for each sentence type. Results showed that listeners were sensitive to prosodic differences in "syntactic change" and "focus change" sentences, but there was a greater difference within the "syntactic change" sentence pairs (i.e., (15)) than within the "focus change" sentence pairs (i.e., (19)).

In Experiment 2, the authors studied whether prosody helped recognition memory for words. In the presentation phase, participants heard sentences similar to those in Experiment 1; after a brief delay, they were presented test sentences and were asked to write "old" if they had previously heard the words of the test sentence and "new" if the words were not exactly the same as those in the presentation sentences. They also gave a confidence rating for their answer. Match items had test and presentation sentences with identical words and prosody; foil items had the same prosody with different words; and mismatch items had the same words but a different prosody, as shown in example (20):

(20) Recognition list item:

They are FRYING chickens.

Presentation list items:

Match: *They are FRYING chickens.*

Mismatch: *They are frying CHICKENS.*

Foil: *They are COOKING apples.*

The results showed that recognition performance was better in the match conditions than in the mismatch and foil conditions.

Experiment 3 was like Experiment 2, but with prosodically structured nonsense strings instead of words. The results again showed that recognition performance was better in the match conditions than in the mismatch conditions, and was worst in the foil conditions. These results indicate that at least some part of prosodic structure is retained in memory independently of the words. The authors concluded that their findings were consistent with principle-based rather than exemplar-based theories of sentence processing, indicating that comprehension of auditory language begins with the recognition of rule-based structures. The authors suggest that current theories of sentence processing should include a prosodic component.

Birch and Garnsey (1995) define focus as the most important and emphasized constituent. That is, it is related to intonation, but linguistic information other than intonation can be used to convey focus, for example syntax (e.g., *It was Kim who caught the frisbee*, p. 234) or the use of certain words (e.g., Chafe & Li, 1976), like the word *this* in the example ... *in the back of where I lived my father knew this guy, 'n he had two sons...* (example from Wald, 1983, in Birch and Garnsey, 1995). Birch and Garnsey examined how focus affected memory for written words in sentences. They hypothesized that people might pay more attention to what is most salient for better comprehension. In their word recognition task, participants recognized words faster when the words had previously been focused. Even when a delay was introduced between the prime and the recognition test (a delay of on average 35 seconds), participants responded to identical targets more quickly. They responded to phonologically related targets with segmental overlap (e.g., *caucus-caution*) more slowly when the primes had been focused, but not when the primes had not been focused. Therefore, words seemed to be more activated after a delay if the

word had been focused. The authors concluded that the enhanced availability of focused words might contribute to comprehension by facilitating the process of integrating information during language comprehension.

In addition to facilitating recognition memory for words, prosodic information also contributes to sentence processing as a whole, as prosody interacts with syntax. Indeed, some aspects of prosody occur at the level of units larger than the word. These aspects play a role in sentence processing in a different way from word-level prosody. Schafer, Carter, Clifton, and Frazier (1996) tested two hypotheses. The first hypothesis was the Focus Attraction Hypothesis: "It is more likely that a phrase that is neither a complement nor syntactically obligatory will be taken to modify a phrase P if P is focused than if it is not, grammatical and pragmatic constraints permitting." (p. 136). The second hypothesis they tested was the Congruence Hypothesis: "A modifier marked as conveying new information preferentially is related to another phrase also marked as new (and a modifier marked as conveying given information is preferentially related to another phrase also marked as given." (p. 137)

Experiment 1 tested the predictions of the Focus Attraction Hypothesis by assessing the interpretations of sentences with complex noun phrases. The sentences were of the type *The detective eyed the entrance of/near the house that showed clear signs of damage.* In these sentences, focus was changed by placing a pitch accent either on *entrance* or *house*. Participants answered questions such as *What showed signs of damage?,* and the answers revealed their attachment preferences (i.e., high if the relative clause was interpreted as modifying the first noun, or low if the relative clause was interpreted as modifying the second noun). The authors found that pitch accents affected the choice of attachment to the focused noun in the direction predicted by Focus Attraction Hypothesis: Participants were more likely to have a low-

attachment preference if the second noun (e.g., *house*) was accented than if the first noun (e.g., *entrance*) was accented.

In order to examine whether the relative clause attachment preferences might be due to information status, they conducted Experiment 2 to test the effect of the information status of the relative clause. Sentences contained short relative clauses. One manipulation was whether the relative clause was prosodically accented (e.g., (21a) and (21b)) or not accented (e.g., (21c) and (21d)). The other manipulation was the number of referents in the context sentence. In sentences where there were multiple referents in the context sentence (e.g., (21a) and (21c)), the specific referent in the matrix clause of the critical sentence bore a contrastive accent. In sentences where the context sentence had only one referent (e.g., (21b) and (21d)), the referent in the matrix clause of the critical sentence was unaccented. In addition to relative clause prominence manipulation, the prominence of the nouns was also varied by accenting the first or second noun, with either an H* consistent with a new noun (Bartels & Kingston, 1994; Pierrehumbert & Hirschberg, 1990) or with a contrastive L+H* consistent with the noun having been mentioned previously in the discourse but being contrastive.

(21) a. *(Some guy at the Advocate is doing a series where he interviews the sisters of famous people.) The reporter recently interviewed the sister of the SENATOR who was so CONTROVERSIAL.*

b. *(The reporter didn't recently interview Al Gore's sister.) The reporter recently interviewed the sister of the senator who was so CONTROVERSIAL.*

c. *(Some guy at the Advocate is doing a series where he interviews the sisters of famous people who are controversial.) The reporter recently interviewed the sister of the SENATOR who was so controversial.*

d. *(The reporter didn't recently interview the sister of the nun who was so controversial.) The reporter recently interviewed the sister of the senator who was so controversial.*

According to the Focus Attraction Hypothesis, the relative clause, whether accented or unaccented, will be favored as modifying a focused phrase. Conversely, the Congruence Hypothesis predicts attachment of the relative clause according to informational congruence and not merely focus. Thus, an unaccented relative clause should not modify a phrase marked as 'new' but can modify a phrase with a contrastive accent, which is not inconsistent with a previously mentioned noun. On the other hand, an accented relative clause can modify the phrase marked as new but also the phrase bearing a contrastive accent.

Results showed that the second noun was chosen as the host of the relative clause more frequently when it was contrastively stressed (and the context contained multiple referents) than when it received an H* accent (and the context contained only one referent). The second noun was also chosen more frequently when the relative clause was (relatively) prosodically unaccented. The authors concluded the following: (i) focus attracts relative clause attachments; (ii) pitch accents for new and given information differ; (iii) the presence of a pitch accent on the relative clause is associated with the presence of a stronger prosodic boundary before the relative clause; and (iv) the presence of a prosodic boundary before the relative clause biases listeners towards high attachment.

Ito and Speer (2008) further studied the processing of pitch accents by native English listeners. The authors used eye tracking to investigate how English listeners use the contrastive accent (L+H*) in speech comprehension. Participants completed a holiday tree decoration task in which their eye movements were recorded as the participants heard instructions and decorated a holiday tree with specified ornaments from a grid. Experiment 1 tested felicitous and infelicitous uses of L+H* on nouns and adjectives in sentences such as (22a) and (22b). The researchers predicted a rapid anticipatory effect of the adjective's intonational prominence on the listener's selection of a candidate noun: Hearing the color adjective with an L+H* accent should, in addition to assigning contrastive status to the color itself, increase listeners' expectations that the most recently mentioned target noun will be repeated in the current utterance. Therefore, fixations to the target ornament should be speeded when the L+H* accent is felicitous but not when it is infelicitous.

(22) a. *Hang the green ball. Now, hang the BLUE ball.*

b. *Hang the green ball. Now, hang the blue BALL.*

Results showed that a contrastive accent led to earlier target fixations only when it was felicitous (i.e., when it was on the contrastive adjective).

To ensure that the results of Experiment 1 were not due to processing difficulties arising from the infelicitous L+H*, Experiment 2 compared the felicitous use of the contrastive accent in sentence like (22a) to a neutral condition that did not contain a contrastive accent in sentences such as (23a), with H* on the adjective and a downstepped !H* on the following noun (where ! indicates contextually triggered lowering of the tone; Beckman & Ayers, 1997). This experiment

also compared the use of the contrastive accent on the adjective with a given (repeated) noun (correct) or a new noun (misleading) (23b) to test whether there would be an anticipatory garden-path effect. These sentences were compared to neutral sentences of the same type (23c).

(23) a. *Hang the green ball. Now hang the blue ball.*

b. *Hang the red angel. Now hang the BLUE drum.*

c. *Hang the red angel. Now hang the blue drum.*

The (22a) to (23a) comparison showed that listeners looked at the previously mentioned ornament noun earlier in the presence of the contrastive accent (22a) than in the neutral condition (23a). The comparison of the infelicitous contrastive accent (23b) to its neutral condition (23c) showed that the presence of the contrastive accent misled listeners, causing them to look at the previously mentioned ornament noun (e.g., *angel*), thus delaying target fixations. Results also showed that both felicitous (22a) and infelicitous L+H* (23b) on the contrastive adjective led to strong anticipation for the previously mentioned ornament noun (e.g., *ball*), confirming the facilitating effect of felicitous L+H* on contrastive adjectives. The authors concluded from Experiments 1-2 that the contrastive accent does evoke contrast and constrains alternatives in the upcoming part of the sentence. This is consistent with findings that people use prosodic information in real-time processing before lexical information is confirmed, suggesting that pitch accents are taken into account to generate expected referents.

Lee and Watson (2011) further investigated the interpretation of relative-clause attachment sentences similar to those of Schafer et al. (1996) with the goal of establishing which of two hypotheses would be more likely: The Syntax Hypothesis, where there is a preference for

attachment of relative clauses to new/important information based on the assumption that the information status of a word directly serves as a signal to syntax; or the Salience Hypothesis, in which there is a bias to respond with the salient constituents in post-sentence analysis, due to the fact that accented words signaling focus are more prominent because of their acoustic features, such as lengthening, better-articulated content, and greater intensity. Thus, according to the Syntax Hypothesis, attaching a relative clause to a focused constituent is due the fact that new or important information tends to be modified syntactically, whereas according to the Salience Hypothesis, accented attachment sites are more salient, resulting in attachment to those sites, and not because the accent signals new information. There are two versions of the Salience Hypothesis: In one version, relative clauses are attached to the most salient referent by a syntactic mechanism; in the other version, the relative clause attachment is due to a post-sentence selection process. Both versions differ from the Syntax Hypothesis in that attachment of a relative clause to a focused referent is due to the acoustic salience of the referent and not to new/important information.

Experiment 1 was a replication of Schafer et al. (1996). Four conditions were created using sentences such as (24).

(24) *The detective eyed the entrance of the house that showed clear signs of damage.*

The baseline was a no accent condition with no pitch accent on either of the critical nouns. The early accent condition had a pitch accent on *entrance*; the late accent condition had a pitch accent on *house*; and the two-accent condition had pitch accents on both *entrance* and *house*. The first accented noun had an L+H* pitch accent while the second accented noun (in the two-accent

condition) had a downstepped !H* accent. Participants heard the sentences and were asked a question probing for high or low attachment: *What showed clear signs of damage?* The results showed that the participants had a preference for the accented critical noun as the head of the relative clause. While this experiment did not directly test the two hypotheses, it showed that the presence of a pitch accent led to an increased likelihood of the focused noun being selected when compared to the baseline condition.

Complex sentences are more difficult to process. Since complex sentences contain more information and more referents, words bearing pitch accents may stand out more, and the parser might rely on this salience (or other such factors) due to limitations on resources overall. Therefore, selection of a complex referent should point to an effect of salience rather than information status. In Experiment 2, Lee and Watson (2011) examined the Syntax and Salience Hypotheses by varying relative clause complexity and accent. In sentences such as (25), the relative clause complexity combined with the position of the accent on *son* or *lady* gave rise to four conditions: complex relative clause + early accent (25a), complex relative clause + late accent (25b), simple relative clause + early accent (25c), and simple relative clause + late accent (25d). Relative clause complexity was manipulated by changing the length of the relative clause (longer clauses are more complex) and the extraction type (object-extracted relative clauses are more complex than subject-extracted relative clauses).

(25) a. *Brandon interviewed the SON of the lady who the man worked with for 5 years in Germany.*

b. *Brandon interviewed the son of the LADY who the man worked with for 5 years in Germany.*

c. *Brandon interviewed the SON of the lady who worked with the man.*

d. *Brandon interviewed the son of the LADY who worked with the man.*

Using the same procedure as in Experiment 1, the authors found that accenting influenced listeners more with a long and object-extracted relative clause than with a short and subject-extracted one, indicating that complexity of sentence structure influences sensitivity to accents, as predicted by the Salience Hypothesis.

Due to the simultaneous manipulation of relative clause length and extraction type in Experiment 2, the effects of relative clause length and extraction type could not be teased apart, so they were manipulated separately in Experiment 3. Experiments 3a and 3b of Lee and Watson (2011) examined individual contributions of relative clause length and extraction type by independently manipulating them. The authors found that only the length of the relative clause affected the effect of accent. These results are consistent with post-sentence selection bias, because longer sentences are also more complex, causing participants to rely more heavily on salient information.

Finally, Experiment 4 tested the possibility of post-sentence selection bias using sentences similar to those in Experiment 2, but with post-sentence questions asking either about relative clause attachment (sensitive to accents) or the content of the matrix clause (which should not depend on accents unless there is a post-sentence selection bias for focused constituents). Participants were presented sentences similar to those in Experiment 2 (e.g., *Brandon interviewed the son of the lady who worked with the man*). Post-sentence questions were manipulated to ask either about the relative clause (e.g., *Who worked with the man?*) or the matrix clause (e.g., *Who did Brandon interview?*). The authors found a strong bias to answer the

post-sentence question with the focused constituent, even when the answer to the question was unambiguous. Thus, Lee and Watson (2011) concluded that there may be a post-sentence selection bias for focused constituents rather than a parsing mechanism that uses focused constituents to resolve ambiguities.

To summarize, the existing research on focus comprehension in English indicates that listeners are sensitive to pitch accents in English and that the contrastive pitch accent is acoustically salient and used in speech comprehension. Furthermore, the contrastive pitch accent has specific discourse implications for speech comprehension, in that native speakers understand the contrastive pitch accent to imply a contrast due to the presence of multiple referents in the discourse.

Several studies have also examined whether speakers convey the information status of discourse referents with pitch accents in speech production. In a study by Ito, Speer, and Beckman (2004), participants completed a task in pairs in which they decorated Christmas trees. The participants produced instruction sentences in which they asked their partner to hang ornaments on a tree. Target words included nouns (ornaments) and adjectives (colors). Items were considered given if mentioned consecutively. For example, when the participant mentioned an ornament for the first time and did so only once (thus giving new information not intended to be contrastive), the participant might produce a nuclear pitch accent on both the adjective and the noun, as shown in the bolded sentence in (26a); however, when the participant mentioned the same ornament in two different colors (thus contrasting the colors), the participant may produce the adjective with a contrastive accent the second time the adjective is produced, but possibly also the first time, as shown in the bolded sentences in (26b) (examples from Ito, Speer, & Beckman, 2004, p. 280).

(26) a. *Director: At the very top there's a white hat.*

Decorator: [shows] That one?

Director: Yeah

Decorator: All right. [places] Okay. next?

Director: ***Next, a blue(H*) house (H*).***

b. *Director: Uh, it's gonna start on the left.*

Decorator: [places on tree] There we go. Okay. Next.

Director: ***Uh, blue(L+H*) bell(!H*).***

Decorator: [shows through window]

Director: Yeah.

Decorator: [places on tree] Okay.

Director: ***Uh, this is an orange (L+H*) bell ().***

Rather than showing a strict correspondence between accents and givenness, the results suggest that the relationship between accents and givenness is more nuanced. For example, Ito, Speer, and Beckman (2004) found evidence that that word position influenced whether or not a word was accented: Adjectives were accented whether they were new or given (80%), whereas new nouns were produced with an accent (83%) more often than given nouns (58%). Furthermore, given nouns were even less likely to have an accent if they were preceded by new adjectives than by given adjectives. Both new and given adjectives carried the contrastive L+H* accent in contrastive contexts more often than new nouns did, and given nouns did not have the L+H* accent at all (however, the authors advise caution in interpreting the lack of an accent on

given nouns as there were only two such trials). The results of this study indicate that while the nature of information (new/given) is important in deciding whether a word bears an accent, other factors may play a role too (see also Beckman & Ayers, 1997; Hirschberg, 1991; Hirschberg & Pierrehumbert, 1986; Nakatani, 1997; Nakatani, Hirschberg & Grosz, 1995).

In summary, the following can be said of English prosody: (i) prominence in English is specified by discourse information, but the location of accents within the word is primarily lexically specified; (ii) nuclear pitch accents (H*) occur on the final word of the Intermediate Phrase, and there may be several of these in one Intonational Phrase; (iii) contrast is expressed by a L+H* tone on the word being contrasted; and (iv) contrastive accents in English highlight the contrast between two referents, and also constrain the possibilities of information further in the sentence.

Given the nature of pitch accents in French and English, and given previous research on the role of these accents in speech comprehension and production, the next chapter discusses what English speakers must learn in order to successfully interpret and produce pitch accents in French.

Chapter 5

From English Prosody to French Prosody

This chapter highlights the differences between prosodic focus in French and in English and defines the problem that English speakers face when learning prosodic focus in French. It then provides an overview of the production and comprehension experiments that native French speakers and English-speaking L2 learners of French completed, and it formulates predictions based on the reviews presented in Chapters 3-4.

Given the observed differences between French and English, English speakers must learn these differences in order to accurately process and produce prosody, in particular focus, in French. These speakers must learn that French prosody works differently from English prosody. More specifically, they must learn that prominence in French is not lexical (unlike that of English), but phrasal and always on the final syllable of the Accentual Phrase (AP), marked by a nuclear pitch accent. Additionally, English speakers must learn that a pitch accent in French that is not at the end of the AP usually marks a contrastive accent. Importantly, the respective locations of contrastive and nuclear pitch accents within the word and the sentence are also different, with the high tone of the contrastive accent in French typically falling on the first syllable of the focused word but with the high tone of the nuclear accent falling on the last syllable of the accented word.

Although contrastive accents have similar discourse entailments in French and in English, these accents are realized differently in the two languages. In French, the contrastive pitch accent differs from the nuclear pitch accent in the location of the accented syllable in the word (initial vs. last syllable, respectively) as well as in the absolute acoustic parameters that signal the accent, such as greater F0, duration, and intensity on the first syllable of the contrastive pitch

accent (Astésano, Magne, et al., 2004; Astésano, 2001; Lacheret-Dujour & Beaugendre, 1999; Di Cristo,1998; Pasdeloup, 1990; Séguinot, 1976). English speakers must learn the mapping between the forms of the contrastive accent and the nuclear accent in French and their respective meanings in the discourse. If L2 learners are able to successfully map the forms of these accents in French to their discourse meanings, they should produce the accents where the context requires it.

However, as Kaan (2014) explains, when processing sentences, L2 learners do not anticipate upcoming words as much as native speakers do (i.e., they do not make predictive use of linguistic information), even though they may demonstrate knowledge of this information in offline asks (e.g., Dussias, Valdés Kroff, Guzzardo Tamargo & Gerfen, 2013; Grüter, Lew-Williams & Fernald, 2012; Grüter & Rohde, 2013; Hopp, 2013; Lew-Williams & Fernald, 2010; Martin et al., 2013). According to Kaan (2014), this lack of anticipatory behavior does not imply a qualitative difference between native and non-native linguistic representations, but rather a quantitative one due to factors such as differences in competing information, frequency biases, task effects, resource deficits, and so on, all of which may inhibit predictive processing even when comprehension is not lacking. Thus, learners may not be able to use information predictively in sentence processing even if they are ultimately sensitive to it.

A second reason why it may prove difficult for L2 learners to use prosodic cues to focus in French speech comprehension is contrastive accents in French can also be signaled by syntax. It is unclear how much exposure L2 learners receive to contrastive accents that occur without syntactic focus (as opposed to environments in which contrastive accents co-occur with syntactic information such as clefting). Corpus studies could not be found on relative frequencies of prosodic focus with and without syntactic focus. However, the results of Féry's (2001) study

suggest that prosodic focus can exist without syntactic focus. Given the limited research on this topic, the frequency with which focus is signaled by both syntax and prosody vs. by prosody alone, and how this input may impact the processing of prosodic focus is unclear.

The present study focuses on French learners who have received the majority of their French input in a classroom setting. Prosody is typically not the object of explicit instruction in French language classes. Instruction on phonetics or pronunciation tends to focus largely on segmental information and possibly some aspects of prosody that interact with segmental information (e.g., the fact that unaccented vowels in French are not reduced as compared to their English counterparts, that stress falls on the last syllable of the last word of the phrase, and so on). This instruction does not usually include aspects of suprasegmental prosodic information such as how prosody signals focus in French. Therefore, learners tend not to be explicitly aware of the existence of the contrastive accent in French and its signaling of focus. Whether and how learners can learn and use prosodic focus in sentence processing and production is thus worthy of investigation.

Given the differences between French and English, this research examines whether L2 learners of French who are native speakers of English can, in the absence of explicit instruction on prosodic focus, learn the correct mapping between the form of prosodic focus in French and what it entails at the discourse level, both in speech processing and in speech production. Importantly, this research will examine whether L2 learners' mapping between the form and meaning of pitch accents is qualitatively different from that of native speakers.

Experiments 1a and 1b examine the comprehension of prosodic focus in French by native French listeners and English-speaking L2 learners of French (respectively). Experiment 1a examines whether native metropolitan French speakers, like native English speakers in previous

research, use pitch accents in online sentence comprehension, specifically whether they anticipate referents in the sentence based on pitch accents. Experiment 1b examines whether English-speaking L2 learners of French can infer the correct mapping between the form of pitch accents and their meaning in the discourse in French, and use this information to anticipate upcoming referents in the sentence. French language proficiency is analyzed alongside the results of Experiment 1b to investigate its potential influence on the processing of pitch accents in French.

Experiments 2a and 2b examine the production of prosodic focus in French by native French speakers and English-speaking L2 learners of French (respectively). Experiment 2a examines whether native metropolitan French speakers produce a nuclear or a contrastive pitch accent in non-contrastive vs. contrastive contexts. Experiment 2b examines whether L2 learners can map the form of the nuclear and contrastive accent to its respective discourse meanings, and produce the contrastive pitch accent where the discourse demands it. As with Experiment 1b, French language proficiency is analyzed alongside the results of Experiment 2b to investigate its potential influence on the production of pitch accents in French.

Ultimately, these experiments will shed some light whether or not native French speakers and English-speaking L2 learners of French process and produce prosodic focus in a qualitatively similar manner, despite L2 learners not receiving explicit instruction on prosodic focus in French language classes.

Chapter 6

Native Speakers' Processing of Focus in French

Experiments 1a and 1b were carried out to examine the use of pitch accents in online sentence comprehension by native speakers, and to further examine whether L2 learners are able to map the form of the accents to their meaning in the discourse similarly to native speakers. Experiment 1a is a visual-world eye-tracking experiment which aims to study native speakers' processing of focus in French through the differential use of the nuclear pitch accent and contrastive accent in processing French sentences.

6.1 Participants

Participants were 20 native speakers of French tested at the Laboratoire de Psychologie et Neurocognition, Université Pierre Mendes France in Grenoble, France.[1] They were all undergraduate students of psychology and completed the experiment for course credit. All native speakers completed a language background questionnaire providing information about their age, other languages they speak, their dialect of French, and the dialect(s) of French and other languages spoken by their parents in the home. Only those participants who spoke no other language but French before five years of age and continued to speak it as their dominant language into adulthood were included in the data presented here. Table 1 shows the native speakers' mean age and percent weekly use of French.

[1] Out of 30 participants tested, 9 had to be excluded because their eye movements were not successfully recorded or they did not finish the experiment. One additional participant was removed randomly from one list in order to have the same number of participants in each of the four lists.

Table 1. Language background information of native-speaking participants in Experiment 1a

	Age	% Weekly Use of French
Mean	20	84.8
SD	1.1	13.9
Min	19	20
Max	22	100

6.2 Materials

Materials in this experiment consisted of French sentences of the type *Clique sur le macaron de Marie-Hélène* ('Click on the macaron of Marie-Hélène'). Each critical trial had two sentences: the context sentence, which established the context for information status, and the experimental sentence, which had one of two different types of pitch accents. Each sentence contained an object noun and a person noun.

The experiment had a 2 x 2 design: The two factors in the experiment were the information status of the person noun (given vs. new, i.e., whether the person was the same vs. different in the context and experimental sentences), and the type of accent on the object noun (i.e., nuclear vs. contrastive). The information status of the person was manipulated by the context (i.e., the person was the same (given) or different (new) in the context and experimental sentences). The information status of the person being new or given in each item was always in relation to the object that belonged to them: If an object-person combination in the critical sentence contained the same person both times, the person was considered given; if the object-person combination to be produced had a different person in the critical sentence as compared to the context sentence, the person was considered new. The accent type was manipulated in the speech signal, with its location being on the object noun. The four conditions resulting from this

manipulation are shown in Table 2. Experimental sentences with a contrastive pitch accent are considered "felicitous" in the given person condition but "infelicitous" in the new person condition (a priori, there is no reason to contrast the new object if the person it belongs to is different).

Table 2. Experiment 1 conditions

	Condition	Context sentence	Experimental sentence
1	Contrastive pitch accent + given person	*Clique sur le macaron de Marie-Hélène.*	*Puis, clique sur le CHO$_{(H)}$coLAT$_{(H*)}$ de Marie-Hélène.*
2	Nuclear pitch accent + given person	*Clique sur le macaron de Marie-Hélène.*	*Puis, clique sur le chocoLAT$_{(H*)}$ de Marie-Hélène.*
3	Contrastive pitch accent + new person	*Clique sur le macaron de Jean-Sébastien.*	*Puis, clique sur le CHO$_{(H)}$coLAT$_{(H*)}$ de Marie-Hélène.*
4	Nuclear pitch accent + new person	*Clique sur le macaron de Jean-Sébastien.*	*Puis, clique sur le chocoLAT$_{(H*)}$ de Marie-Hélène.*
	English gloss	'Click on the macaron of Marie-Hélène/Jean-Sébastien.'	'Now click on the chocolate of Marie-Hélène.'

All stress-bearing AP-final words were carefully chosen to be trisyllabic in order to avoid having two accent-bearing syllables next to each other. In other words, the contrastive accent could not be misinterpreted as being a regular pitch accent because it was always two syllables before the AP-boundary. The stress-bearing nouns (e.g., *macaron* 'macaron,' *chocolat* 'chocolate') were frequently occurring trisyllabic words that were always plausible objects possessed by the person in the sentence (either *Marie-Hélène* or *Jean-Sébastien*). One person was female (*Marie-Hélène*) and the other was male (*Jean-Sébastien*) so that participants would always know the person's name while looking at their picture. The object words were also

carefully chosen such that a particular gender would not be perceived as being more likely to have that object.

Each object (e.g., *macaron, chocolat*) was balanced in the number of times and contexts in which it appeared. Thus, for the sentence *Clique sur le macaron de Marie-Hélène*, for which the object in the new object conditions was *chocolat,* there was a sentence *Clique sur le chocolat de Marie-Hélène* for which the object in the new object conditions was *macaron*. Four lists were created from the above 4 conditions, with each item counterbalanced across the four lists, with a total of 96 experimental items per list. An equal number of filler sentences were added to balance the information status of the object noun. The items were exactly counterbalanced for the object noun and the accent type, but not for the person noun in order to keep the experiment length reasonable.[2] Each participant saw 192 items (384 sentences) in total, and no two participants ever saw the same experimental item in the same condition. Ninety-six additional fillers were added to each list to distract the participants from noticing the experimental conditions of interest. These fillers consisted of similar sentences with unaccented disyllabic and quadrisyllabic objects and the same people as in the experimental sentences. The filler sentences had nuclear and contrastive pitch accents on the person instead of on the object. A complete list of the test items in Experiment 1 can be found in Appendix A.

All stimuli were recorded in a sound proof booth by a female native speaker of French from Bordeaux, France. The spectrograms in Figures 2a and 2b illustrate the two types of accents that participants heard for the stimuli in Table 2.

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[2] Even though each person noun always appeared with certain object nouns in the context condition, and not with other object nouns, this should not influence how the participants interpreted the experimental sentence, as all of the object-person combinations were balanced in all conditions. The spacing of experimental items and filler items also minimized the possibility that participants would notice such a trend, and in the event of that happening, it would not inform their expectations of the upcoming referent.

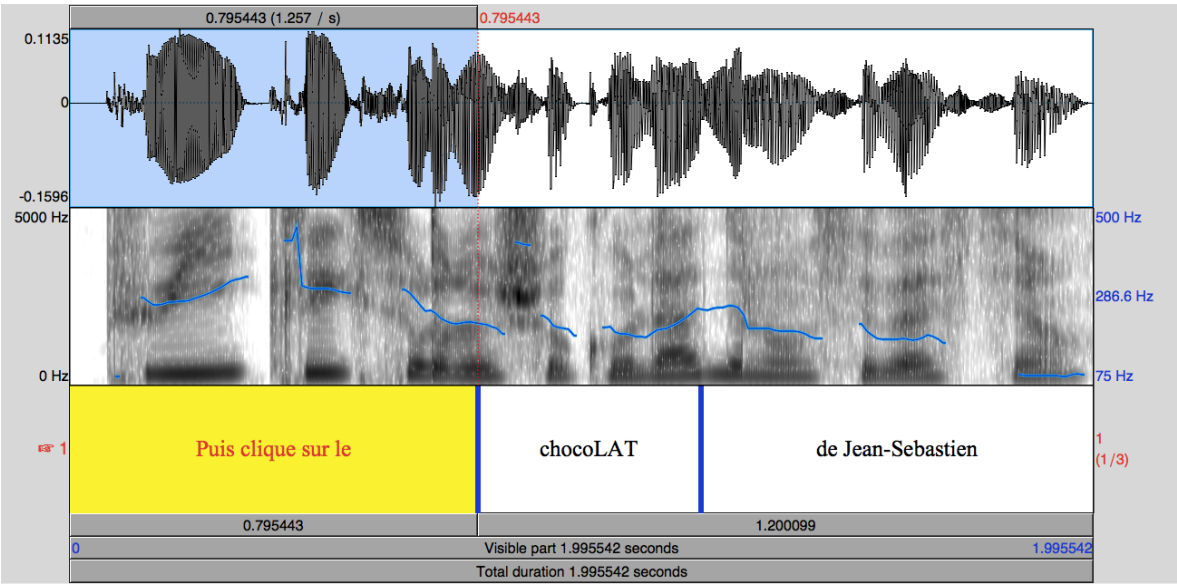

Figure 2a. Nuclear pitch accent

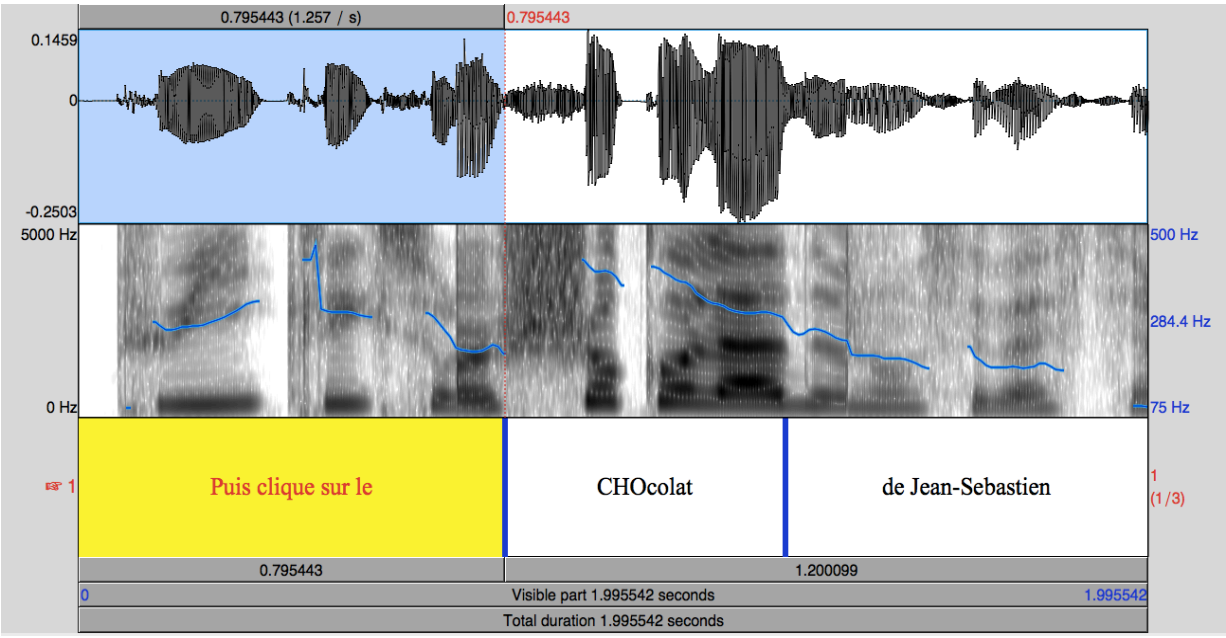

Figure 2b. Contrastive pitch accent

In Figure 2a, the accent on the final syllable of *chocoLAT* is a nuclear pitch accent, as it is realized on the final syllable of the Accentual Phrase (AP), demarcating a prosodic boundary. In Figure 2b, on the other hand, the accent on the first syllable of *CHOcolat* is also contrastive pitch accent, in that it is realized on the first syllable of the focused noun and has overall higher F0, longer duration, and higher intensity than the nuclear pitch accent. In this case, the word-final syllable (which was also always the AP-final syllable) still has its phrase-final lengthening because of the AP-final boundary.

The experimental sentences were created by cross splicing them. All sentences were of the type *Puis clique sur* + article + object noun+ *de* + person noun. The article, object noun, and *de* were extracted from one recording and cross spliced with *Puis clique sur* and with the person noun to create the experimental sentence. This was done to preserve prosodic boundary information for both boundaries surrounding the object. Thus, *puis clique sur* was identical across all items, and the person nouns (*Marie-Hélène* and *Jean-Sébastien*) were identical across all experimental items that had those person nouns.

The object nouns were analyzed acoustically using Praat (Boersma & Weenink, 2015). Each object noun was segmented using textgrids. Praat scripts were then used to extract the average duration (milliseconds) and amplitude (decibels) and the pitch contour of the objects (Hertz). For the pitch contours, each object noun was divided into 10 time intervals, and the mean pitch of each of these intervals was extracted. Table 3 gives the mean values of duration, amplitude and pitch for the object noun in each condition. Figure 3a shows the pitch contour for the objects in the nuclear pitch accent conditions. Figure 3b shows the pitch contour for the objects in the contrastive pitch accent conditions.

Table 3. Acoustic measurements for object noun in Experiment 1: mean (standard deviation)

	Duration (ms)	Amplitude (db)	Pitch (Hz)
Nuclear accent conditions	555 (46)	63.86 (1.5)	218 (13)
Contrastive accent conditions	677 (92)	66.98 (0.83)	276 (23)

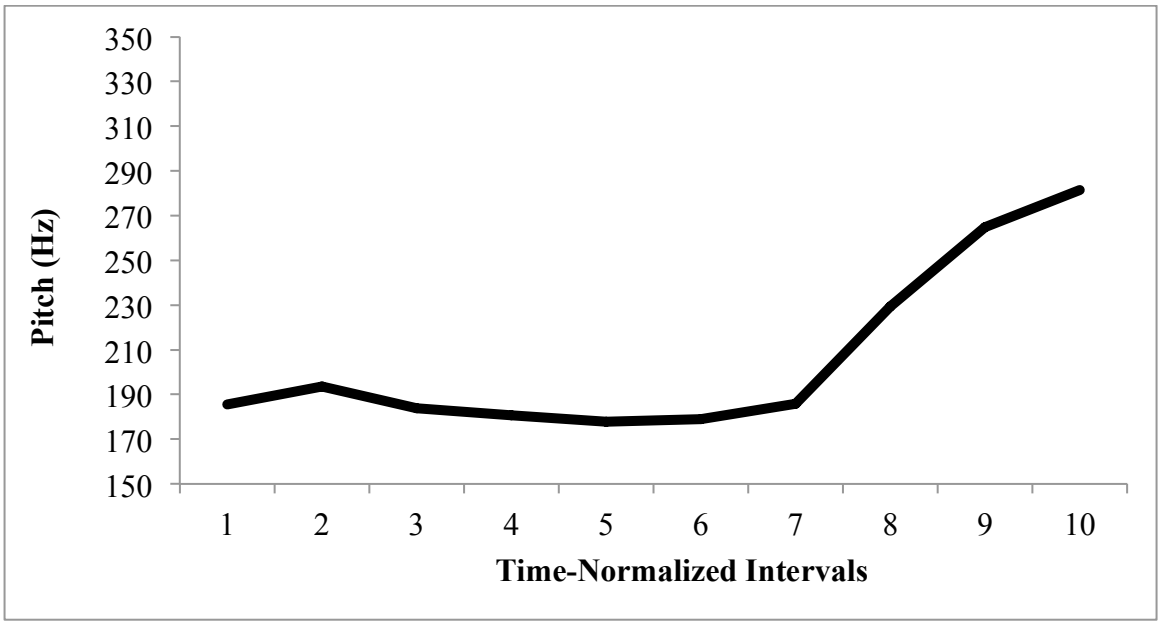

Figure 3a. Pitch contour of stimulus object in the nuclear accent conditions

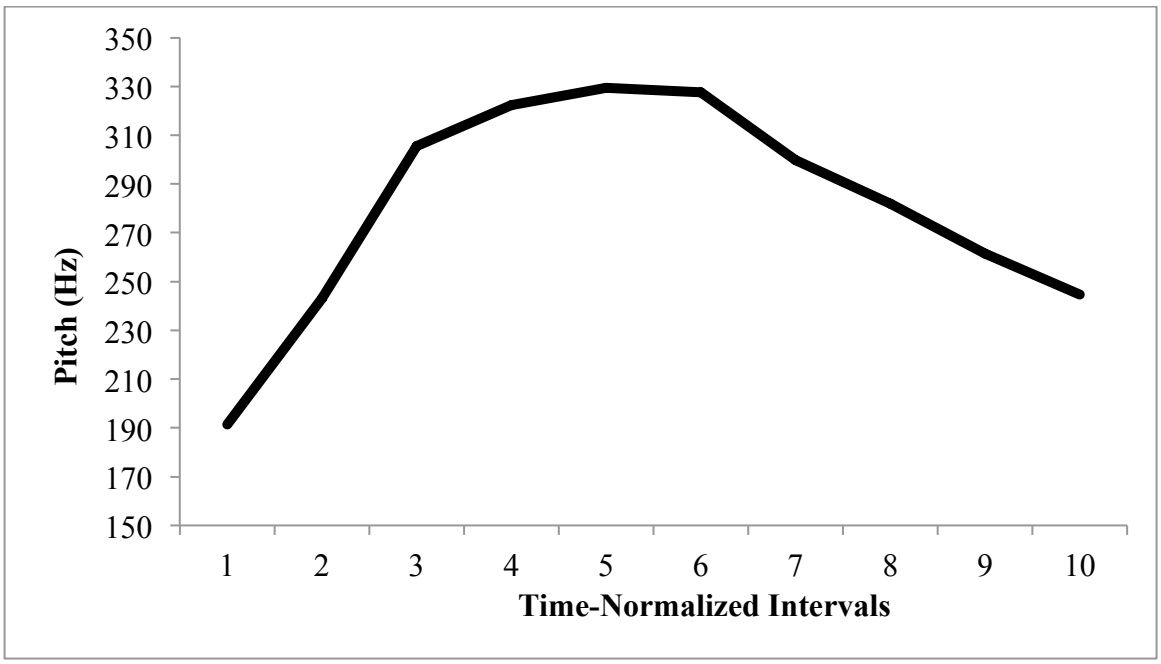

Figure 3b. Pitch contour of stimulus object in the contrastive accent conditions

Recall that the experimental and filler items each consisted of two sentences: the context sentence and the experimental sentence. The pictures displayed for both sentences within the same item remained the same. The experimental sentence was distinguished from the context sentence with the discourse marker *Puis* ('then') at the beginning of the sentence. Participants were unaware that only the latter was the experimental sentence, but the use of the discourse marker told them that there was continuity of context between the first and second sentences of the item. This was done to avoid the possibility of participants interpreting the experimental sentence as being independent of the preceding sentence.

During the experiment, participants saw four images: one target, one competitor, and two distractor images. The images for the sentences presented in Table 2 are shown in Figure 4. For example, for the sentence *Clique sur le chocolat de Marie-Hélène*, the four images are: Marie-Hélène with a chocolate (target), Jean-Sébastien with a chocolate (competitor), Marie-Hélène

with a macaron (distractor 1), and Jean-Sébastien with a macaron (distractor 2). The image of the target object with the competitor person is considered the competitor image because while the participants are hearing the object, there is still competition between the two people (i.e., at that point in time, the person has not yet been heard). The same two people were used throughout the experiment. The same person appearing in both sentences was considered as the "given" condition and different people appearing in the two sentences was considered as the "new" condition. The information status of the person being new or given in each item was thus always in relation to the object that belonged to them: If an object-person combination to be produced in the critical sentence contained the same person both times, the person was considered given; if the object-person combination to be produced had a different person in the critical sentence as compared to the context sentence, the person was considered new. Both people, were, however, always present in every display of every item.

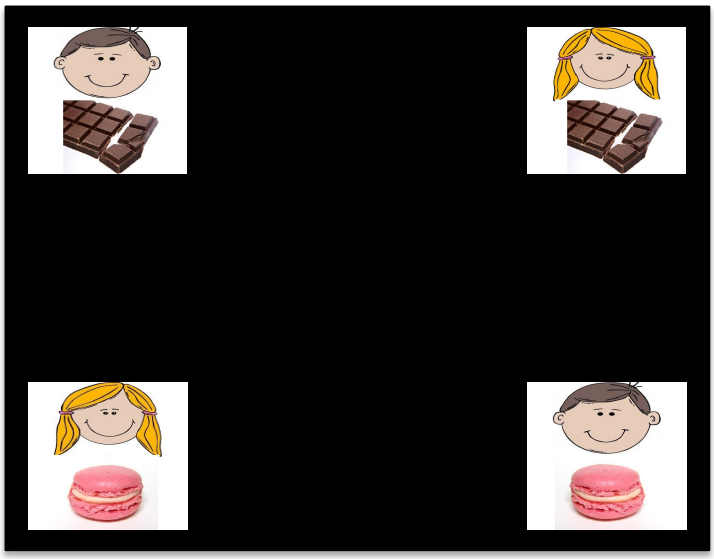

Figure 4. Example of eye-tracking display

6.3 Procedures

The visual-world eye-tracking experiment was built using Experiment Builder Software from SR Research and administered with a portable desktop-mounted Eyelink 1000 eye-tracker. This computer was also equipped with an ASIO-compatible sound card to ensure accuracy of audio timing. The audio was presented using noise-cancelling headphones to avoid any outside sound interference. A chin rest was provided for the participants to rest their chin on in order to minimize head movements.

The experiment was administered in a quiet isolated booth in a laboratory to ensure least interference from outside sound. The experiment consisted of four blocks: a practice block of 4 items (8 sentences) and three experimental blocks of 64 items (128 sentences) each. The camera was calibrated before each block or whenever the researcher judged necessary it to do so (e.g., if the participant moved, if eye fixations drifted since the last calibration).

Participants first read the instructions. Then, the eye-tracker camera was calibrated. Participants were told not to move their head (on the chin rest) during the block once calibration had taken place. Participants then began the practice session. After the practice session, if there were no questions, the experiment began with recalibration after every block or when necessary and with a break of a few minutes between blocks to minimize fatigue. Native speakers completed this experiment in one session lasting approximately 50 minutes.

In each trial, participants saw four pictures on a non-displayed 2 x 2 grid for two seconds. Then, the pictures disappeared and a fixation cross appeared at the center of the screen for 500 milliseconds. After the fixation cross disappeared, the pictures reappeared and participants simultaneously heard the auditory stimulus for the context sentence. Participants then had to click on the picture that corresponded to the auditory stimulus. The context and experimental

sentences proceeded in the same manner. The inter-trial interval was 1,000 ms. The eye-tracking signal was sampled every millisecond.

6.4 Data Analysis and Predictions

For every millisecond of each trial, participants' eye movements were recorded for the right eye. Only the experimental items were included in the analyses. Items which received incorrect responses (i.e., where the participant clicked on the wrong image instead of the target image) or where eye movements could not be recorded by the camera were excluded from the analysis. Responses where the participant clicked on the competitor image were also considered incorrect and excluded, because it implied lack of attention to the person noun in word-final position (the competitor was always the image with the same object as the target image but with the other person). The proportions of fixations to each image were calculated as proportions of the sum of fixations to all four images (i.e., fixations outside the four interest areas that correspond to the four images were not included in this sum). Samples in which the sum of fixations to all four images was zero were thus not analyzed (there was nothing to analyze for these data). 19.2% of the native speaker data was excluded from the analyses for these reasons.

The eye fixation proportions were generated for all time bins up to 2,300 ms from the beginning of the sentence. Each bin was 10 ms long. For analysis, the data were divided into two separate time windows: the ambiguous time window, and the post-disambiguation time window. The ambiguous time window corresponded to the onset of the object and the preposition *de* (e.g., in the sentence *Puis clique sur le chocolat de Jean-Sébastien*, the ambiguous time window was *chocolat de*), and the post-disambiguation time window corresponded to the name of the person (e.g., in the sentence *Puis clique sur le chocolat de Jean-Sébastien*, the post-

disambiguation time window was *Jean-Sébastien*). The ambiguous time window was thus calculated as including all time bins from the onset of the object noun to the end of *de,* with a delay of 200 ms to account for the time it takes for eye movements to reflect speech processing (e.g., Matin, Shao, & Boff, 1993). Similarly, the post-disambiguation time windows included all time bins from the onset to the offset of the of the person noun, with the same delay of 200 ms. Since the sentences were created by cross-splicing the object and the person, the ambiguous time window was almost identical across stimuli except for the article, and the post-ambiguous time window was identical across all test items. Given that the object onsets were slightly different (owing to slight differences in the lengths of individual productions of the article), the time windows were calculated individually for each item in each condition. Note that the time window for the object was smaller in the nuclear pitch accent conditions as compared to that in contrastive pitch accent conditions. This is explained by the significant duration difference in the first syllables of the object in the two conditions.

The difference between target fixation proportions and competitor fixation proportions in the ambiguous and post-disambiguation time windows for each type of object (given, new) and each accent (nuclear, contrastive) were then analyzed with linear mixed-effects models using the lme4 package in R (Baayen, 2008). All models had: (i) the difference between the proportion of target fixations and the proportion of competitor fixations as the dependent variable; (ii) person, accent, and the person-accent interaction as the fixed effects; and (iii) participant and item as random variables. The fixed effects were added individually to the model and their effects on model fit were evaluated with model comparisons using the ANOVA function of R. Improvements in model fit were evaluated using –2 times the change in log-likelihood, which is distributed as χ^2 with degrees of freedom equal to the number of parameters added. The fixed

effects were kept in the model only if they improved the fit of the model. Person and accent were contrast coded, with the new person and the nuclear pitch accent being coded as –0.5 and the given person and contrastive accent coded as 0.5.

Native French listeners are predicted to process nouns that receive a contrastive accent as signaling a contrast between two referents in the discourse. This means that when hearing the sentences *Clique sur le macaron de Marie-Hélène. Puis clique sur le CHOcolat de Marie-Hélène.* ('Click on the macaron of Marie-Hélène. Now click on the chocolate of Marie-Hélène.'), where the word *CHOcolat* bears a contrastive accent, native French listeners should show larger proportions of target fixations and lower proportions of competitor fixations to Marie-Hélène than to Jean-Sébastien. However, it should be noted that the contrastive accent in French often co-occurs with syntactic cues to focus, and so focus is cued more reliably by both syntactic and prosodic cues than by prosodic cues alone. Thus, it is unclear whether native French listeners use contrastive accents to actively predict referents the way listeners do in English, that is, in the ambiguous time window. However, if native French listeners are sensitive to the meaning entailed by the contrastive accent, in the post-disambiguation time window, they should show some interference in processing a person type incompatible with the contrastive accent, in the form of lexical competition. Therefore, upon hearing *Clique sur le macaron de Marie-Hélène. Puis clique sur le CHOcolat de Jean-Sébastien.* ('Click on the macaron of Marie-Hélène. Now click on the chocolate of Jean-Sébastien.'), where the word *CHOcolat* bears a contrastive accent, French listeners should show greater lexical competition in the post-disambiguation window if what they ultimately hear is the new person rather than the given person.

The nuclear pitch accent in French, on the other hand, does not provide new information, as its location is decided by the sentence structure. Therefore, the nuclear accent provides cues to

prosodic (and syntactic) structure rather than specific expected referents. The absence of a nuclear pitch accent in AP-final location is not a cue in this experiment either, in the sense that its absence in this experiment always co-occurs with the presence of the contrastive accent. Given the fact that the nuclear accent does provide information about type of accent (in that it is not contrastive), it is predicted that native speakers should show an interaction between accent and person, but without the effect predicted for the contrastive pitch accent. In other words, listeners should have no cause to expect a given person to appear in the sentence after a nuclear pitch accent on the object noun.

6.5 Results

Figure 5a shows the proportions of fixations to the target and competitor in the two nuclear accent conditions. Figure 5b shows the proportions of fixations to the target and competitor in the two contrastive accent conditions.

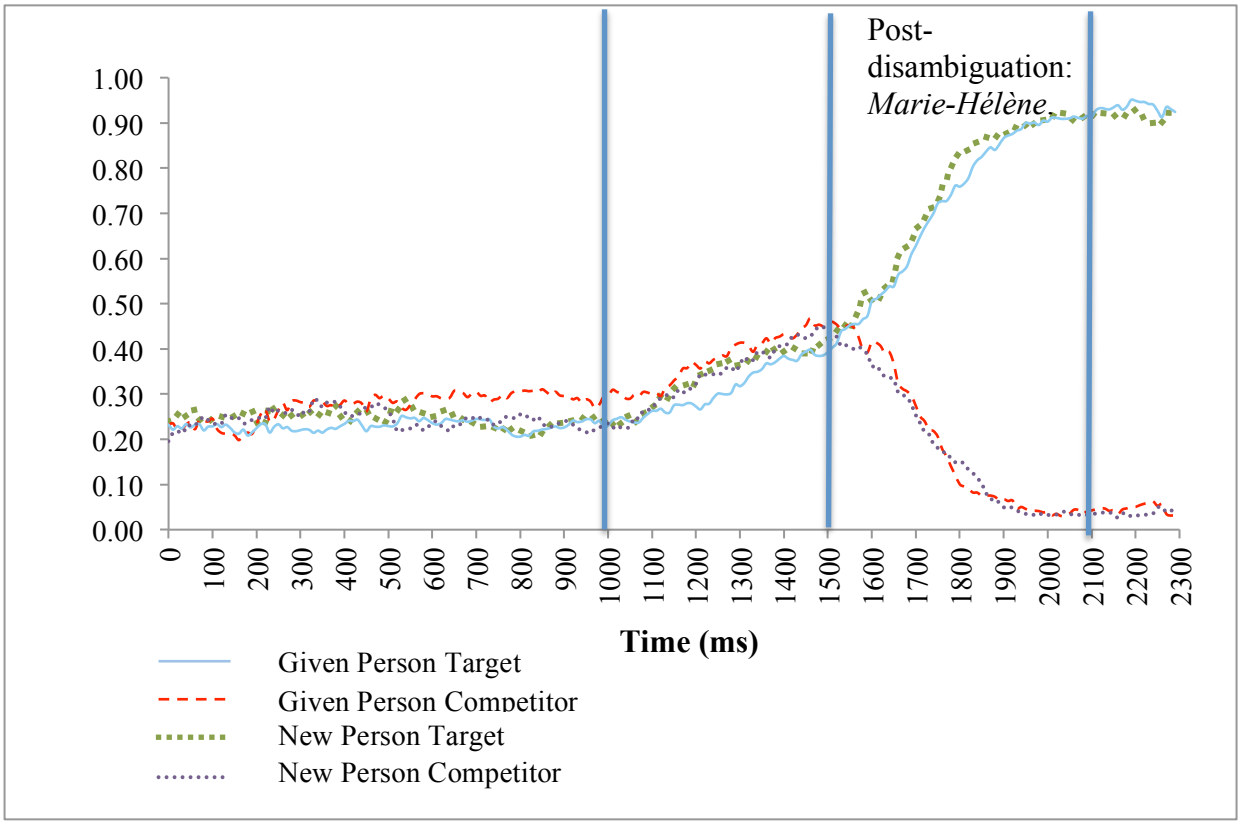

Figure 5a. Native speakers' fixations in the nuclear accent conditions

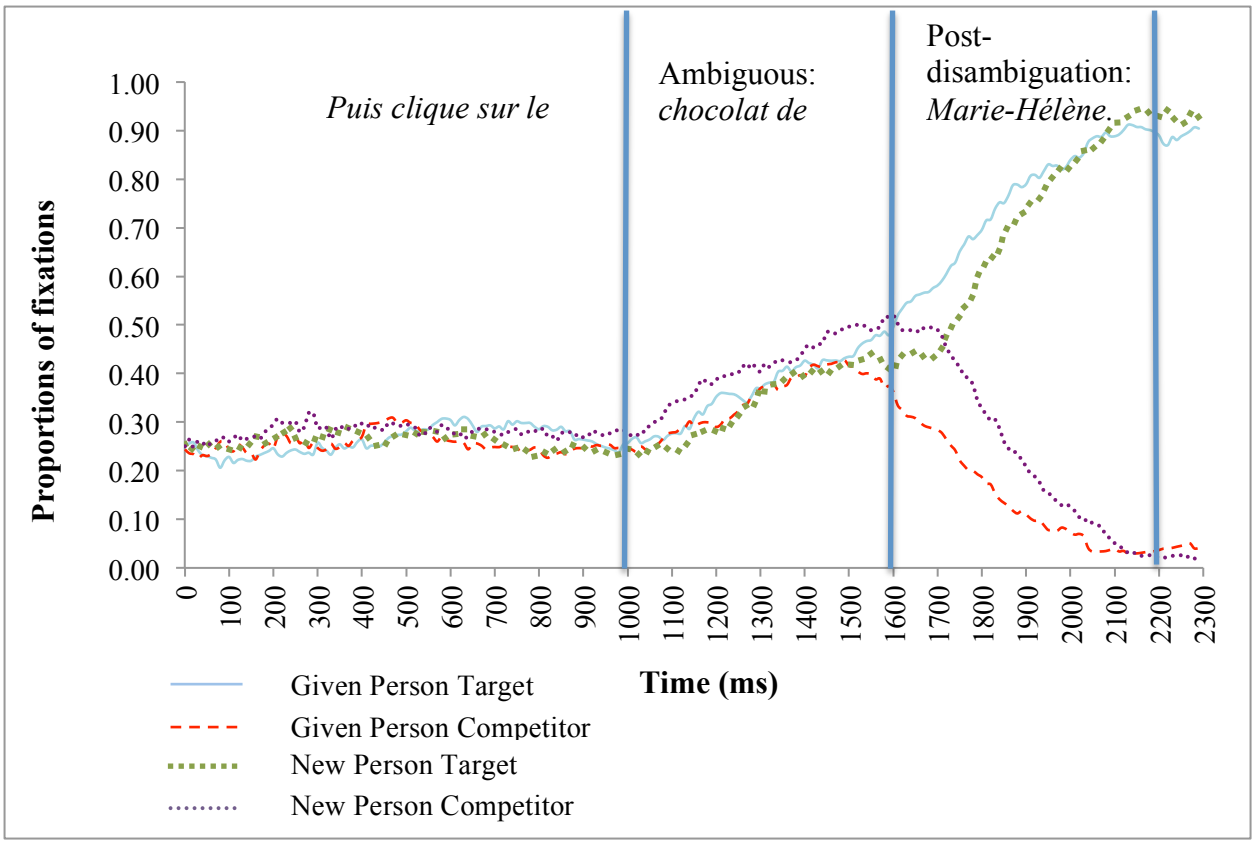

Figure 5b. Native speakers' fixations in the contrastive accent conditions

It should be noted that the lack of anticipatory behavior in the ambiguous time window does not imply that listeners do not generate any expectations about referents. Potential expected referents based on contrastive accents can still cause lexical competition at the level of speech integration when participants hear the referent in the discourse. In other words, native French listeners may not use contrastive accents to actively predict upcoming referents in French, but they may nonetheless integrate this information in their representation of discourse information as they hear the speech signal. The next models were carried out to test this possibility.

Likelihood ratio tests revealed that the best linear mixed-effects model on the difference between French listeners' proportion of target fixations and their proportion of competitor fixations in the post-disambiguation time window was one that included accent, person, and the

interaction between accent and person as fixed effects. Table 4 shows the results of this model. As can be seen in Table 4, the model revealed a significant effect of person and a significant accent x person interaction on the proportion of target fixations.

Table 4. Linear mixed-effects model on the difference between native speakers' proportion of target fixations and proportion of competitor fixations in the post-disambiguation time window

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.53076	0.02885	18.397	**< .05**
Accent	–0.01222	0.03154	–0.387	> .05
Person	0.09147	0.03154	2.900	**< .05**
Accent x Person	0.15049	0.06309	2.385	< .05

Given the significant interaction between person and accent, subsequent models were run separately on the contrastive and nuclear accent conditions, with person as fixed variable. For the nuclear accent conditions, the likelihood ratio tests showed that model with the best fit was one without any fixed effects. Thus, when the accent is nuclear, there is no significant effect of person on the difference between the proportion of target fixations and the proportion of competitor fixations: Whether the person is given or new does not influence participants' proportion of fixations when the accent is nuclear.

By contrast, the likelihood ratio tests for the contrastive accent conditions showed that the model with the best fit was one with person as a fixed effect. As can be seen in Table 6, when the accent is contrastive, there is a significant effect of person on the difference between the proportion of target fixations and the proportion of competitor fixations: French listeners show

larger fixation proportions when the person is given than when the person is new when the accent is contrastive.

Table 5. Linear mixed-effects model on the difference between L1 target and competitor fixation proportions for contrastive accent conditions

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.53352	0.02901	18.389	**< .05**
Person	0.15282	0.04676	3.268	**< .05**

The models in Tables 4 and 5 indicate that listeners had a greater difference between their proportion of target fixations and their proportion of competitor fixation in the contrastive accent conditions when the person was given than when the person was new. In other words, when participants heard a contrastive accent, they expected the person to be given; when it was instead new, they showed significantly more lexical competition, indicating that the new person went against their expectations of the given person based on the contrastive pitch accent on the object noun.

6.6 Discussion

The French listeners' differing eye fixation results in the two different time windows can be interpreted as follows. From the results of the ambiguous time window, we can see that French listeners did not show anticipatory looks to a specific person based on the type of accent on the object; in other words, their fixations to target and competitor words were not modulated by whether the person is given or new for either accent condition. For the nuclear pitch accent

conditions, these results are explained by the fact that the accent is uninformative in terms of upcoming referents in French, with the location of nuclear pitch accents being determined by the prosodic structure of the sentence (e.g., Jun & Fougeron, 2000, 2002; Welby, 2006). For the contrastive accent conditions, the results are more complex, because the contrastive accent in French does provide information about the newness or givenness of the upcoming referent. However, this information can co-occur with syntactic focus, with focus being cued more reliably by syntactic and prosodic cues than by prosodic cues alone. Therefore, one possibility is that although native French listeners show sensitivity to prosodic focus, they may rely more on syntactic focus than the native English-speaking listeners in previous studies to generate expected referents prior to encountering these referents in the speech signal. In other words, their relative reliance on the two cues might differ from those of English-speaking listeners, and would perhaps explain why native French listeners do not actively predict the referents in the ambiguous time window. Since the present research did not examine the use of syntactic cues to focus in French, their exact role in the anticipation of expected referents in French is unclear. Further research should assess native French listeners' reliance on prosodic cues alone vs. on prosodic and syntactic cues combined in the processing of French sentences.

In the post-disambiguation time window, however, native French listeners' fixations were modulated by whether the person was given or new in the contrastive accent conditions, but not in the nuclear accent conditions. The absence of anticipated referent effect in the nuclear accent conditions is not surprising given the lack of informativeness of this accent. Importantly, in the contrastive accent conditions, lexical competition in the post-disambiguation time window increased when the new person was infelicitous given the contrastive accent. This indicates that French listeners' interpretation of referents is constrained by the contrastive accent at the speech

integration level; that is to say, although French listeners do not appear to actively predict upcoming referents based on prosodic information alone, they are sensitive to this information and show a delay in integrating it when the target referent is infelicitous due to the contrastive accent. These results are in line with Magne et al. (2005) who, using ERP recordings, found that French listeners showed sensitivity to the presence and absence of contrastive pitch accents in pragmatically congruous and incongruous locations in the discourse.

It is important to note that in this experimental paradigm, the felicitous and infelicitous conditions were perfectly balanced so that participants would not receive clues as to what they were being tested on. Givenness and newness of the object were similarly perfectly balanced for the same reasons. As a result, the contrastive accent was even less informative in the context of this experiment than it is in real life (i.e., half the time, the contrastive accent was not followed by the given person). Yet, native French listeners showed sensitivity to this accent in their integration of speech information, indicating that the accent did constrain their interpretation of the speech signal as they heard the referents in the sentence.

Overall, these results suggest that native French listeners are sensitive to the contrastive pitch accent in French, showing a different pattern of eye fixations in the two accent conditions. Prosodic cues alone, even in the absence of syntax, constrain their interpretation of referents in the discourse. The traditional view of focus in French is strongly based on syntax, even though it is generally agreed upon that prosodic cues accompany syntactic cues. This experiment finds that when presented in isolation, prosodic cues can signal focus quite efficiently for native listeners. These results thus suggest that prosodic cues may actually be more important than previously thought.

We now move on to Experiment 1b, which investigated whether English-speaking L2 learners of French use contrastive accents in French to actively predict and integrate referents in sentence processing.

Chapter 7

Second Language Learners' Processing of Focus in French

Experiment 1b sought to examine whether L2 learners can map the form of the nuclear and contrastive pitch accents to their meanings in the discourse by using the accents in online sentence comprehension. In doing so, this experiment examined whether L2 learners can use these accents to anticipate upcoming discourse referents in the sentence. Experiment 1b was an eye-tracking experiment identical to Experiment 1a, with English-speaking L2 learners of French.

7.1 Participants

Participants were 32 L2 learners of French whose L1 was English. They were tested at the University of Illinois at Urbana-Champaign. A language background questionnaire was administered to all L2 learners, in which they provided information about various individual factors such as their age, age of first exposure to French, number of years of instruction in French, number of months of residence in a French-speaking environment, percent weekly use of French, contexts in which they use French, and dialects of French they have been exposed to. The L2 learners also described their knowledge of other languages. Participants were screened for whether or not they spoke only English before the age of five, learnt French after the age of nine, and had moderate-to-high proficiency in French. Table 6 shows the L2 learners' mean age, months of French immersion, percent weekly use of English, and percent weekly use of French.

Table 6. Language background information of L2 participants in Experiment 1

	Age	Immersion (months)	% weekly use of English	% weekly use of French
Mean	19.6	0.8	79	17
SD	1.2	1.9	18	14
Min	18	0	35	2
Max	24	10.3	98	50

The L2 learners also completed a cloze test to assess their global proficiency in French. Cloze tests are an established, reliable method of assessing language proficiency (e.g., Bachman, 1985; Brown, 1980, 2002; Oller, 1973). The French cloze test used here has independently been shown to provide valid and reliable estimates of global L2 proficiency in French (e.g., Tremblay, 2011; Tremblay & Garrison, 2010). The cloze test was scored with acceptable responses rather than exact responses (for details, see Tremblay, 2011). The L2 learners obtained an average of 19 (out of 45) on the cloze test (standard deviation: 4.2). This corresponds roughly to an intermediate level of proficiency (Tremblay, personal communication, May 3, 2015).

Learners completed the experiment in two sessions of approximately 45 minutes each. The eye-tracking experiment was conducted in Session 1. In Session 2, carried out 48 hours after Session 1, the learners completed (1) the language background questionnaire, (2) the cloze test, and (3) listening span tasks not included here.[3] The participants were tested in two sessions to minimize fatigue.

[3] None of the eye-tracking results showed significant relationships with the listening-span test scores. Hence, these tasks will not be discussed in more detail.

7.2 Eye Tracking Experiment

The materials and procedures for this eye-tracking experiment were identical to those in Experiment 1a. For the data analysis, L2 learners were first compared to native speakers in a larger mixed-effects model in which group was added as additional fixed variable. Then, L2 learners' results were analyzed separately from those of native speakers, with proficiency (i.e., cloze test scores) as additional fixed variable.

7.3 Data Analysis and Predictions

The analysis of L2 learners' eye-tracking data was carried out in a manner identical to that of native listeners' data. Items which received incorrect responses (i.e., where the participant clicked on the wrong image instead of the target image) or where eye movements could not be recorded by the camera were excluded from the analysis. The proportions of fixations to each image were calculated as proportions of the sum of fixations to all four images (i.e., fixations outside the four interest areas that correspond to the four images were not included in this sum). Samples in which the sum of fixations to all four images was zero were thus not analyzed. 31.7% of learner data was excluded for these reasons.

A first linear mixed-effects model was performed on the same dependent variable (i.e., the difference between the proportion of target fixations and the proportion of competitor fixations), comparing native and L2 listeners. This model included group in addition to person and accent as fixed effects, and it included participant and item as random variables. The fixed effects were added individually to the model and their effects on model fit were evaluated with model comparisons using the ANOVA function of R. Improvements in model fit were evaluated using –2 times the change in log-likelihood, which is distributed as χ^2 with degrees of freedom

equal to the number of parameters added. The fixed effects were kept in the model only if they improved the fit of the model. Person and accent were contrast coded, with the new person and the nuclear pitch accent being coded as –0.5 and the given person and contrastive accent coded as 0.5. Subsequently, linear mixed-effects models were conducted separately on the L2 data. These models were identical to those conducted on the native listener data, with the addition of proficiency as fixed variable. The fixed effects were kept in the model only if they improved the fit of model, as determined by the same likelihood ratio tests.

Like native listeners, L2 learners have been exposed to nuclear pitch accents in French speech input, and they have been exposed to the use of contrastive accents at least in sentences where focus is expressed syntactically, but possibly also in sentences where focus is expressed only prosodically. These two accents exist in English, but their placements and realizations are different in the two languages. In light of these differences, one can predict that L2 learners, already aware of accenting and focus in their L1, will also become sensitive to accenting and focus in the L2, even if the realizations are different. Namjoshi, Gaillard, and Tremblay (2013) found that English-speaking L2 learners of French are able to use phrase-final accents in sentence processing. However, it is unclear whether learners can use pitch accents to anticipate referents in the discourse.

While the nuclear pitch accent in English signals new information in the discourse, it is merely a phrase-final accent in French that does not signal the informativeness of referents in the discourse. The nuclear pitch accent is thus more informative in the learners' L1 (English) than in their L2 (French). Since L2 learners have received considerable input and instruction on the nuclear pitch accent it is predicted that they will not use the accent on the new object to expect the given referent, patterning like native speakers. If that is the case, two possible interpretations

exist: (i) learners may have potentially learnt that the nuclear pitch accent is uninformative in French, and thus do not expect referents based on the nuclear pitch accent; or (ii) they do not show an effect of person because they have difficulty using L2 information to anticipate referents in sentence processing, at least in the ambiguous time window (e.g., Dussias, Valdés Kroff, Guzzardo Tamargo, & Gerfen, 2013; Grüter, Lew-Williams & Fernald, 2012; Grüter & Rohde, 2013; Hopp, 2013; Kaan, 2014; Lew-Williams & Fernald, 2010; Martin et al., 2013). Thus, if learners do not show an effect of person in the nuclear pitch accent conditions, it will be difficult to draw firm conclusions with respect to their representation of what the nuclear pitch accent entails in French.

Since the use of the contrastive accent is quite widespread in English (more than in French when focus is expressed only prosodically) and words tend to be accented on the initial syllable in English, L2 learners should in theory be sensitive to contrastive accents in French. Although L2 learners should be aware of the interaction between accent type and information status (at least in their L1), it is unclear whether their exposure to prosodic focus in their French input has been sufficient for them to pattern similarly to native listeners in their processing of focus. Although prosodic focus constrains the interpretation of discourse referents similarly in English and French, the form of contrastive pitch accents differs from that of nuclear pitch accents in French. L2 learners must therefore be able to map the form of the two accents onto their respective discourse meanings. If L2 learners receive sufficient exposure to French, they may be able to do so, in which case they should transfer the use of contrastive accent as a means to anticipate upcoming discourse referents from English to French. In other words, transfer from English to French may enhance English listeners' use of contrastive accents in French, but only if L2 learners have formed the correct mapping between the two pitch accents and what these

accents entail in the discourse. If L2 learners' results pattern in the same direction as those of native French listeners, we will be able to conclude that L2 learners' representations of prosodic focus are qualitatively similar to those of native French listeners.

Given the limited input that L2 learners of French receive and the absence of explicit instruction on prosodic focus and contrastive accent in French, however, it is possible that L2 learners will not use contrastive accents to anticipate referents in the sentence. These results could be interpreted as reflecting that L2 learners do not know that French has prosodic focus (in the absence of syntactic cues) or they do not recognize the form of prosodic focus in French. If this were the case, L2 learners would not show an effect of contrastive accent in their anticipation of the person in either time window of the contrastive accent condition, suggesting their representations of prosodic focus in French may be qualitatively different from those of native speakers (though caution is warranted in drawing strong conclusions from the absence of an effect). Alternatively, it is possible that L2 learners recognize contrastive accents in French and know what they entail at the discourse level, but have difficulty using this information predictively in sentence processing (e.g., Dussias et al., 2013; Grüter et al. 2012; Grüter & Rohde, 2013; Hopp, 2013; Kaan, 2014; Lew-Williams & Fernald, 2010; Martin et al., 2013). If this were the case, L2 learners would fail to use the contrastive accent predictively (i.e., in the ambiguous time window), but they may still show an effect of integration of accent information in the post-disambiguation time window, like native French listeners did. With such results, we would able to conclude that L2 learners' representations are qualitatively similar to those of native speakers. Finally, language proficiency is expected to explain why some L2 learners pattern more like native listeners in their processing as compared to others.

7.4 Results

Figure 6a shows the L2 learners' proportions of fixations to the target and competitor in the two nuclear accent conditions. Figure 6b shows the proportions of fixations to the target and competitor in the two contrastive accent conditions.

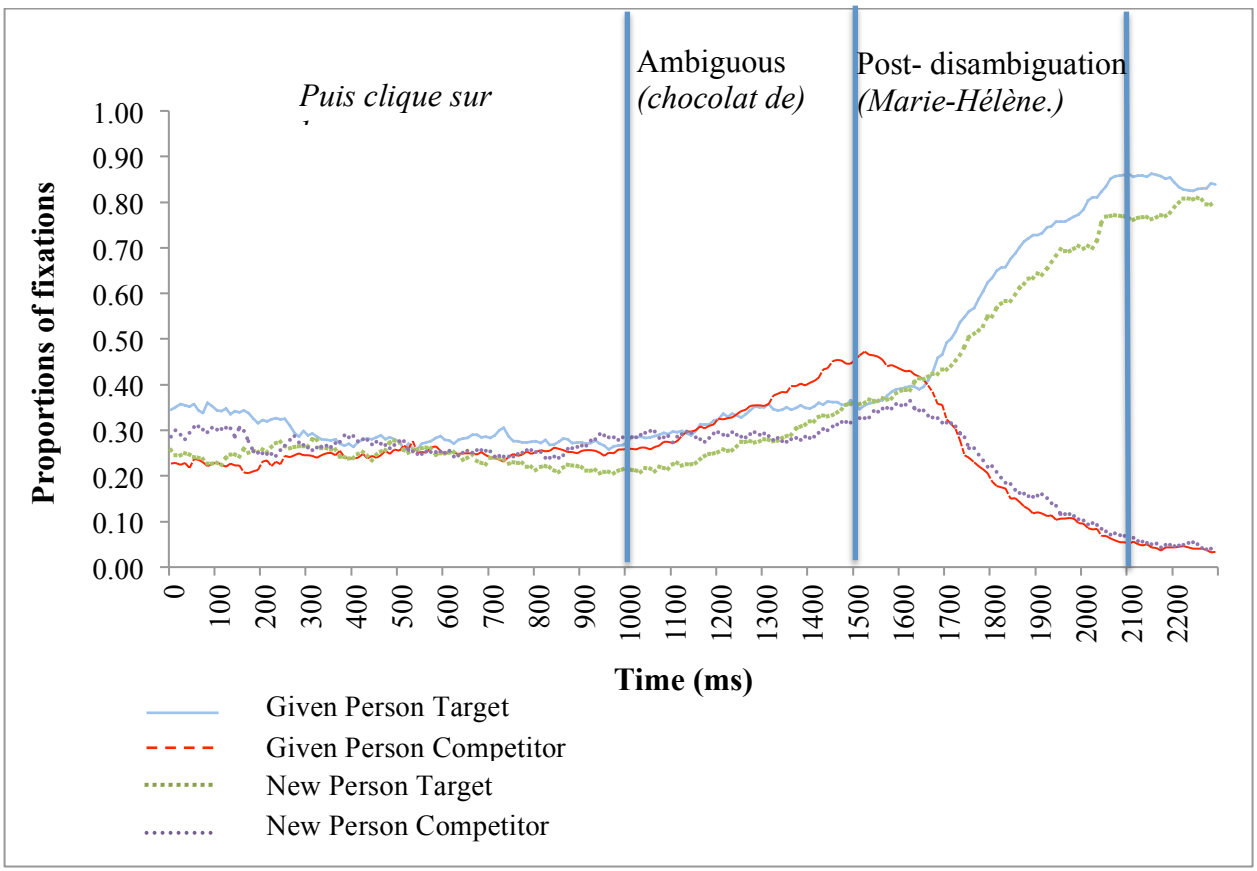

Figure 6a: L2 learners' fixations in the nuclear accent conditions

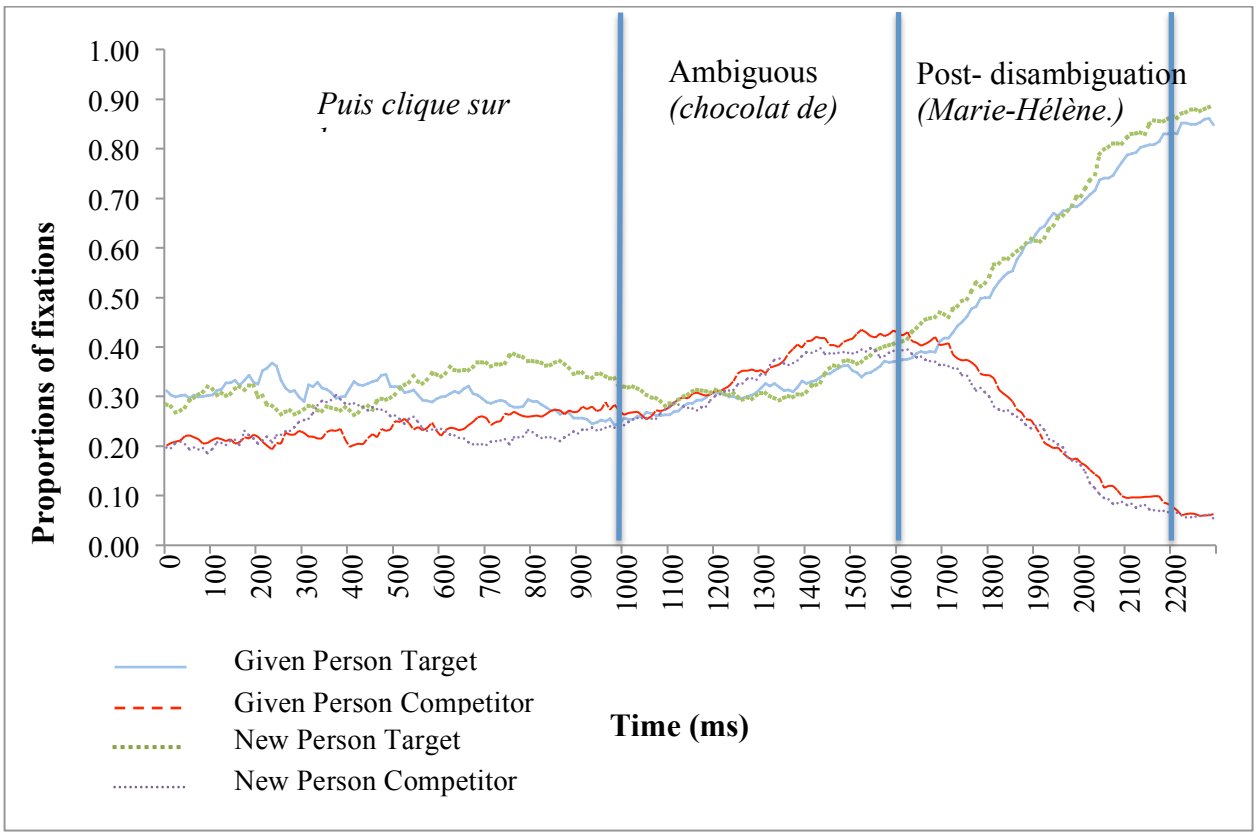

Figure 6b: L2 learners' fixations in the contrastive accent conditions

In order to determine whether L2 learners' results pattern similarly with those of native listeners, linear mixed-effects models were first performed on the difference between the proportion of target fixations and the proportion of competitor fixations in the ambiguous time window for both groups. Likelihood ratio tests indicated that the model with the best fit included accent, person, L1 (native language), and the interaction of person and L1 as fixed effects. However, despite this being the best model, there was no significant effect of accent, person, L1, or interaction between person and L1. Therefore, no further models were carried out on the ambiguous region for L2 learners.

Another linear mixed-effects model was conducted on the difference between the proportion of target fixations and the proportion of competitor fixations in the post-

disambiguation time window for both groups. Likelihood ratio tests indicated that the model with the best fit included accent, person, L1, and all interactions as fixed effects. Table 7 shows the results of this model. As can be seen in Table 7, there is a significant effect of L1 as well as a significant three-way interaction between accent, person, and L1 on the difference between proportions of target and competitor fixations. Given this three-way interaction, the L2 learners' results were analyzed separately.

Table 7: Linear mixed-effects model on the difference between all participants' proportion of target fixations and proportion of competitor fixations in the post-disambiguation time window

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.45056	0.02313	19.477	**< 0.05**
Accent	0.01684	0.02220	0.759	> 0.05
Person	0.04408	0.02220	1.986	**< 0.05**
L1	0.16529	0.04253	3.887	**< 0.05**
Accent x Person	0.01445	0.04439	0.325	> 0.05
Accent x L1	–0.03974	0.04436	–0.896	> 0.05
Person x L1	0.06004	0.04436	1.353	> 0.05
Accent x Person x L1	0.27480	0.08871	3.098	**< 0.05**

A linear mixed-effects model was conducted on the difference between L2 learners' proportion of target fixations and their proportion of competitor fixations in the post-disambiguation time window. Likelihood ratio tests indicated that the model with the best fit included accent, person, and the interaction between accent and person as fixed effects.

Proficiency was not retained as it did not improve the model. As can be seen in Table 8, the model yielded a significant interaction between accent and person.

Table 8. Linear mixed-effects model on the difference between L2 learners' proportion of target fixations and proportion of competitor fixations in the post-disambiguation time window

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.36766	0.03077	11.949	> 0.05
Accent	0.03594	0.02940	1.223	> 0.05
Person	0.01373	0.02942	0.467	> 0.05
Accent x Person	–0.12420	0.05877	–2.113	**< 0.05**

Given the significant interaction between person and accent, subsequent models were performed separately on the contrastive and nuclear accent conditions, with person as fixed variable. Likelihood ratio tests revealed the models with the best fit to be ones without any fixed effects (either accent or person) in both cases (contrastive and nuclear pitch accents in separate models). This suggests that L2 learners' interpretation in the post-disambiguation time window is unaffected by whether the person is given or new.

Given the significant interaction between person and accent, subsequent models were also performed separately on the given and new person conditions, with accent as fixed variable. The likelihood ratio tests revealed that the model with the best fit for the given person conditions was one without any fixed effects. Therefore, there is no significant effect of accent when the person is given. Table 9 shows the results of the model in the new person condition. The likelihood ratio tests revealed the model with the best fit to be the one with accent as the fixed

effect. As can be seen in Table 9, there is a significant effect of accent such that when the person is new, learners reached the target faster when hearing the contrastive pitch accent than when hearing the nuclear pitch accent. The effect of the contrastive pitch accent in the new person condition suggests an effect of saliency: The contrastive accent, being overall more prominent, may help learners integrate it more easily to reach the target faster.

Table 9. Linear mixed-effects model on L2 target-competitor fixation proportions for new person conditions

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.35969	0.03592	10.013	> 0.05
Accent	0.08116	0.03826	2.121	**< 0.05**

7.5 Discussion

In the ambiguous time window, L2 listeners behaved like native French listeners, in that they were not influenced by the type of accent on the object to look at a certain person in anticipation; that is to say, they used neither nuclear pitch accents nor contrastive pitch accents to actively predict upcoming referents. In the post-disambiguation time window, however, there was a significant interaction between accent and person on the difference between target and competitor fixation proportions, signaling that L2 learners were sensitive to prosodic focus in French. Nevertheless, subsequent models yielded no effect of person in either the nuclear or contrastive pitch accent conditions; instead, they revealed an effect of accent in the new person condition.

In case of the nuclear pitch accent conditions, L2 learners thus patterned like native speakers in that they did not show a preference for a specific person. This lack of effect of person indicates that L2 learners did not transfer their discourse representations from the L1 when processing the nuclear pitch accent in French. However, this does not necessarily mean that L2 learners' discourse representations were qualitatively similar to those of native speakers. Given L2 learners' difficulty in using linguistic information predictively in the L2 (e.g., Dussias et al., 2013; Grüter et al., 2012; Grüter & Rohde, 2013; Hopp, 2013; Kaan, 2014; Lew-Williams & Fernald, 2010; Martin et al., 2013), it is possible that L2 learners simply failed to make predictive use of the accent to infer the information status of discourse referents when processing the sentence, at least in the ambiguous time window. In other words, L2 learners not using the nuclear pitch accent to anticipate referents in French does not necessarily entail that L2 learners have learned that the nuclear pitch accent is not informative with respect to the information status of discourse referents in French.

In the case of contrastive pitch accents, L2 learners' online interpretation of the sentence was not constrained in the same way as that of native speakers, since L2 learners did not show an effect of person in the contrastive pitch accent conditions in either time window. These results can be interpreted in one of two ways: either L2 learners were not able to integrate and use this contrastive accent in online sentence interpretation, or they just did not recognize the contrastive accent as such, and thus did not link it to the correct discourse interpretation. For fixations in the ambiguous time window, the first interpretation would be in line with theories of L2 processing that suggest that L2 learners have difficulty using L2 information predictively (e.g., Dussias et al., 2013; Grüter et al., 2012; Grüter & Rohde, 2013; Hopp, 2013; Kaan, 2014; Lew-Williams & Fernald, 2010; Martin et al., 2013). However, the L2 learners' results also showed no effect of

person for the contrastive accent conditions in the post-disambiguation time windows. At that point in time, native French listeners showed an effect of integration of accent information with more lexical competition in the infelicitous condition as compared to the felicitous condition. L2 learners did not show this effect. This suggests that L2 learners' difficulty may in fact lie in recognizing the contrastive accent as such and linking it to the correct discourse interpretation. In other words, L2 learners may not have made the form-to-meaning mapping that would be required to correctly interpret the contrastive accent. Given the fact that learners receive little input on contrastive accents and focus, especially in the absence of syntactic cues, it is possible that L2 learners have not yet reached a stage in which they have learned the differing roles of nuclear and contrastive pitch accents in French. This would suggest that L2 learners' linguistic representation of prosodic focus would differ qualitatively from those of native listeners, though of course it is difficult to draw firm conclusions based on the absence of an effect.

It is important to note that the L2 learners did show an effect of accent in the new person conditions in the post-disambiguation time window. This indicates that despite their difficulty integrating the accent in comprehension, they were sensitive to the accent such that it helped them reach the target faster. This is likely to be a saliency effect, due to the overall more prominent nature of contrastive pitch accents. Thus, it appears that L2 learners' difficulty stems from the link between pitch accents and their corresponding discourse interpretation in French.

Another possibility to consider is whether L2 learners may not have shown an effect of person because they did not rely on prosodic cues to process focus in French, relying instead on syntactic cues. This would contrast with native speakers, who, from their effect of person in the contrastive accent conditions, showed sensitivity to prosodic focus in their sentence interpretation. Since syntactically focused constituents in French are also prosodically prominent,

when hearing a contrastive accent, the L2 learners should have shown more lexical competition in the infelicitous condition than in the felicitous condition at least in the post-disambiguation window, when listeners integrated the speech signal with their ongoing representation of the sentence and of the discourse. The fact that L2 learners did not show such an effect lends further weight to the possibility that learners may not have developed sufficient knowledge of the discourse implication of the contrastive accent in French despite its saliency, and that their discourse representations may thus be qualitatively different from those of native speakers.

In this study, no effect of proficiency was found on L2 learner's interpretation of nuclear and contrastive pitch accents; consequently, proficiency was not included as a variable in the reported models. If the L2 learning of the contrastive accent in French is something that takes place at advanced levels of proficiency, the absence of an effect of proficiency is not all that surprising given that most of the learners in this study placed at an intermediate level of proficiency. If most of these learners have not yet learned the correct mapping between the contrastive accent in French and what it entails at the discourse level, due at least in part to insufficient input, then we would not expect their processing of the accent to be modulated by proficiency, at least not yet. More proficient learners, who have spent a significant amount of time in immersion, would perhaps be more likely to show proficiency effects if they have been sufficiently exposed to the contrastive accent in French. Further research should be conducted with such learners who have spent a significant amount of time in immersion in French-speaking countries.

From Experiments 1a and 1b, it can be seen that native speakers integrate pitch accents in speech comprehension, but intermediate-level L2 learners are unable to do the same. It should be noted that focus, as signaled by pitch accents in the context of this experiment, was prosodic

alone, without syntactic cues. This leads to the question of whether native speakers and L2 learners would produce prosodic focus in contexts where the use of syntactic cues is not permitted, that is, where participants are explicitly instructed to follow a model sentence that does not have syntactic focus. Chapters 8-9 attempt to answer this question by examining native French speakers and English-speaking L2 French learners' production of prosodic focus in an interactive speech production task modeled after Experiment 1.

Chapter 8

Native Speakers' Production of Focus in French

Experiment 2a investigates whether native French speakers produce prosodic focus in contrastive contexts if their production is modeled after a sentence that does not contain syntactic focus. Specifically, it examines whether native speakers convey the contrastive status of referents in the discourse by highlighting them in their speech production with higher amplitude and higher pitch on the first syllable. This speech production experiment is interactive, with participants giving instructions to the researcher to click on objects in a display; as such, it encourages participants to produce sentences that are meaningful (and thus felicitous) at the discourse level.

8.1 Participants

Participants were 12 native speakers of French tested at the University of Illinois. Most participants were exchange students who had been in the United States for less than two months at the time of testing. All native speakers completed a language background questionnaire providing information about their age, other languages they spoke, dialect of French, and the dialect(s) of French and other languages spoken by their parents in the home. The general dialect of French spoken by all participants was Metropolitan French. Table 10 shows the native speakers' mean age and percent weekly use of French. As can be seen from Table 10, these native French speakers' percent weekly use of French is lower than that of the native speakers tested in Experiment 1a, because the French speakers tested for Experiment 2a lived in the in the United States at the time of the testing.

Table 10. Language background information of native-speaking participants in Experiment 2a

	Age	**% Weekly use of French**
Mean	23.9	42.9
SD	3.5	24.7
Min	19	10
Max	30	88

8.2 Materials

In Experiment 2, participants gave instructions to the researcher to click on objects in a display. Participants saw sets of four images, with each set being displayed twice consecutively. The first display intended to elicit the context sentence and the second display intended to elicit the critical sentence. Each display consisted of four images: the context image (i.e., the image to be mentioned in the context sentence), the critical image (i.e., the image to be mentioned in the critical sentence), and two distractor images. Each image consisted of an object and a person.

The variable manipulated was the information status of the person in the critical sentence (i.e., whether it was new or given as compared to the person in the context sentence). As in Experiment 1, the same two people were used throughout the experiment. The same person appearing in both sentences was considered as the "given" condition and different people appearing in the two sentences was considered as the "new" condition. The objects, however, were never repeated in the experiment. The information status of the person being new or given in each item was thus always in relation to the object that belonged to them: If an object-person combination to be produced in the critical sentence contained the same person both times, the person was considered given; if the object-person combination to be produced had a different person in the critical sentence as compared to the context sentence, the person was considered

new. Both people, were, however, always present in every display of every item. Figure 7 illustrates the types of displays participants saw, and Table 11 provides the sentences that the display in Figure 7 intended to elicit.

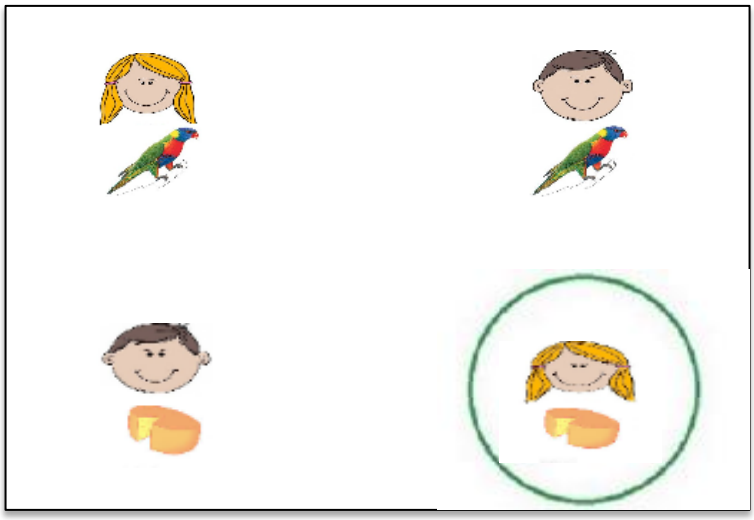

Figure 7. Example of a display from Experiment 2

Table 11. Experimental sentences elicited in Experiment 2

	Condition	Context sentence	Expected Critical sentence
1	Given person	*D'abord clique sur le perroquet de Marie-Hélène.*	*Puis, clique sur le CA$_{(H)}$membert de Marie-Hélène.*
2	New person	*D'abord clique sur le perroquet de Jean-Sébastien.*	*Puis, clique sur le camemBERT$_{(H*)}$ de Marie-Hélène.*
	Gloss	'First click on the parrot of Jean Sébastien/ Marie-Hélène.'	'Now click on the camembert of Jean Sébastien/ Marie-Hélène.'

Like in Experiment 1, all stress-bearing AP-final words were carefully chosen to be trisyllabic in order to avoid having two accent-bearing syllables next to each other. In other words, the contrastive accent could not be misinterpreted as being a nuclear pitch accent because

it was always two syllables before the AP-boundary. The stress-bearing nouns (e.g., *perroquet* 'parrot,' *camembert* 'camembert') were frequently occurring trisyllabic words that were always plausible objects possessed by the person in the sentence (either *Marie-Hélène* or *Jean-Sébastien*). The trisyllabic words used in experiments 1 and 2 overlapped, but the combinations were different. During Experiment 1, certain words were reported to be difficult by some learners (these words were duly excluded from the analyses for those learners). Care was taken to avoid using these words as experimental words in Experiment 2, and they were instead used as fillers. Furthermore, critical words in Experiment 2 were carefully chosen such that they would be easy for L2 learners to pronounce, to minimize any difficulty in analysis due to incorrect phonetic production. Due to these reasons, it was not possible to have the same context-critical word pairs in the two experiments. The complete list of test items can be found in Appendix B. One person was female (*Marie-Hélène*) and the other was male (*Jean-Sébastien*) so that participants would always know the person's name while looking at their picture. The targeted word for the analysis of the results is this trisyllabic object word. The object words were also carefully chosen such that a particular gender would not be perceived as being more likely to have that object. All objects words were masculine in order to prevent gender recall for the preceding article from influencing the production of the object noun. It should be noted that French does not have the genitive construction 'person's object' that is available in English; therefore, no other structure was naturally available to describe the given display in French.

Experiment 2 contained a total of 16 experimental items. The 16 experimental items were counterbalanced in two lists, with participants never seeing the same item in more than one condition. In the experimental conditions, the object was always new in the critical sentence as compared to the context sentence, but this was counterbalanced throughout the experiment with

an equal number of distractor items in which the object in the critical and context sentences was the same. Sentences with these given objects will serve as control sentences for the purpose of ensuring that the experiment worked: Because the objects are repeated from the context sentence to the critical sentence, participants are expected to produce them with smaller duration, lower amplitude, and lower pitch as compared to objects that are different from the context sentence to the critical sentence, irrespective of the discourse status of the person (for reduced prominence of repeated referents in English, see Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010).

In addition to the previously mentioned 32 items, 32 distractor items were added in which the display of objects and persons was not symmetrical (e.g., Jean-Sébastien with a baby (*bébé*), Jean-Sébastien with a baby, Marie-Hélène with a baby, Jean-Sébastien with a rock (*pierre*)) in order to prevent the participants from guessing the nature of the experiment.

8.3 Procedures

Before completing the experiment, participants completed a word-image association training. They were given a sheet with images and names of all the objects (128) and persons (2) in the experiment. Participants were asked to study the sheet such that they would be able to remember the associations between the words and images. Participants were allowed to take up to 15 minutes to study the words and images. This training was followed by a test in which participants were asked to associate the images they saw with the corresponding words. This test was intended to further strengthen the participants' association of the words and images such that hesitations to remember the word could be avoided during the experiment. This task was 7-10 minutes long and was designed and run with E-Prime (Schneider, Eschman & Zuccolotto, 2002).

Although the training was in general sufficient for participants to be able to use the correct words for the objects and persons in the experiment, participants were nonetheless explicitly told before the beginning of the experiment that if they did not remember the name of the object for any of the trials, they should simply skip the trial. This was done to reduce their stress during the experiment.

After the training and testing phases, participants were shown a short PowerPoint animation demonstrating the experimental task they would have to do. Participants were informed that they would see four person-object combinations, one of which would be circled in green. The researcher, on a different computer, would see the same display but not the green circle. The participant's task was to instruct the researcher to click on the correct object. The PowerPoint animation gave the participants the two sentence structures to be used in the experiment, but in written format to avoid any priming from speech. These structures were: *D'abord clique sur le object name de person name* 'First, click on the object name of person name' for the first sentence; and *Puis clique sur le object name de person name* 'Now, click on the object name of person name' for the second sentence. Participants were explicitly instructed not to use any other structures, thus ruling out their possible production of focus via syntactic means.

The production experiment was designed using E-Prime (E-Studio) and presented using E-Run (Schneider et al., 2002). The experiment began with a practice session of four items. The main session was divided into two blocks of 32 items (64 sentences) each. In each trial, participants first saw a display screen bearing the words *Allons-y!* ('Let's go!') for five seconds. This screen meant participants had to be ready to receive the first set of images, which would automatically appear after five seconds. The set of images would then appear, with one of the

four object-person combinations circled. At that point in time, participants produced the first (context) sentence. After speaking the sentence, they pressed the space bar to continue. Participants were thus allowed to control how long they spoke for. After pressing the space bar, participants saw a blank screen for one second. This was followed by a presentation of the same display but with the same or a different object-person combination circled.[4] When participants finished speaking the second sentence, they pressed space and returned to the *Allons-y* display to begin the next trial.

Participants were audiorecorded in a sound-proof booth as they completed the production experiment. Recordings were done using a head-mounted microphone connected to the display computer. Each sentence spoken by the participants was automatically labeled, recorded separately and saved with the item label using E-Prime (Schneider et al., 2002). Native speakers completed the experiment in one session lasting approximately 50-60 minutes.

8.4 Data Analysis and Predictions

Each participant's productions were recorded by E-Run software separately for each sentence (Schneider et al., 2002). The application was programmed to automatically label each production with the item number. Of productions, the experimental sentences were retained and analyzed using Praat (Boersma & Weenink, 2015). Then, textgrids were created using Praat to segment the production at the level of the sentence, word, syllable, and vowel. Praat scripts were then used to extract the average duration (milliseconds) and amplitude (decibels) and the pitch contour of the objects (Hertz). For the pitch contours, each object noun was divided into 15 time

[4] 25% of critical items had the same object-person combination circled in both critical and context sentences in order to balance the experiment to avoid any bias to expect either object or person.

intervals (5 intervals per syllable), and the mean pitch of each of these intervals was extracted. Productions that contained the incorrect word, were mispronounced or repeated, or contained very long pauses before the object noun were excluded from the analyses. The productions were also examined individually, and instances of pitch doubling or halving were also excluded from the analyses. 11.7% of native speakers' productions were thus excluded for these reasons.

The acoustic analyses presented here focus on the duration, amplitude, and pitch of the trisyllabic object noun. The average duration and amplitude were analyzed with linear mixed-effects models using the lme4 package in R (for discussion, see Baayen, 2008). The pitch contours were analyzed with growth curve analysis (Mirman, 2014; Mirman, Dixon, & Magnuson, 2008), also using the lme4 package in R (Baayen, 2008). There were two fixed effects in the analyses: the information status of the person (new, contrast-coded as 0.5, and given, contrast-coded as –0.5), and the information status of the object (new, contrast-coded as 0.5, and given, contrast-coded as –0.5). The linear mixed-effects model included information status of the object, information status of the person, and their interaction as fixed effects, and participant and item as random variables. In addition to these variables, the growth curve analysis also included five orthogonal time coefficients (linear, quadratic, cubic, quartic, and quantic, computed from the 15 time intervals) as fixed effects and their interaction with the other fixed effects in the model, and the time coefficients were included as random slopes or curvatures for the participant random variable. The fixed effects were added individually to the model and their effects on model fit were evaluated with model comparisons using the ANOVA function of R. Improvements in model fit were evaluated using –2 times the change in log-likelihood, which is distributed as χ^2 with degrees of freedom equal to the number of parameters added. The fixed effects were kept in the model only if they improved the fit of the model.

It is predicted that overall duration, amplitude, and pitch of the object word should be greater when the object noun is new (different in the context and critical sentences) as compared to when it is given (the same in the context and critical sentences).

If native French speakers produce a contrastive pitch accent in the contrastive context (i.e., when the object is new but the person is given), they should produce the new object word with higher amplitude and the first syllable of the object word with higher pitch when the person is given than when the person is new; for pitch, this means the pitch contour for the new object in the given person condition should have a more negative slope and/or a more concave shape than the pitch contour for the new object in the new person condition. An effect of person is not expected on the duration of the new object noun since duration has instead been argued to signal AP-final boundaries (Jun & Fougeron, 2000, 2002; Vaissière, 1999).

8.5 Results

8.5.1 Duration

Figure 8 shows object word duration for native speakers in all four conditions. The likelihood ratio tests revealed that the linear mixed-effects model with information status of the object and person as fixed effects had the best fit. Table 12 reports the results of this model.

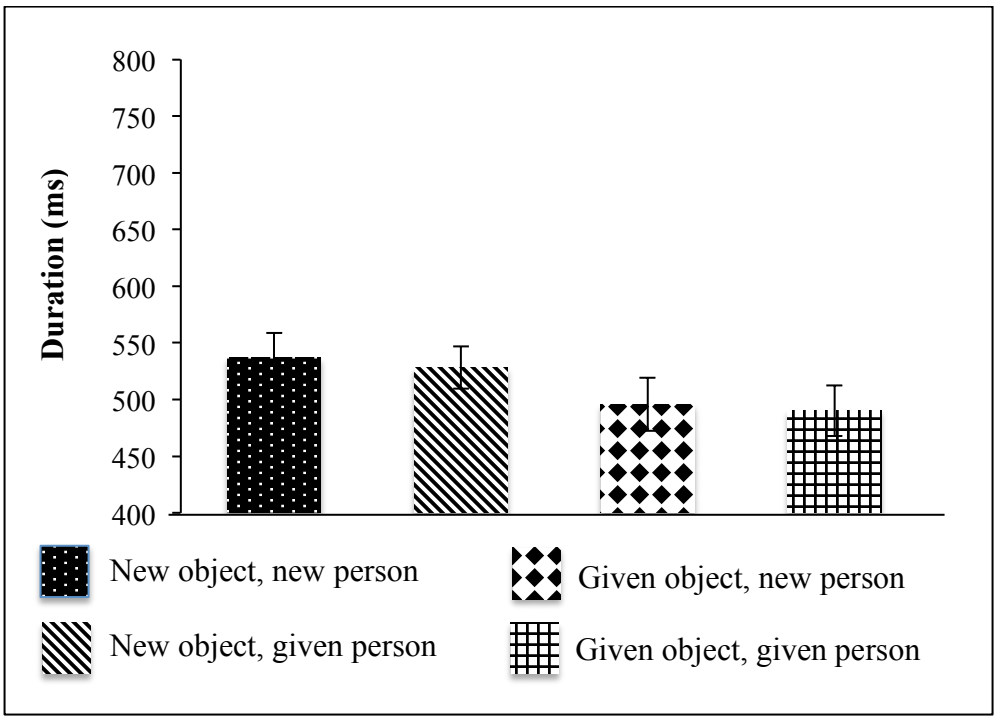

Figure 8. Native French speakers' object word duration (mean and standard error)

Table 12. Linear mixed-effects model on native speakers' object word duration with object and person as fixed effects

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.513919	0.021379	24.038	**< .05**
Object	0.043729	0.006154	7.106	**< .05**
Person	0.005880	0.006161	0.954	> .05

As shown in Table 12, the model yielded a significant effect of object but no effect of person on the average duration of the objects. The directionality of the coefficient indicates that the duration of the word was longer when it was a new object than when it was a given object.

The absence of effect of person on object word duration indicates that native speakers did not produce the word with significantly different durations depending on the person type.

These duration results for French thus pattern similarly to those of previous studies in English (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell et al., 2009; Fowler & Housum, 1987; Lam & Watson, 2010), showing that new object words have longer durations than given (repeated) object words also in French. Since the interaction between object and person did not improve the model, and since no effect of person was found, these results suggest that native French speakers do not use duration to realize a contrastive accent in French; that is, when the object is new, French speakers do not produce object words of longer duration in the given person condition than in the new person condition (if anything, the numerical results pattern in the opposite direction).

8.5.2 Amplitude

Figure 9 shows the mean amplitude of the object word for native speakers in all four conditions. The likelihood ratio tests revealed that linear mixed-effects model with object and person as fixed effects had the best fit. This model is presented in Table 13.

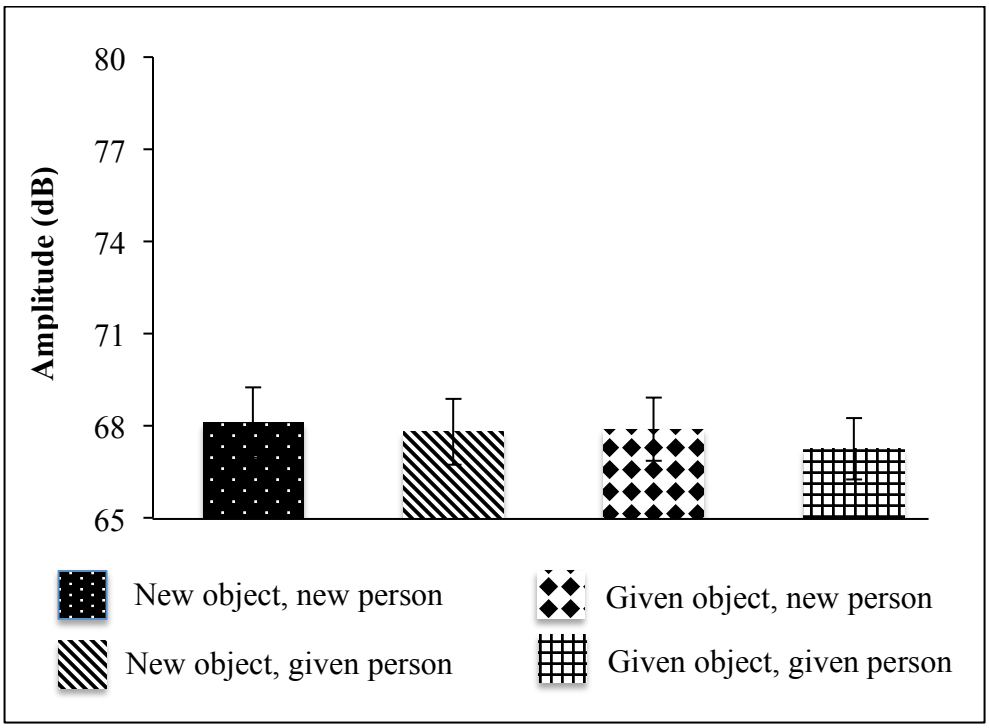

Figure 9. Native French speakers' object word amplitude (mean and standard error)

Table 13. Mixed-effects model on native speakers' object word amplitude with object and person as fixed effects

Variable	Estimate	Standard Error	*t*	*p*
Intercept	67.7366	1.0809	62.66	**< .05**
Object	0.3444	0.2020	1.70	> .05
Person	0.4801	0.2019	2.38	**< .05**

As can be seen in Table 13, the model revealed a significant effect of person. The directionality of the coefficient indicates that the amplitude of the object word was higher when it was with a new person than when it was with a given person.

The absence of an effect of object in French pattern differently from those observed in previous studies on English (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell et al. 2009; Fowler & Housum, 1987; Lam & Watson, 2010). However, even though the effect size did not reach significance, the effect was in the same direction as in English, so the amplitude in French may be larger for new words than given, but not reliably so. The absence of an interaction between object and person, and the effect of person in the opposite direction to what was predicted for the new object condition, suggest that native French speakers do not use amplitude to realize a contrastive accent in French. In fact, given these results, French speakers appear to signal the information status of both the object and person, but not contrast the two objects belonging to the same person.

8.5.3 Pitch Contour

Figure 10 shows the pitch contour of the word for native speakers in all four conditions. Growth curve analysis was used to analyze the pitch contour of the object word. The best shape for the modeled line (determined with a comparison of linear, quadratic, cubic, quartic, and quantic models) was consistently that corresponding to a quantic model, which included five orthogonal time coefficients (for details, see Mirman et al., 2008; Mirman, 2014). This is consistent with the overall shape of the contour in Figure 10.

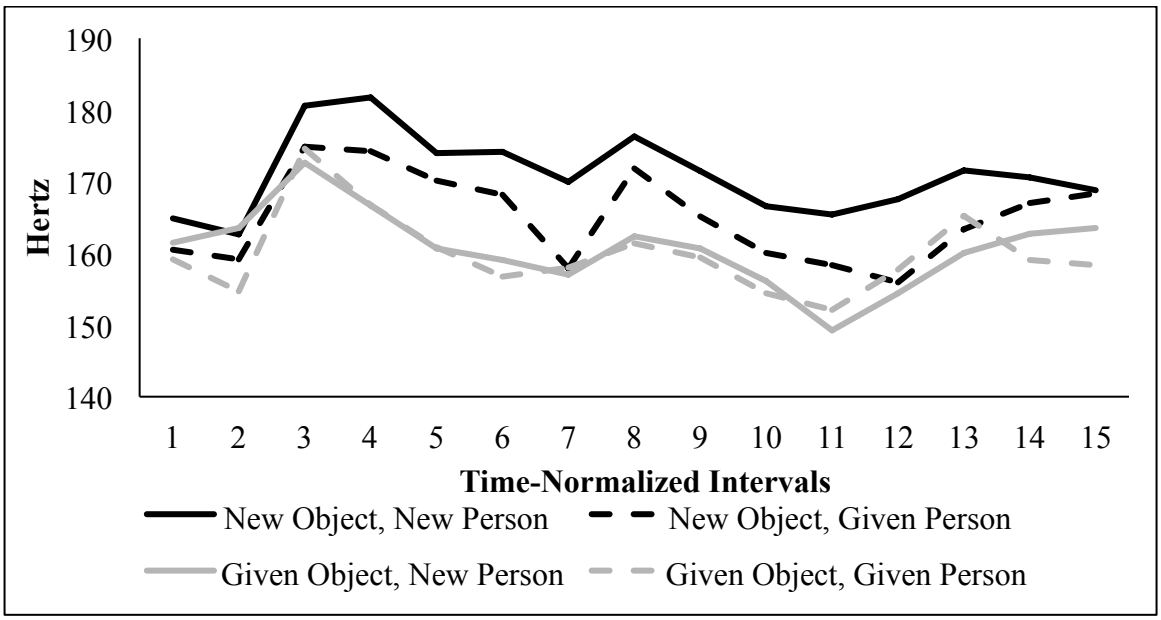

Figure 10. Native speakers' pitch contour for the object

Therefore, a model comparison was carried out with all five orthogonal time coefficients, object, person, and all interactions as fixed effects. The model with the best fit was one with the time coefficients, object, person, and an interaction between the time coefficients and object. Table 14 shows the results of this model. The five orthogonal time coefficients are abbreviated as ot1, ot2, ot3, ot4, and ot5.

Table 14. Growth curve analysis on native speakers' pitch contour with orthogonal time coefficients, object, person, and the interaction of the time coefficients with object

	Estimate	Standard Error	*t*	*p*
(Intercept)	162.3840	14.6577	11.078	**< .05**
ot1	–0.7744	1.3405	–0.578	> .05
ot2	–12.6315	2.5561	–4.942	**< .05**
ot3	12.0191	2.0752	5.792	**< .05**
ot4	0.2825	1.4878	0.190	> .05
ot5	6.1668	2.6841	2.298	**< .05**
Object	2.7333	0.5981	4.570	**< .05**
Person	1.4901	0.5938	2.510	**< .05**
ot1:Object	0.4430	2.3115	0.192	> .05
ot2:Object	–6.9416	2.3647	–2.936	**< .05**
ot3:Object	1.2688	2.4024	0.528	> .05
ot4:Object	1.0634	2.3789	0.447	> .05
ot5:Object	–0.5161	2.2632	–0.228	> .05

From Table 14, we can see that the pitch contours show significant quadratic, cubic, and quintic curvatures. There is a significant effect of object, with higher pitch on the object when the object word is new than when it is given. The effect of object also interacts with the quadratic time term of the model, indicating that the pitch contour of the new object is more concave than the pitch contour of the given object. There is a significant effect of person, with higher pitch being produced on the object when the person is new than when the person is given. The

interaction term between object and person was not retained in the model, as it did not improve the model.

Thus, these pitch results indicate that new object words have higher pitch than given (repeated) object words, and they also have higher pitch (and more concave pitch contours) if these objects are used with a new person than if they are used with a given person. Like the amplitude results, the absence of an interaction between object and person, and the effect of person in the opposite direction to what was predicted for the new object condition, suggest that native French speakers use pitch to signal the information status of both the object and person, but not to contrast the two objects belonging to the same person. These results differ from those reported in studies on English (Ito, Speer & Beckman, 2004).

8.6 Discussion

The above results show that French speakers produced given (repeated) object nouns with shorter duration, and lower pitch as compared to new object nouns. However, in the new object conditions, the effect of person was either not significant or it was in the opposite direction to what was predicted, with the new object for the new person being larger in amplitude or higher in pitch than the new object for the given person. These results suggest that native speakers signaled the information status of the object and the person as new vs. given, but they did not contrast the new object for the given person (i.e., they did not produce a contrastive accent on the new object in the given person condition).

The effect of object type on the prominence (here, duration and pitch, but not amplitude) of the object noun produced by native French speakers is interesting to note. Research shows that objects can be reduced in prominence for a variety of reasons, such as repetition, frequency,

transitional probability, and predictability (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010; Watson, 2010; Watson, Arnold & Tanenhaus, 2008). In the case of these object words, frequency is unlikely to be a factor as all chosen words were frequent, and due to counterbalancing, all words appeared in both object types, canceling any potential minor frequency differences.

One might attribute the lack of a contrastive accent in the native speakers' results to the constraint on the sentence structure given to the participants, from which they were not allowed to deviate. The model sentence that participants were asked to use did not contain syntactic means of focusing constituents, such as clefting. Hence, one might hypothesize that the frequency of co-occurrence of syntactic and prosodic focus in French may lead native French speakers to produce the contrastive accent only if they are also allowed to use syntax to convey focus. Recall, however, that in Féry's (2001) study, native French speakers produced prosodic focus even when the questions they heard (and the responses they formulated for these questions) did not contain any clefting. In fact, Féry's (2001) native speakers produced syntactic clefting after questions that did not contain such clefting only 5% of the time. Féry (2001) maintains that in cases where clefting was not used, focus-induced phrasing overrode syntax-induced phrasing. Given Féry's (2001) results, it appears unlikely that the native French speakers in the present study did not produce the contrastive accent due to their not being allowed to produce focus in the absence of syntactic cues.

A perhaps more likely reason for the absence of contrastive focus in the present study is that the number of person referents was limited to only two individuals; consequently, native French speakers may not have felt the need to contrast the new object in trials with the same person as compared to trials with two different people. Similar studies conducted with native

English speakers (e.g., Ito, Speer, & Beckman, 2004) used more referents (e.g., in Ito et al., 2004, participants could contrast the colors of several tree ornaments). In the present study, the number of people was deliberately kept at a minimum in order to accommodate L2 learners, for whom the task would be more cognitively demanding with a larger number of referents to retain in their working memory (van den Noort, Bosch, & Hugdahl, 2006). As the learners tested in the present study were of intermediate proficiency, this limitation would be difficult to overcome without increasing task demands on them. As a result of this methodological decision, native speakers may not have felt the need to contrast the new object in the given person condition.

Another possible explanation for the absence of contrastive accent in native speakers' productions is that the participants may not have found the experimental interaction with the researcher meaningful enough to produce contrastive accents. Contrastive pitch accents are difficult to elicit, because they must be produced voluntarily by the speaker in order to convey a meaningful contrast in the discourse. If participants are not engaged in the task with the researcher, they may also not feel the need to produce such a contrastive accent. For this reason, many experimental studies on the production of contrastive accents have had participants do the task in pairs or had an assigned confederate pretending to be a participant rather than having the researcher perform as confederate (e.g., Bard & Aylett, 1999; Ito, Speer & Watson, 2004; Lam & Watson, 2010). This explanation of the results is still consistent with the finding that given words are produced with smaller duration and lower amplitude and pitch as compared to new words, because the given vs. new distinction is also relevant to the speaker under various accounts of prominence in which frequent, predictable and repeated words are produced with reduced prominence (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010).

Contrastive accents without syntactic focus are very frequent in English (Pierrehumbert, 1980, Pierrehumbert & Hirschberg, 1990). If L2 learners have learned the mapping between the form of the nuclear and contrastive pitch accents in French and what they entail in the discourse, they may be able to transfer knowledge of the relationship between these accents and their discourse meaning from their L1 and use these accents in French, even though the native French speakers in this study did not. Experiment 2b therefore examines L2 learners' production of nuclear and contrastive pitch accents in French, using the same methodology as in Experiment 1a. Since the L2 learners in Experiment 2b were different from those in Experiment 1b, the L2 learners' lack of sensitivity to the contrastive accent in Experiment 1b in principle does not entail that the L2 learners in Experiment 2b will not produce the contrastive accent in felicitous contexts in French, especially since the proficiency of the L2 learners in Experiment 2b was numerically higher than that of the L2 learners in Experiment 1b. Hence, we now turn to Experiment 2b, which investigate L2 learners' production of the nuclear and contrastive pitch accents in French.

Chapter 9

Second Language Learners' Production of Focus in French

Experiment 2b examines whether L2 learners convey the contrastive status of referents in the discourse by highlighting them in their speech production, and how their production compares to that of native speakers. This was an interactive speech production experiment identical to Experiment 2a.

9.1 Participants

Participants were 24 L2 learners of French whose L1 is English, tested at the University of Illinois at Urbana-Champaign. A language background questionnaire was administered to all learners, in which they provided information about various individual factors such as their age, age of first exposure to French, number of years of instruction in French, number of months of residence in a French-speaking environment, percent weekly use of French, contexts in which they use French, and dialects of French they have been exposed to. The learners also described their knowledge of other languages. Participants were screened for whether or not they spoke only English before the age of five, learnt French after the age of nine, and had moderate to high proficiency in French. Table 15 shows L2 learners' mean age, length of total immersion, and percent weekly use of French, and percent weekly use of English.

Table 15. Language background information of L2 participants in Experiment 2

	Age	Immersion (months)	% weekly use of English	% weekly use of French
Mean	23.6	5.7	80	17.1
SD	4.5	8.8	13.6	12.1
Min	18	0	50	4
Max	34	94	96	50

The learners also completed a cloze test to assess their global proficiency in French. Cloze tests are an established reliable method of assessing language proficiency (Bachman, 1985; Brown, 1980, 1983, 2002; Oller, 1973). The French cloze test used here (out of 45) has independently been shown to provide valid and reliable estimates of global L2 proficiency in French (e.g., Tremblay, 2011; Tremblay & Garrison, 2010). The cloze test is scored with acceptable responses rather than exact responses (for details, see Tremblay, 2011). The L2 learners obtained an average of 25 (out of 45) on the cloze test (standard deviation: 7.63). This corresponds roughly to a high-intermediate level of proficiency (Tremblay, personal communication, May 3, 2015).

9.2 Materials

The materials for this experiment were identical to those in Experiment 2a, with the addition of a pen-and-paper cloze test to assess proficiency.

9.3 Procedures

Procedures were identical to those in Experiment 2a. The only difference was that the written instructions prior to the experiment were in English instead of French. L2 learners also completed a cloze test (20 minutes long), which the L1 French speakers did not do. Learners completed the experiment in one session lasting approximately 90 minutes.

9.4 Data Analysis and Predictions

L2 learners' results were analyzed using the same methods as native speakers. Each participant's productions were recorded by E-Run software separately for each sentence (Schneider et al., 2002). The application was programmed to automatically label each production with the item number. Of productions, the experimental sentences were retained and analyzed using Praat (Boersma & Weenink, 2015). Then, textgrids were created using Praat to segment the production at the level of the sentence, word, syllable, and vowel. Praat scripts were then used to extract the average duration (milliseconds) and amplitude (decibels) and the pitch contour of the objects (Hertz). For the pitch contours, each object noun was divided into 15 time intervals (5 intervals per syllable), and the mean pitch of each of these intervals was extracted. Productions that contained the incorrect word, were mispronounced or repeated, or contained very long pauses before the object noun were excluded from the analyses. The productions were also examined individually, and instances of pitch doubling or halving were also excluded from the analyses. 23.70% of learners' productions were thus excluded for these reasons.

The acoustic analyses presented here focus on the duration, amplitude, and pitch of the trisyllabic object noun. The average duration and amplitude were analyzed with linear mixed-effects models using the lme4 package in R (for discussion, see Baayen, 2008). The pitch

contours were analyzed with growth curve analysis (Mirman, 2014; Mirman, Dixon, & Magnuson, 2008), also using the lme4 package in R (Baayen, 2008). There were three fixed effects in the analyses: the information status of the person (new, contrast-coded as 0.5, and given, contrast-coded as –0.5), the information status of the object (new, contrast-coded as 0.5, and given, contrast-coded as –0.5), and the proficiency of the participant (cloze test score on a scale of 45). The linear mixed-effects model included proficiency, information status of the object, information status of the person, and their interaction as fixed effects, and participant and item as random variables. In addition to these variables, the growth curve analysis also included five orthogonal time coefficients (linear, quadratic, cubic, quartic, and quantic, computed from the 15 time intervals) as fixed effects and their interaction with the other fixed effects in the model, and the time coefficients were included as random slopes or curvatures for the participant random variable. Proficiency was not added as a fixed effect to the growth curve analysis as the model was complex and already had a large number of fixed effects. The fixed effects were added individually to the model and their effects on model fit were evaluated with model comparisons using the ANOVA function of R. Improvements in model fit were evaluated using –2 times the change in log-likelihood, which is distributed as χ^2 with degrees of freedom equal to the number of parameters added. The fixed effects were kept in the model only if they improved the fit of the model.[5]

Native speakers of French in Experiment 2a produced object nouns with greater overall duration, amplitude and pitch when it was new (different in the context and critical sentences) as

[5] Unlike the analysis of the eye-tracking data, L2 learners' production data will not be analyzed in a larger model on both L2 learners and native speakers' data, with L1 as fixed variable, because a straightforward comparison of the production measurements cannot be done between two groups with different participants, who have different speech rate and pitch ranges. The production data were not standardized (e.g., z-scores) because the number of participants in each group differs substantially, giving rise to z-score values that are also difficult to compare.

compared to when it was given (the same in the context and critical sentences). Similar findings have been reported for native English speakers ((e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010)). Therefore, it is predicted that overall duration, amplitude, and pitch of the object word should be greater when the object noun is new (different in the context and critical sentences) as compared to when it is given (the same in the context and critical sentences).

Native speakers did not produce a contrastive accent in the contrastive context (i.e., when the object was new but the person was given) in Experiment 2a. However, native speakers of English are known to produce a contrastive accent in this context in English (e.g., Ito, Speer & Beckman, 2004). It is possible that L2 learners will transfer their discourse representations from the L1 and produce a contrastive accent in French as they would in English. However, in order for L2 learners to make this transfer, they would first have to successfully map the contrastive accent to its discourse implications and then produce the contrastive accent in the appropriate context. In this case, in order to form the correct mapping, it is likely that the L2 learners in Experiment 2b would need to be at a higher proficiency than the L2 learners in Experiment 1b, who appeared to lack the correct mapping. Although the L2 learners in Experiment 2b are higher in proficiency than those in Experiment 2b (19 vs. 25), an independent samples t-test revealed that this difference is not significant, probably due to the broader proficiency range of the L2 learners in Experiment 2b. There is thus a chance that the L2 learners in Experiment 2b would produce contrastive accents in contexts that required them, even though those in Experiment 1b did not show a different performance in the felicitous (given person) and infelicitous (new person) conditions, and even though native French speakers in Experiment 2a did not produce such an accent. If learners produce a contrastive pitch accent in the contrastive context (i.e.,

when the object is new but the person is given), they should produce the new object word with higher amplitude and the first syllable of the object word with higher pitch when the person is given than when the person is new; for pitch, this means the pitch contour for the new object in the given person condition should have a more negative slope and/or a more concave shape than the pitch contour for the new object in the new person condition. However, it would be difficult to determine from such results whether L2 learners' representation of the contrastive pitch accent differs from that of native speakers, in that native speakers' non-production of a contrastive accent was attributed to methodological limitations rather than to a characteristic of French.

Since the two groups of L2 learners were not found to be significantly different in their French proficiency, there is a possibility that the L2 learners in Experiment 2b will behave comparably to those in Experiment 1b, possibly due to a lack of correct form-to-meaning mapping, as was hypothesized for Experiment 1b. Alternatively, the methodological flaws of Experiment 2a may also result in L2 learners' inability to produce the contrastive accent in the contrastive context in Experiment 2b. If L2 learners do not produce a contrastive accent in the required context, it will be difficult to assess whether these results are due to some qualitative difference between L2 learners' and native speakers' representations of the accent or to some methodological limitations of the task.

L2 learners in Experiment 1b patterned similarly to native French speakers in their use of the nuclear pitch accent in sentence comprehension, although it is unclear whether this difference can be attributed to their learning of nuclear pitch accents in French. However, input on the nuclear pitch accent, either through exposure to native speech or via explicit classroom instruction, is very frequent in French. Therefore, it is expected that the L2 learners in

Experiment 2b should produce pitch contours that approximate that of the nuclear pitch accent in French, at least for the conditions where no contrastive accent is expected.

9.5 Results

9.5.1 Duration

Figure 11 shows the object word duration for L2 learners in all four conditions. The likelihood ratio tests found that the linear mixed-effects model with object, person, proficiency, and the interaction between object and proficiency as fixed effects had the best fit. This model is provided in Table 16.

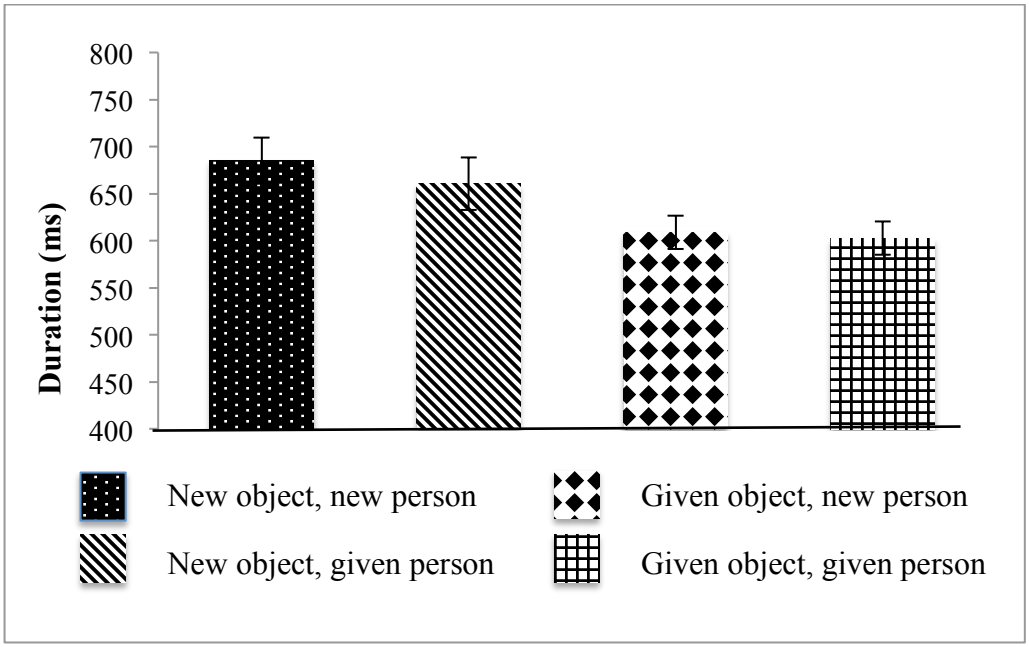

Figure 11. L2 learners' object word duration (mean and standard error)

Table 16: Linear mixed-effects model on L2 learners' object word duration with object, person, proficiency, and the interaction between object and proficiency as fixed effects

Variable	Estimate	Standard Error	*t*	*p*
Intercept	0.7809630	0.0672976	11.605	**< .05**
Object	0.0678908	0.0292198	2.323	**< .05**
Person	0.0150164	0.0070688	2.124	**< .05**
Proficiency	–0.0052818	0.0023859	–2.214	**< .05**
Object x Proficiency	–0.0002836	0.0010221	–0.277	>.05

There were significant effects of object, person, and proficiency on duration, but no interaction between proficiency and object (despite the interaction term improving the model). The directionality of the coefficient for the effect of object suggests that the duration of the object word was longer when it was a new object than when it was a given object. The directionality of the coefficient for the effect of person also suggests that the duration of the object word was longer when the person was new than when the person was given. The negative coefficient for the effect of proficiency indicates that as proficiency increased, the overall object word duration decreased. Since there was no significant interaction between any of the variables, it can be said that this effect of person is true for both object types.

The effect of object that L2 learners showed is similar to that observed in previous studies on English (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010), and it is similar to the effect shown by the native French speakers in Experiment 2a, indicating that L2 learners produced given (repeated) object words with shorter duration, amplitude and pitch as compared

to new object words. However, in the new object condition, the object word is not produced with greater duration in the given person condition than in the new person condition. Although these results pattern like those of the native French speakers in Experiment 2a, they differ from the findings of previous research in English (e.g., Ito, Speer & Beckman, 2004). Finally, the effect of proficiency can be interpreted as an overall increase in L2 speech rate (decrease in duration) with increasing proficiency, which is consistent with previous studies on L2 speech rate (e.g., Lennon, 1990; Towell, 2002; Trofimovich & Baker, 2006), although it should be noted that some of these previous studies use other variables such as age of arrival in the L2 environment and/or length of residence as indices of proficiency (rather than language proficiency). Given the lack of interaction between proficiency and the other fixed effects, proficiency did not modulate the production of duration based on information status of the referents in this study.

9.5.2 Amplitude

Figure 12 shows L2 learners' object word amplitude in all four conditions. According to the likelihood ratio tests, the model with the best fit was one that included object, person, proficiency, and the interaction between object and proficiency as fixed effects. This model is presented in Table 17.

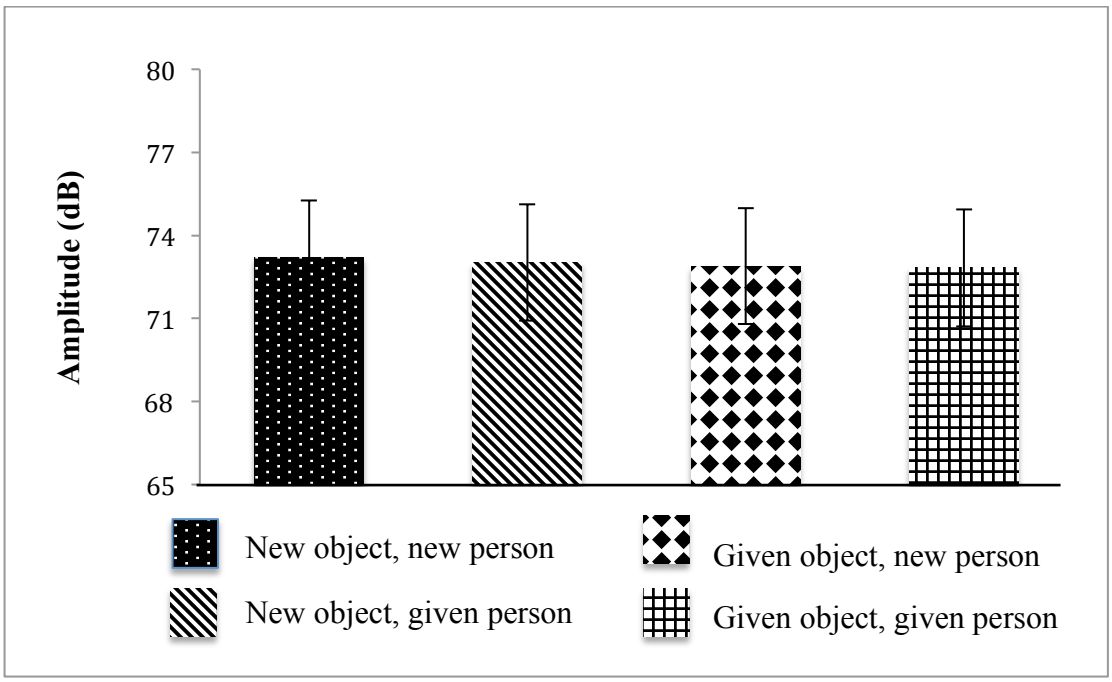

Figure 12: L2 learners' object word amplitude (mean and standard error)

Table 17: Linear mixed-effects model on L2 learners' object word amplitude with object and person as fixed effects

Variable	Estimate	Standard Error	*t*	*p*
Intercept	74.41828	8.00773	9.293	**< .05**
Object	1.13857	0.59118	1.926	**< .05**
Person	0.09096	0.14377	0.633	>.05
Proficiency	–0.05249	0.28967	–0.181	>.05
Object x Proficiency	–0.02879	0.02069	–1.391	>.05

There was a marginally significant effect of object on amplitude. The directionality of the coefficient indicates that the amplitude of the word was higher when it was a new object than

when it was a given object. There was no effect of person on object word amplitude, indicating that learners did not produce the word with significantly different amplitude depending on the person.

L2 learners' results for the effect of object thus also pattern similarly to those observed in previous studies on English (e.g., Aylett & Turk, 2004; Bard & Aylett, 1999; Bell, Brenier, Gregory, Girand, & Jurafsky 2009; Fowler & Housum, 1987; Lam & Watson, 2010), and similarly to the results of the native French speakers in Experiment 2a, indicating that new object words have larger amplitude than given (repeated) object words in French. However, in the new object condition, the object word was not produced with larger amplitude in the given person condition than in the new person condition. These results differ from the findings of previous research in English (e.g., Ito, Speer & Beckman, 2004), suggesting that L2 learners do not use amplitude to realize a contrastive accent in French. The absence of an effect of person also suggests that unlike the native French speakers in Experiment 2a, L2 learners in this experiment do not use amplitude to signal the information status of the person on the object word.

9.5.3 Pitch Contours

Figure 13 shows L2 learners' pitch contour for the object word in all four conditions. Growth curve analysis was used to analyze the pitch of the object word. As can be seen in Figure 13, all words appear to be produced with a clear rise on the final syllable, suggesting that the L2 learners were aware of the nuclear pitch accent marking a final rise in French. The best shape for the modeled line (determined with a comparison of linear, quadratic, cubic, quartic, and quantic models) was consistently that corresponding to a quartic model, which included four orthogonal time coefficients, despite the apparent quantic shape of the lines in Figure 13.

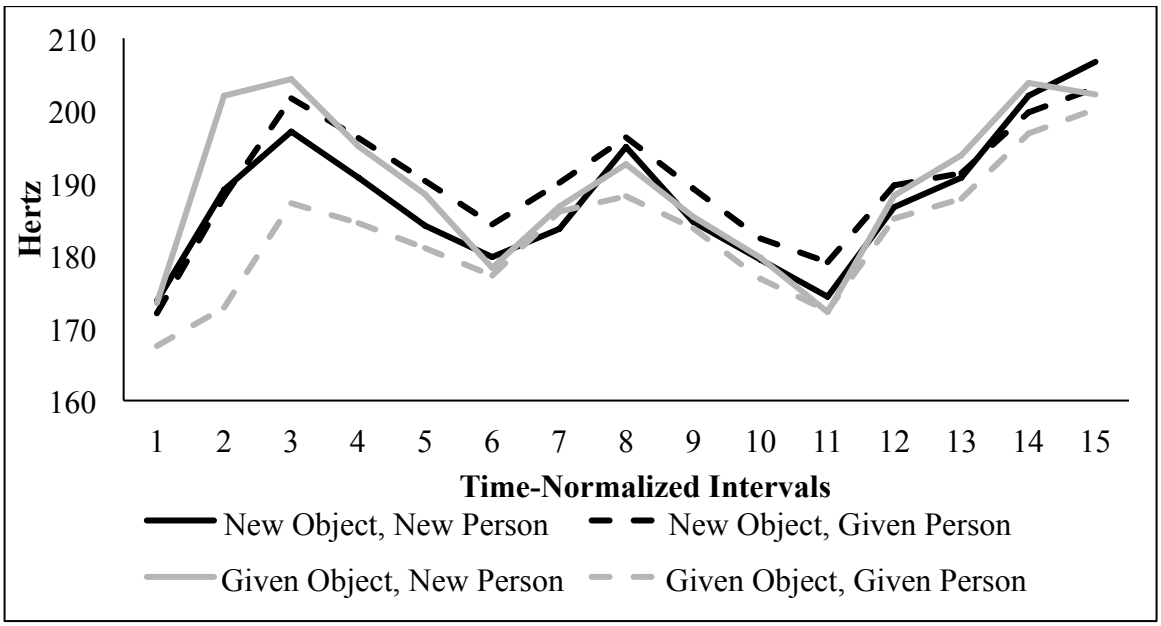

Figure 13. L2 learners' pitch contour for the object

Thus, a model comparison was carried out with all four orthogonal time coefficients, object, person, and all interactions as fixed effects. The model with the best fit was one with the four time coefficients, object, person, and the interaction between the time coefficients and both object and person as fixed effects. Proficiency was not added to this model as it would have further increased the complexity of the model, making it difficult to interpret the results. Table 18 shows the results of this model. The four orthogonal time coefficients are abbreviated as ot1, ot2, ot3, and ot4.

Table 18: Growth curve analysis on L2 learners' pitch contour with orthogonal time coefficients, object, person, and the interaction of the time coefficients with both object and person

	Estimate	Standard Error	*t*	*p*
(Intercept)	187.5835	8.0140	23.407	**< .05**
ot1	12.0658	5.1037	2.364	**< .05**
ot2	13.4460	4.5967	2.925	**< .05**
ot3	19.4952	2.9434	6.623	**< .05**
ot4	–2.2467	1.9935	–1.127	> .05
Object	4.2348	0.6663	6.356	**< .05**
Person	2.1708	0.6612	3.283	**< .05**
ot1:Object	1.9102	2.7439	0.696	> .05
ot2:Object	–1.4392	2.7914	–0.516	> .05
ot3:Object	4.5174	2.6425	1.710	> .05
ot4:Object	3.1795	2.5156	1.264	> .05
ot1:Person	0.1383	2.7362	0.051	> .05
ot2:Person	3.7762	2.7798	1.358	> .05
ot3:Person	–0.2696	2.6308	–0.102	> .05
ot4:Person	–2.1017	2.5073	–0.838	> .05
Object:Person	–1.7725	1.3246	–1.338	> .05
ot1:Object:Person	16.0862	5.4815	2.935	**< .05**
ot2:Object:Person	–0.2702	5.5745	–0.048	> .05
ot3:Object:Person	–2.3871	5.2739	–0.453	> .05
ot4:Object:Person	8.2273	5.0191	1.639	> .05

From Table 18, we can see that the pitch contours show a significant positive slope as well as significant quadratic and cubic curvatures. There is a significant effect of object, with higher pitch on the object word when the object is new than when it is given. There is also a significant effect of person, with higher pitch on the object word when the person is new than when it is given. Furthermore, there is a significant three-way interaction between the linear time coefficient, object, and person. The directionality of the coefficient, together with the visualization in Figure 13, suggests that this three-way interaction stems from the greater effect of object on the slope of the pitch contour in the new person condition as compared to the given person condition, with the pitch contour having a steeper (more positive) slope in the new object condition than in the given object condition only when the person is new, not when the person is given. In Figure 13, for the new person conditions, it can been seen that the flatter slope of the given object as compared to the new object results from the increase in pitch early on in the word, indicating that L2 learners produced the given object word with an initial pitch rise. These pitch results suggest that L2 learners produce new object words with higher pitch than given (repeated) object words, and they produce object words with higher pitch if these objects are used with a new person than if they are used with a given person. Like the amplitude results, the absence of an effect of person in the new object conditions indicates that L2 learners, like native French speakers, do not use pitch to contrast the two objects belonging to the same person.

Notice that L2 learners produce an early pitch rise in the given object condition as compared to the new object condition when the person is new but not when the person is given. However, this early rise cannot be interpreted as a contrastive pitch accent for the following reasons: First, the early rise is observed as an effect of object and not an effect of person, suggesting that it is not anticipatory in nature (an anticipatory accent would have been produced

to distinguish between the two different person nouns). Second, the interaction between object and person (which was modulated by time) was found only in the analysis of pitch, not in the analysis of duration or amplitude. Third, L2 learners produced the AP-final object word with a pitch rise (consistent with the nuclear pitch accent) in all four conditions. In French, the immediate post-focal sequence should be de-accented; in other words, in the presence of a contrastive pitch accent on the initial syllable of the word, the third and final syllable would not bear a nuclear pitch accent. This evidence strongly points to the early rise not being a contrastive pitch accent.

9.6 Discussion

The above results show that L2 learners, like the native French speakers in Experiment 2a and native speakers of English in previous research, produced given (repeated) object nouns with shorter duration, lower amplitude, and lower pitch as compared to new object nouns. However, in the new object conditions, the effect of person was either not significant or it was in the opposite direction to what was predicted, with the new object for the new person being longer in duration or higher in pitch than the new object for the given person. These results suggest that L2 learners signaled the information status of the object and the person as new vs. given, but did not produce the expected contrastive accent on the new object in the given person condition.

While native speakers of English are known to produce a contrastive accent in a similar context in English (e.g., Ito, Speer & Beckman, 2004), the L2 learners in this study did not transfer their discourse representation of the accent from English to produce a contrastive accent in French. One possible interpretation of these results is that the L2 learners in Experiment 2b may have failed to map the contrastive accent to its discourse implications in French. This

conclusion would be consistent with that of Experiment 1b, where L2 learners did not show sensitivity to the contrastive accent at the speech integration level. The L2 learners in Experiment 2b had numerically higher proficiencies than those in Experiment 1b (25/45 vs. 19/45, respectively, on the cloze test), but this difference was not statistically significant, as revealed by an independent samples t-test. Thus, it would not be surprising if the L2 learners in Experiment 2b also had discourse representations of the contrastive accent that were qualitatively different from those of native speakers at that point in their L2 linguistic development. One important caveat remains, however: Since the native speakers in Experiment 2a fail to produce a contrastive pitch accent in the expected context (something that was attributed to possible methodological limitations with the task), the same limitations may hold true for the L2 learners in Experiment 2b. In other words, no firm conclusion can be drawn from L2 learners' non-production of a contrastive accent in Experiment 2b.

A three-way interaction between the linear time coefficient, object, and person indicated that the pitch contour when the person was new had a steeper slope when the object was new than when the object was given. However, this initial rise is unlikely to be a contrastive pitch accent, because L2 learners did not show the same pattern of results in the duration and amplitude measurements. Furthermore, all four word types had a final rise, suggesting that prosodically the L2 learners may have instead produced a nuclear pitch accent in all conditions. (Native speakers did not show such final rise, because they produced the sentences at a faster rate and thus the object word may not have been in AP-final position.) Therefore, it cannot be said that the L2 learners' early pitch rise was an instantiation of a contrastive accent. It should be noted that the French speakers in Experiment 2a did not produce such a rise, however. This

difference suggests that the learners may not have the same representations as native speakers, even though neither group produced a contrastive pitch accent.

It was also predicted that L2 learners would produce the nuclear pitch accent in contexts where they did not produce a contrastive pitch accent. As mentioned above, in all four conditions in Experiment 2b, L2 learners produced the object word with a final rise, consistent with the final nuclear pitch accent in French. Thus, L2 learners appeared to have attempted to produce a nuclear pitch accent in French, the pitch height of which was modulated by the newness/givenness of the object and of the person. These results ultimately suggest that L2 learners have learned that the AP in French ends with a final rise.

Chapter 10 discusses the findings of Experiments 1 and 2 in light of previous research on the acquisition of suprasegmentals in the L2.

Chapter 10

General Discussion and Conclusions

The central question addressed in this dissertation research is whether L2 learners' processing and production of pitch accents in French is qualitatively similar to that of native speakers, as evidenced by the mapping of the accents (or lack thereof) to their discourse implications. While firm conclusions cannot be drawn, evidence from the two experiments presented here suggests that L2 learners may have difficulty in mapping the contrastive pitch accent to its discourse meaning. The first experiment examined the question by investigating native speakers' and L2 learners' comprehension of words that receive a nuclear or contrastive pitch accent, and the second experiment examined it by investigating their production of these pitch accents. The combined findings of both experiments for each accent are discussed below.

Experiment 1 illustrates that neither native French listeners nor L1-English L2 learners of French use the nuclear pitch accent to actively predict referents. The nuclear pitch accent does not constrain their interpretation of sentences, as all referents remain possible upon hearing the nuclear pitch accent. In this respect, L2 learners pattern like native speakers. These results are consistent with the fact that the nuclear pitch accent is uninformative in terms of upcoming referents in French. Rather, the location of nuclear pitch accents is determined by the prosodic structure of the sentence (e.g., Jun & Fougeron, 2000, 2002; Welby, 2006). The frequency with which nuclear pitch accents occur in French, and the fact that they tend to be taught in the teaching of French pronunciation, may explain why L2 learners did not interpret this accent as signaling new referents in the discourse. However, it is difficult to know whether these results are indicative of any L2 learning given that they stem from the absence of an effect of person.

Unlike the nuclear pitch accent, the contrastive accent in French does provide information about the status of referents in the discourse. Experiment 1 shows that native French speakers' sentence interpretation is constrained by the contrastive pitch accent, increasing the amount of lexical competition when the actual referent does not match the expected referent of the listener. These results are consistent with the findings of Magne et al. (2005), who demonstrated French listeners' sensitivity to the contrastive pitch accent. These results also show that French listeners' interpretation is constrained similarly to that of native speakers of English (e.g., Ito & Speer, 2008), but unlike native English speakers, native French listeners do not use the contrastive accent to actively predict referents. Instead, they show sensitivity to this accent at the level of integration of speech information, when they encounter a referent that would not be expected based on the accent. A possible reason is that focus may be cued more reliably by syntactic and prosodic cues together than by prosodic cues alone, and native French listeners, despite their sensitivity to prosodic focus, may rely more on syntactic focus than the native English-speaking listeners in previous studies to actively predict referents.

In the case of English L2 learners of French, the contrastive pitch accent suggests difficulty using this information to make inferences about discourse referents, even though they appear to be sensitive to its saliency. In Experiment 1, L2 learners do not use the contrastive pitch accent to actively predict referents in the discourse, much like native listeners. There are a few possible explanations for this observation. One possibility is that L2 learners have successfully learnt the mapping between the form of the contrastive pitch accent and its meaning in the discourse, but, like native speakers, they may have come to expect a combination of prosodic and syntactic cues to signal focus, thereby failing to use just prosodic cues to actively predict referents. A second possibility is that L2 learners have successfully learned the mapping

between the form of the contrastive pitch accent and its meaning in the discourse, but are not able to use it to actively predict referents due to general difficulties in using linguistic information predictively (e.g., Kaan, 2014; Dussias et al., 2013; Grüter et al., 2012; Grüter & Rohde, 2013; Hopp, 2013; Lew-Williams & Fernald, 2010; Martin et al., 2013). However, unlike native French listeners, L2 learners do not show sensitivity to the contrastive accent at the level of speech integration, when they encounter a referent that would not be expected based on the accent. This perhaps suggests that L2 learners may not have learned the mapping between the form of the contrastive pitch accent and its meaning in the discourse, and may have qualitatively different discourse representations compared to native speakers.

The results of Experiment 2 show that native speakers did not produce a contrastive pitch accent in a context that would require them to produce this accent. Comparable native speakers in Experiment 1, however, did use this accent in speech comprehension, and had the appropriate discourse interpretation of the accent. One explanation of these diverging results could be methodological limitations of Experiment 2 (e.g., Experiment 2 included only two referents, thus limiting the need for French speakers to distinguish among different referents). Given the findings of previous studies on the production of contrastive accents in French (e.g., Féry, 2001), the circumstances under which and the frequency with which French speakers produce contrastive accents are unclear. Corpus studies would be useful to show the relative frequencies of the contrastive and nuclear pitch accents in French. This would in turn help identify how these accents should be presented in second language instruction.

The results of Experiment 2 show that L2 learners attempted to produce a nuclear pitch accent in French, as evidenced by their production of the object word with a final rise, with the pitch height of this accent being modulated by the newness/givenness of the object and of the

person. This rise suggests that L2 learners have learned that the nuclear pitch accent (final rise) in French signals the end of the AP. However, it is clear from the results of Experiment 2 that L2 learners did not produce a contrastive accent in the context in which they were expected to. In this case, it is difficult to draw firm conclusions, since the control group (native speakers) also failed to produce the contrastive accent, something that we attributed to possible methodological limitations of Experiment 2. A possible interpretation is that the L2 learners have indeed failed to map the contrastive accent to its discourse interpretation. Such an interpretation is consistent with the findings of Experiment 1 with L2 learners being comparable in proficiency to those in Experiment 2. It may thus be that L2 learners at this point in their linguistic development have not linked the form of the contrastive accent to the corresponding discourse representations. However, it is also possible that the experimental design simply did not succeed in eliciting a contrast between the two different objects of a given referent. L2 learners did produce an initial rise on the first syllable of the object word, but it cannot be interpreted as a contrastive pitch accent due to the fact that they produced a final rise in all word types.

L2 learners have to learn how French and English differ in their realization of nuclear and contrastive pitch accents in order to successfully use them to comprehend and produce sentences. In the present study, L2 learners learning French would have to first learn that prominence in French is not lexical, but phrasal, and therefore different from English. This entails learning that words in French are not stressed on the first syllable, as is the tendency in English, where this location is lexically determined. They have to learn that instead, it is the final syllable of the word that is stressed, and the location of the nuclear pitch accent signaling this phrase-final rise is determined not lexically, but by sentence structure. The nuclear pitch accent in French thus serves a very different function from the one in English, in that it does not provide information at

the level of the discourse. L2 learners must then learn that a nuclear pitch accent in French does not signal new (or any) information at the level of the discourse, unlike in English, but instead simply provides a cue to the syntactic and prosodic structure of the sentence.

The fact that L2 learners in this study do not integrate the nuclear pitch accent in comprehension to predict referents is not conclusive evidence of native-like patterns of discourse representations, but is consistent with such an explanation. When it comes to producing the nuclear pitch accent, it is clear that L2 learners are able to produce the object word with a final rise. This indicates that they have learnt not to stress the word on the initial syllable, but on the final one. Thus, these L2 learners at high-intermediate proficiency levels appear to have learned to signal AP-final words with a nuclear pitch accent.

The contrastive pitch accent has similar discourse implications in both French and English. The location of this accent is determined lexically in English, but in French, it usually appears on the first syllable. However, the L2 learners in this study did not integrate the contrastive pitch accent in speech comprehension in that the accent did not increase the amount of lexical competition when used infelicitously. While the lack of predictive use of the accent can be explained by general difficulty in using linguistic information predictively (for discussion, see Kaan, 2014), the lack of lexical competition points to difficulty in mapping the accent to its discourse implication. The effect of the accent helping learners reach the target faster is likely to be a saliency effect; as such L2 learners seem to be sensitive to the increased overall prominence of the word (see Figure 3 and Table 3). Thus, despite similarities between the discourse implications of the accent in the L1 and L2, learners may have failed to correctly map the accent to its discourse implications.

Previous studies have argued that L2 learners may not rely on prosody due to factors such as over-reliance on lexical information (e.g., White, Melhorn, & Mattys, 2010), differences between L1 and the L2 of the learners (e.g., Tremblay, Coughlin, Bahler, and Gaillard, 2012), and difficulty in integrating different types of information (e.g., Dekydtspotter et al, 2008). One or more of these factors, especially difficulty integrating different types of information, may be responsible for our L2 learners' results.

In this study, proficiency was not found to modulate L2 learners' use of pitch accents in relation to their anticipation or production of discourse referents. The L2 learners in this study were of intermediate to high-intermediate proficiency. Lower-proficiency L2 learners could not be tested, as they would not have been able to complete the task due to its high cognitive demands. However, it is possible that task demands were high even for the L2 learners in this study. In other words, the L2 learners in this study may not have shown sufficient variability in their knowledge of the contrastive accent in French, with most of them possibly not knowing the accent or having been sufficiently exposed to it or not having been taught it. Further research examining very highly proficient learners with extensive immersion in the target language may help shed more light on whether proficiency in fact modulates the ability to map the contrastive accent to its discourse meaning.

The inability of L2 learners at an intermediate proficiency level to map the contrastive accent to its discourse implication is not completely surprising given the absence of prosodic focus in classroom French instruction and the relatively limited exposure most L2 learners receive to spoken French. It is possible that L2 learners could be taught how to use contrastive pitch accents in the classroom. Further research can examine whether additional input and/or explicit instruction would make pitch accents more learnable for L2 learners. Given that they are

sensitive to the accents, it may be possible to help them complete the mapping of the accent to its discourse implication with the help of language instruction.

Appendix A. List of experimental words in experiments 1a and 1b

bactérie	graffiti
baladeur	hamburger
balancoire	haricot
bandana	heptagone
baromètre	hérisson
bazooka	jacuzzi
beaujolais	jambonneau
calicot	jardinet
caligramme	kangourou
camembert	kimono
camionnette	labyrinthe
camomille	limonade
canapé	macaron
caravane	pamplemousse
cerf-volant	panini
champignon	pantalon
chocolat	parapluie
clarinette	perroquet
comité	porte-savon
confiture	pyjama
cornichon	satellite

dalmatien	tabouret
dentifrice	téléphone
formulaire	xylophone

Appendix B. List of critical words produced in experiments 2a and 2b

brocoli	microphone
canari	mocassin
caramel	panini
cardigan	pantalon
carrousel	papillon
champignon	parasite
chandelier	perroquet
chemisier	piranha
chocolat	pyjama
chrysantheme	recyclage
crocodile	satellite
graffiti	saucisson
jacuzzi	spaghetti
kangourou	téléphone
kimono	toboggan
macaron	volleyball

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