Prosodic Constraints in the Acquisition of English Primary Stress by French Canadian L2 Learners

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1. Introduction

The acquisition of second language (L2) prosodic representations has been investigated in several studies (e.g., Archibald, 1993; Brown, 1998; Steele, 2006). However, less frequent is research on the development of L2 prosodic representations across proficiency levels (for examples of longitudinal studies, see Abrahamsson, 2003 and Hansen, 2004). Examining the developmental path that L2 learners follow when acquiring abstract L2 prosodic representations is important for understanding how L2 acquisition takes place, because it can reveal the ways in which the interlanguage grammar is prosodically constrained at different developmental stages and why not all L2 learners ultimately reach target-like prosodic representations.

The present study sheds some light on these issues by investigating the acquisition of primary word stress by French Canadian L2 learners of English at three proficiency levels. Word stress is a particularly relevant linguistic phenomenon, because it reflects the shape of the prosodic structure that underlies L2 learners' production of L2 words. Since Canadian French and English differ substantially in their prosodic structure, they provide an ideal constellation of native language (L1) and target language for looking into this phenomenon. It will be shown that native speakers of Canadian French follow two different developmental paths in the acquisition of English stress, one which yields a target-like prosodic grammar and one which does not. It will further be argued that it may be difficult for L2 learners to recover from the non-target-like prosodic grammar they have acquired.

The paper is organized as follows: Section 2 presents the analysis of word stress that will be assumed for Canadian French and English; Section 3 reviews a study on the acquisition of English word stress by native speakers of Canadian French; Section 4 describes the method used in this study; Section 5 presents its results; Section 6 provides a discussion of the findings; and Section 7 concludes the paper.

2. Stress in (Canadian) French and English

In this study, stress is assumed to stem from the abstract prosodic structure of language. Consider the Prosodic Hierarchy partially represented in (1), which displays the suprasegmental units of

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organization of spoken language at and below the phrase level (e.g., McCarthy & Prince, 1986; Nespor & Vogel, 1986; Selkirk, 1984). Each of the units represents a well-defined domain in which specific phonological processes apply.

(1) PP (Phonological Phrase)
|
PW (Prosodic Word)
|
Ft (Foot)
|
σ (Syllable)
|
μ (Mora)

In this hierarchy, stress is the instantiation of the head of the foot, and stress placement is determined by the shape of the foot and its alignment with lower- and higher-level prosodic units (e.g., McCarthy & Prince, 1993).

2.1 (Canadian) French

In European French, the most prominent syllable is typically the last syllable not containing a schwa in the (Phonological) Phrase (Fouché, 1934; Garde, 1938; Jun & Fougeron, 2000; Mertens, 1993). In Canadian French, however, the most prominent syllable appears to be the last syllable not containing a schwa in the (Prosodic) Word (e.g., Walker, 1984; see Paradis & Deshaies, 1990 for evidence from perception data). These patterns are exemplified in (2), where primary stress is represented with an acute accent (´).

		European French	*Canadian French*
(2) a.	merveilleux chapeau 'wonderful hat'	[mɛʁvɛjøʃapó]$_{PP}$	[mɛʁvɛjǿ]$_{PW}$ [ʃapó]$_{PW}$
b.	merveilleux théâtre 'wonderful theater'	[mɛʁvɛjøteátχ(ə)] $_{PP}$	[mɛʁvɛjǿ]$_{PW}$ [teátχ(ə)]$_{PW}$

In Canadian French, the penultimate syllable can also be perceived as stressed if it contains a nasal vowel (/ã, ẽ, ɔ̃, œ̃/), an inherently long vowel (/ɛ, ø, o, ɑ/), or a syllable-final voiced fricative (/v, z, ʒ, ʁ/) (e.g., Ouellet & Thibault, 1996; Paradis & Deshaies, 1990). It is not clear, however, whether this effect is indeed the instantiation of the head of the foot or whether it is purely segmental, because stress is realized predominantly with duration in French (e.g., Walker, 1984; Wioland, 1984) and rhymes containing nasal vowels, inherently long vowels, and syllable-final voiced fricatives are longer than other rhymes in Canadian French.

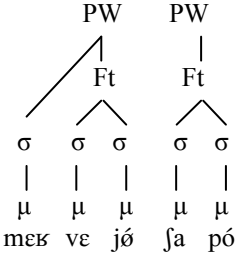
Stress does not appear to be iterative in Canadian French, as prominent and non-prominent syllables do not alternate in long words. Nevertheless, like in European French (e.g., Jun & Fougeron, 2000), there is an optional high tone (Hi) realized as higher pitch on the first or second syllable of the first content word in the phrase (e.g., Poiré & Kaminskaïa, 2004), as shown in (3). Some have considered this tone as evidence for secondary stress (e.g., Goad & Buckley, 2006), but the fact that it is optional makes it difficult to draw firm conclusions.

(3) a.	merveilleux 'wonderful'	[mɛʁvɛjǿ] Hi
b.	merveilleux chapeau 'wonderful hat'	[mɛʁvɛjǿʃapó] Hi

Given the usual word-final prominence in Canadian French, it has been proposed that the language has a single iambic (i.e., unstressed-stressed) foot, with its right edge being aligned with the

right edge of the Prosodic Word, as shown in (4) (e.g., Charette, 1991; Goad & Buckley, 2006; cf. Selkirk, 1978, and Montreuil, 2002 for European French). Word-final syllables optionally containing a schwa (e.g., words ending in an obstruent + liquid cluster) cannot be the head of the foot due to their weak or empty nucleus. They therefore lie outside the foot, as illustrated in (4b). These syllables have been analyzed as empty-headed syllables (e.g., Féry, 2003). Such a proposal accounts for both the optional production of a schwa in these syllables and the ordering of the consonants in the cluster (which would otherwise violate the Sonority Hierarchy).

(4) a.



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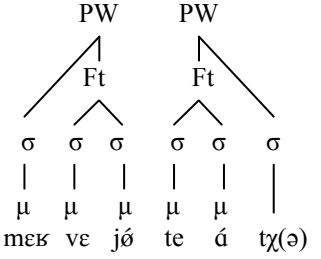


This analysis of Canadian French is the most plausible one, because prominence is typically word-final and predictably non-iterative in Canadian French. It is cross-linguistically preferable, as it assumes that Canadian French also has a foot (cf. Jun & Fougeron, 2000, Mertens, 1993, and Verluyten, 1982 for the proposal that European French does not have stress). Furthermore, it is consistent with the research showing that languages with an iambic foot realize stress predominantly with duration (e.g., Hayes, 1995).

2.2 English

By contrast, in English, the most prominent syllable in the majority of monomorphemic verbs and adjectives is the word-final syllable if it is heavy (i.e., if it contains a long vowel or a complex coda), and otherwise the penultimate syllable, as shown in (5); as for monomorphemic nouns, the most prominent syllable is typically the penultimate syllable if it is heavy (i.e., if it contains a long vowel or a simple coda), and otherwise the antepenultimate syllable, as illustrated in (6) (from Halle & Vergnaud, 1987, pp. 227–231). Multimorphemic words may or may not follow these patterns depending on the affix(es) attached to them.[1]

(5) a. direct (v.) [dɪɹɛ́kt]
b. absurd [əbsɜ́ɹd]
c. imagine [ɪmǽʤɪn]
d. certain [sɜ́ɹtn̩]

(6) a. agenda [ədʒɛ́ndə]
b. aluminium [əlʊ́mɪnm̩]

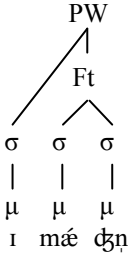
Unlike Canadian French, English has iterative stress. In monomorphemic, even parity words, stressed and unstressed syllables tend to alternate, as exemplified in (7a); in monomorphemic, odd parity words, they do not always alternate, as there is an overriding preference for initial stress, as illustrated in (7b) (from Halle & Vergnaud, 1987, pp. 243–245). Primary stress is usually placed on the rightmost stressed syllable in the word, and secondary stress on the remaining stressed syllables.

(7) a. onomatopoeia [ɑ̀nɔmæɾɔpíːə]
b. abracadabra [æ̀bɹəkədǽbɹə]

[1] A more thorough discussion of how affixation influences stress placement in English is beyond the scope of this study. The possible influence of surface stress patterns on L2 learners' prosodic representations will be discussed in Section 6.

English is generally analyzed as having a trochaic (i.e., stressed-unstressed) foot whose right edge is aligned with the right edge of the Prosodic Word, as illustrated in (8a) (e.g., Hammond, 1999; Pater, 2000). In order to explain the behavior of monomorphemic verbs and adjectives on the one hand, and of monomorphemic nouns on the other hand, it has been proposed that the last syllable of English nouns is extraprosodic (i.e., ignored for foot construction) (e.g., Hayes, 1981),[2] in which case the right edge of the foot aligns with the closest visible syllable to the right edge of the Prosodic Word, as shown in (8b). The sensitivity of stress placement to syllable weight has been attributed to the alignment of the head of the foot with heavy (i.e., bimoraic) syllables, as exemplified in (8c) and (8d) (e.g., Hammond, 1999; Hayes, 1995). For secondary stress, one foot is built at the left edge of the Prosodic Word, with all remaining feet being aligned with the right edge of the Prosodic Word, as illustrated in (8e) and (8f) (e.g., Hammond, 1999; Pater, 2000). Monomorphemic words that exceptionally do not follow this analysis (e.g., *banana, assassin,* etc.) are assumed (in this study) to have their stress placement lexicalized (for discussion of these exceptions, see Halle & Vergnaud, 1987, Hayes, 1981, Kager, 1989, Rice, 1996, and Selkirk, 1984).

(8) a.



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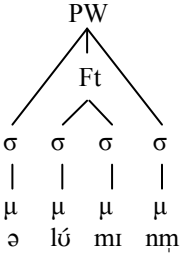

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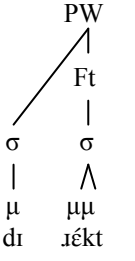

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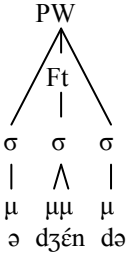
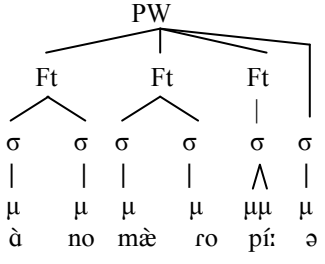
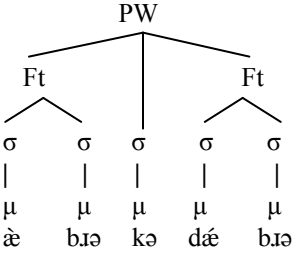


e.



f.



In light of the above analyses, in order to acquire the prosodic structure of English, native speakers of Canadian French must (among other things) reset foot headedness to the left and align the head of the foot with heavy syllables. Arriving at target-like generalizations may not be easy, as words with seemingly identical stress placement can have different underlying representations (e.g., (8a) vs. (8d)). The fact that syllables of different shapes attract stress in different word classes (e.g., (5a) vs. (6a)) can also pose difficulties to L2 learners. This research will determine whether target-like L2 prosodic representations can nevertheless be acquired, and if so, how they develop across proficiency levels. The focus will be on foot headedness and on the alignment of the head of the foot with heavy syllables.

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[2] Note, however, that the last syllable of monomorphemic nouns is not extraprosodic when it contains a long vowel and is closed by a coda (e.g., *police* [pəlíːs]).

3. Pater (1997)

Working within the Principles and Parameters Theory (Chomsky, 1981), Pater (1997) investigated whether native speakers of Canadian French learning L2 English can set the parameters underlying stress placement from the French value to the English value. The parameters that are pertinent for this study are presented in (9). They were adapted from Archibald (1993), who in turn relied on Hayes' (1981) analysis and Dresher and Kaye's (1990) model.

(9)

Parameter	*English setting*	*French setting*
P2: Foot Size	Bounded	Unbounded
P3: Foot Headedness	Left	Right
P4: Quantity Sensitivity	On	Off
P6: Word Headedness	Right	Right

In Dresher and Kaye's account (among other accounts), feet were classified as bounded (i.e., usually binary) or unbounded: languages were considered to have bounded feet if they had iterative stress and unbounded feet if they had non-iterative stress.[3] Foot Size (P2) was thus set to "bounded" in English and to "unbounded" in French. Foot Headedness (P3) was considered "left" in English because the foot in English is trochaic, but it was considered "right" in French because stress in French is word-final. In English but not French, Quantity Sensitivity (P4) was set to "on," because syllable weight influences stress placement. Finally, Word Headedness (P6) was considered "right" in both languages, because it is the rightmost stressed syllable in the word that receives primary stress.

French Canadian L2 learners of English in their first week of a summer immersion program and native speakers of English completed a nonsense word production task. The use of nonsense words was indeed necessary for tapping the generalizations that L2 learners had made with respect to stress placement, as accurate stress placements in real words could also have been lexicalized. The stimuli included trisyllabic and quadrisyllabic nonsense words containing a light (i.e., CV, where C represents a consonant and V a vowel) or heavy (i.e., CVC/CVV) penult. All the words were contextualized as nouns and were produced at the beginning of a sentence. The participants with a target-like grammar were expected to produce primary stress on the penult when it was heavy and the antepenult when the penult was light, and they were expected to produce secondary stress two syllables to the left of the syllable with primary stress.

The native speakers' stress patterns were more or less as expected in the trisyllabic words, but there was some variability in the quadrisyllabic words, with primary stress falling on some of the light penults. According to Pater, these results reflect the native speakers' sensitivity to the class of exceptional English nouns in which stress is placed on the penultimate syllable even if it is light (e.g., *banana, assassin,* etc.). Despite this variability, the placement of secondary stress in the quadrisyllabic words was consistently two syllables to the left of the syllable with primary stress.

Similarly to the native speakers, the L2 learners almost always stressed the trisyllabic words with a light penult word-initially, which suggests that they had little difficulty resetting foot headedness to the left. Yet, on the trisyllabic words with a heavy penult, they stressed either the penult or the antepenult, and when they stressed the antepenult, there was a tendency for the vowel in this position to be tensed. Pater interpreted these results as an indication that the L2 learners were in the process of learning that syllable weight influences stress placement in English. However, since no individual results were reported, it is unclear whether some L2 learners but not others were sensitive to syllable weight, or whether all L2 learners had indeterminate interlanguage grammars. As for the quadrisyllabic words, secondary stress tended to fall two syllables to the right of the syllable with primary stress. This led Pater to conclude that the L2 learners built binary feet iteratively, but that word headedness had been mis-set to the left.

The present study, to which we now turn, further investigates the acquisition of the trochaic foot and the alignment of the head of the foot with heavy syllables by French Canadian L2 learners of

[3] In constraint-based phonology, because constraints are violable, all feet are binary and the syllable(s) that cannot be incorporated into the foot link(s) directly to the Prosodic Word (McCarthy & Prince, 1993).

English, but it does so with a slightly different experimental design, and it examines the group *and* individual results of L2 learners at distinct proficiency levels in English. This will help tease apart L2 prosodic indeterminacy from inter-learner variability while shedding light on the developmental path that native speakers of Canadian French follow when acquiring English word stress.

4. Method

4.1 Participants

Seventy-six French Canadian L2 learners of English with little knowledge of other languages (age 18–51) and 31 native speakers of Canadian or American English with little knowledge of French (age 18–55) took part in the study. The L2 learners and native speakers were allowed to participate in the study only if they qualified their knowledge of languages other than English and their knowledge of French (respectively) as no higher than "intermediate". Information collected in a language background questionnaire revealed that the L2 learners had first been exposed to English at the age of 9;1 (standard deviation (SD) = 1;10); most of them (65/72) had first been exposed to English at school; they had received 9 years 7 months of English instruction (SD = 3;1); and they had spent between 0 and 15 years in an English environment.

The L2 learners were grouped into three proficiency levels on the basis of a cloze (i.e., fill-in-the-blank) test and a read-aloud task. The cloze test (Brown, 1980) aimed to assess the L2 learners' morphosyntactic, lexical, and discourse competence. The read-aloud task provided a measure of L2 phonological competence (see Colantoni & Steele, 2007, for a similar procedure). Specifically, the L2 learners were audio-recorded while reading aloud a short excerpt from a newspaper article, and their foreign accents were rated by five native speakers of English (3 Canadian, 2 American) on a scale from 1 to 5 (1 = very strong accent; 2 = strong accent; 3 = noticeable accent; 4 = mild accent; 5 = no accent). Global proficiency scores were computed by adding the L2 learners' accuracy rates on the cloze test and the mean accent ratings they received on the read-aloud task, with each proficiency measure receiving equal weight. Three groups were formed from the global scores. Fewer participants were included in the most advanced group on the basis of the author's intuition that few L2 learners were highly proficient in English. The scores on the individual proficiency tests and the global proficiency scores are presented in Table 1.

Table 1. Mean Scores (SD's) on Proficiency Measures

Proficiency Level	Cloze (/5)	Read-aloud (/5)	Global (/10)
Intermediate (n = 29)	3.1 (0.8)	2.5 (0.5)	5.6 (1.0)
Low-advanced (n = 29)	4.1 (0.3)	3.2 (0.4)	7.3 (0.3)
High-advanced (n = 18)	4.3 (0.4)	3.9 (0.4)	8.2 (0.4)

4.2 Materials

The participants completed a nonsense word production task. The test items included 12 disyllabic words containing light syllables (i.e., LL, e.g., [dʌʃm̩]), 12 trisyllabic words containing a light, a heavy, and a light syllable (i.e., LHL, e.g., [ʃʌmolfn̩]), and 24 filler words, all of which were contextualized as nouns (see the Appendix for the complete list of experimental items). Initial syllables contained a lax vowel (i.e., /ʌ, ɪ, ʊ/) and final syllables contained a syllabic sonorant (i.e., /m̩, n̩, l̩/) so that the nonsense words would be phonologically possible in English.[4] The penult in the trisyllabic words contained a liquid in coda position so that it would be heavy.

[4] Due to its prosodic structure, English does not have multisyllabic words that both end with a syllabic sonorant and are stressed word-finally. There is therefore a possibility that the participants will not stress word-final syllables because they contain a syllabic sonorant. Unfortunately, this problem could not be avoided. The only way to determine whether L2 learners have acquired a trochaic foot is by using light syllables, because heavy syllables can form a monosyllabic foot on their own. Word-final light syllables in English (i.e., word-final syllables not considered heavy in any word class) contain either a syllabic sonorant (e.g., *button* [bʌ́.ʔn̩]) or a schwa (e.g., *comma* [kʌ́.mə]). Since schwas are never stressed in French, using a word-final schwa would not have

The disyllabic words were used to determine if foot headedness had been (re)set to the left (since single light syllables cannot form a foot). The trisyllabic words were used to establish if the head of the foot was aligned with the heavy syllable. Table 2 provides a typology of the possible interlanguage grammars that the L2 learners might exhibit.

Table 2. Typology of Interlanguage Grammars

Production	Grammar	Foot Headedness	Alignment with H
(L<u>L</u>) + L(H<u>L</u>)	L1 Transfer	–	–
(<u>L</u>L) + (<u>L</u>H)L	Type A	+	–
(L<u>L</u>) + (L<u>H</u>)L	Type B	–	+
(<u>L</u>L) + L(<u>H</u>)L	Target-like	+	+

Note. The underlined syllable is the head of the foot, and the parentheses represent foot edges.

If the L2 learners have not reset foot headedness to the left and do not align the head of the foot with the heavy syllable (i.e., L1 transfer), they should stress the last syllable of both word types; if they have reset foot headedness to the left but do not align the head of the foot with the heavy syllable (i.e., Type A grammar), they should stress the first syllable of both word types; if they have not reset foot headedness to the left but do align the head of the foot with the heavy syllable (i.e., Type B grammar), they should stress the second syllable of both word types; finally, if the L2 learners have reset foot headedness to the left and align the head of the foot with the heavy syllable (i.e., target-like grammar), they should stress the penult of both word types.[5] The remaining two logical possibilities (i.e., <u>L</u>L + LH<u>L</u>, L<u>L</u> + <u>L</u>HL) are not expected under the analyses presented in Section 2.

All the words were produced in the sentence "The yellow ____ was sold yesterday." This sentence made it possible to contextualize the nonsense words as nouns, and it decreased the likelihood that the nonnative speakers would use the high tone (Hi) found at the beginning of the Phonological Phrase in (Canadian) French to produce English stress (e.g., Jun & Fougeron, 2000): if they were to produce the high tone, the latter would fall on the first syllable of *yellow* rather than on the nonsense word, since *yellow* is the first content word in the Phonological Phrase.

The nonsense words were recorded one syllable at a time by a phonetically trained native speaker of American English. They were recorded with a Marantz PMD 660 Solid State recorder and a Rode NT 1-A Condenser microphone at a sampling rate of 44,100 kz and 32-bit. The recordings were then transferred digitally onto a notebook computer and manipulated with the audio editor software Audacity (<u>www.audacity.sourceforge.net</u>). The syllables were normalized for amplitude, duration, and

been appropriate to identify the foot shape that French Canadian L2 learners of English use to produce English words. Word-final syllables containing a lax vowel (e.g., [ʊ], [ɪ], [ʌ], etc.) but no coda could not be used either, because they are not attested in English. Since English syllabic sonorants *can* be stressed when they are not in word-final position (e.g., *bully* [bl̩.li]), it was judged that this syllable type would be the best for the last syllable of the nonsense words in this experiment.

[5] An anonymous reviewer pointed out that disyllabic words stressed initially may not provide evidence for the trochaic foot if the syllable containing the syllabic sonorant is analyzed as an empty-headed syllable and left out of the foot. First, it is worthwhile mentioning that Canadian French does not have syllabic sonorants, and empty-headed syllables do not often contain a schwa in continuous speech. In fact, it is much more common for empty-headed syllables with complex onsets to have their liquid dropped (e.g., *théâtre noir* [teάtnwáʁ] 'black theater') than to contain a schwa (e.g., [teάtχənwáʁ]). It is thus somewhat unlikely that French Canadian L2 learners of English will produce syllables containing a syllabic sonorant as empty-headed syllables. Second, this analysis is largely incompatible with the results (see Section 5), which show that most L2 learners stress the first syllable of both word types—it is not clear how L2 learners with an iambic foot could stress the first syllable of trisyllabic words. This analysis would also predict that many L2 learners would stress the second syllable of the trisyllabic words, which is not the case. The current typology of L2 grammars therefore seems to make the right predictions for the acquisition of L2 prosodic representations.

fundamental frequency so that the nucleus in each syllable would have a similar intensity, length, and pitch.[6]

4.3 Procedures

The participants were tested individually in a quiet room. They heard the test items over headphones. For each nonsense word, the individual syllables were presented at a 500-millisecond interval. One-hundred-millisecond tones alternating between fundamental frequencies of 440 and 500 hertz were inserted in the middle of each interval, as well as 200 milliseconds before the first and after the last syllables, in order to mask subtle pitch differences between the syllables. The stimuli were presented twice in each trial, and they were pseudo-randomized in the experiment. The participants were instructed to combine the syllables they heard and produce the resulting word in the sentence "The yellow ____ was sold yesterday." Their productions were audio-recorded on an Olympus WS-300M digital voice recorder at a sampling rate of 44,100 kz with a Uni-Tex UM300 condenser microphone.

4.4 Data Analysis

Three sets of analyses were performed on the data. First, the syllable with primary stress was identified in each of the participants' productions. This was done by the author, a native speaker of Canadian French. Excluded from these analyses were the sentences in which (i) there was a pause between the syllables in the nonsense word, (ii) all the syllables were stressed, or (iii) changes in the segments of the nonsense words affected syllable weight (e.g., tensing of lax vowels, insertion of codas, etc.). The participants who did not have at least 4 remaining disyllabic words and 4 remaining trisyllabic words were excluded from the analyses. This led to the exclusion of 6 L2 learners in the intermediate group, 3 L2 learners in the low-advanced group, and 2 native speakers. For the remaining participants, 20% of the native speakers' data and 28% of the L2 learners' data did not meet the inclusion criteria because of (i)–(iii). For reliability purposes, 10% of the remaining data were analyzed for stress placement by a native speaker of American English. The results indicate an inter-coder reliability rate of 80% for the L2 learners' data and 91% for the native speakers' data. These rates are more than acceptable given the difficulty involved in judging L2 stress placement.

Second, the number of participants who produced a given stress pattern at a consistency rate of 75% or higher was identified. This arbitrary cut-off point was deemed appropriate to establish which of the prosodic grammars (in Table 2) the participants adopted. This further led to the exclusion of 9 L2 learners in the intermediate group, 8 L2 learners in the low-advanced group, 8 L2 learners in the high-advanced group, and 6 native speakers. All the remaining data were reanalyzed for stress placement, this time by a native speaker of American English. Disagreements between the original coding and the second coding were resolved, and if they could not be resolved, judgments were sought from a second native speaker of American English.

Third, the sentences where changes in the segments of the nonsense words affected syllable weight (i.e., (iii) above) were analyzed, because they provide important information about the generalizations that L2 learners have made with respect to the relationship between stress and syllable weight.

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[6] An anonymous reviewer suggested that this normalization process may be problematic for generalizing the results of this study to what goes on in the L2 acquisition of stress. An important point to remember is that this study did not investigate L2 learners' perception of stress, but the generalizations that these learners have made with respect to L2 stress placement. If the aural syllables had not been normalized, it would have been impossible to tell whether the L2 learners produced a given stress pattern because they perceived one of the syllables presented to them as more prominent than the other(s) due to uncontrolled variations in intensity, length, and pitch. Controlling for the cues that contribute to the perception of stress was therefore crucial.

5. Results

Table 3 presents the percentage of syllables that the L2 learners and native speakers stressed in the disyllabic and trisyllabic words.

Table 3. Mean Percent Distribution (SDs) of Stressed Syllables

	Disyllabic		Trisyllabic		
Groups	σ1	σ2	σ1	σ2	σ3
Intermediate L2 (n = 23)[a]	67 (33)	33 (33)	51 (37)	12 (26)	37 (37)
Low-advanced L2 (n = 26)[b]	83 (30)	17 (30)	54 (38)	30 (39)	16 (27)
High-advanced L2 (n = 18)[c]	77 (21)	23 (21)	51 (37)	44 (38)	5 (12)
Native Speakers (n = 29)[d]	81 (16)	19 (16)	8 (12)	91 (12)	1 (2)

Note. [a] Total: 201 disyllabic words, 157 trisyllabic words; [b] Total: 256 disyllabic words, 198 trisyllabic words; [c] Total: 184 disyllabic words, 157 trisyllabic words; [d] Total: 274 disyllabic words, 284 trisyllabic words.

The results show that the all the groups tended to stress the first syllable of the disyllabic words, although the intermediate L2 group did not do so to the same extent. As for the trisyllabic words, the percentage of stressed word-final syllables decreases as proficiency increases, but approximately half of the words continue to be stressed word-initially, even at the high-advanced level. This stands in sharp contrast with the native speakers, who consistently stressed the penultimate syllable.

The high standard deviations in Table 3 indicate that stress placement varies considerably between the L2 learners. The individual results were therefore examined closely. Figure 1 shows the percentage of participants within each proficiency level who adopted a particular grammar type among the participants who were consistent (≥ 75%).[7]

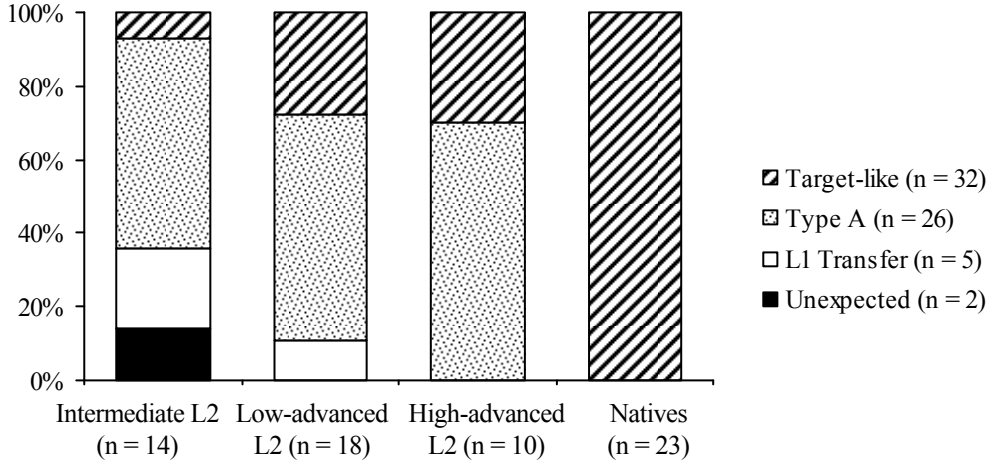

Figure 1. Within-level Distribution of Participants by Grammar Type

The results indicate that few L2 learners used the L1 grammar to produce English word stress, and that number decreases and eventually disappears as proficiency increases. Some L2 learners were able to acquire a target-like grammar, but most display a grammar that is neither like the L1 nor target-like: they have reset foot headedness to the left, but do not align the head of the foot with heavy syllables

[7] The results presented in Table 3 and Figure 1 vary slightly from those reported in Tremblay (2007). After the dissertation was filed, the data from the participants with consistent productions were analyzed again by a native speaker of American English, as indicated in Section 4.4. There were a few items for which the author's and the native speaker's judgments of stress placement conflicted. These conflicts were resolved, but they changed some of the original coding and resulted in small discrepancies between the results reported in Tremblay (2007) and those presented herein.

(i.e., Type A grammar). This grammar is so pervasive that it shows no tendency to be abandoned at higher proficiency. Interestingly, a few L2 learners in the intermediate group display one of the unexpected patterns: they stressed the disyllabic words on the initial syllable but the trisyllabic words on the final syllable. One possible explanation for these results is that the trisyllabic words were more vulnerable to transfer effects because they are longer and thus subject to a higher processing load. Last but not least, no L2 learner showed evidence of a grammar in which they did not reset foot headedness to the left but aligned the head of the foot with the heavy syllable (i.e., Type B grammar). The significance of this finding will be discussed in Section 6.

In light of the above results, we might wonder why most L2 learners fail to align the head of the foot with the heavy syllable in the trisyllabic words. Three possibilities come to mind: (i) the L2 learners do not know that CVC syllables are heavy; (ii) they do not know that heavy syllables are only licensed as the head of the foot; or (iii) they have knowledge of (i) and (ii), but their productions are prosodically constrained such that the left edge of the foot must be aligned with the left edge of the Prosodic Word at all cost. Given the design of the study, it is not possible to determine which of (i) or (ii) is correct, but (i) and (ii) can be teased apart from (iii) by examining the productions that were excluded from the initial analyses due to changes in syllable weight. If the L2 learners with a Type A grammar have some knowledge of (i) and (ii), we would predict that among their excluded trisyllabic words, most of those containing a change in syllable weight would be produced with a light (instead of heavy) penult. This non-random distribution of weight changes would indicate that they have at least some knowledge that CVC syllables are heavy and that heavy syllables are only licensed as the head of the foot. Table 4 presents the percentage of trisyllabic words containing this and other weight changes for the L2 group exhibiting a Type A grammar and, as a control, for the groups exhibiting a target-like grammar.

Table 4. Percent Distribution of Excluded Trisyllabic Words

Weight Changes	Type A L2 Grammar (n = 26)[a]	Target-like L2 Grammar (n = 9)[b]	Natives (n = 23)[c]
LHL → LLL	75	86	74
Other weight changes	25	14	26

Note. [a] Total: 110 words; [b] Total: 14 words; [c] Total: 42 words.

As shown in the results, the majority of trisyllabic words that were excluded due to changes in syllable weight were produced with a light (instead of heavy) penult. Further analyses indicate that almost all of these words were stressed on the initial syllable. This suggests that, similarly to the participants with a target-like grammar, the L2 learners with a Type A grammar have at least some knowledge that CVC syllables are heavy and that heavy syllables are not found in unstressed positions. Their failure to align the head of the foot with the heavy syllable may instead be the result of prosodic constraints aligning the left edge of the foot with the left edge of the Prosodic Word. This interpretation of the data is discussed below.

6. Discussion

The purpose of the nonsense word production task was to establish whether French Canadian L2 learners of English at different proficiency levels can reset foot headedness to the left and align the head of the foot with heavy syllables in English. In view of the above findings, it is first necessary to determine why the L2 learners had little difficulty resetting foot headedness to the left in English. The answer to this question may lie in the fact that disyllabic and trisyllabic English nouns containing light syllables (e.g., *button, paddle, Canada, citizen,* etc.) provide unique evidence for the trochaic foot, as stress surfaces on the left edge of these words, thus making it impossible for the foot to be iambic (recall that single light syllables cannot form a foot). This may also be the reason why no L2 learners arrive at a grammar in which they have not reset foot headedness to the left but align the head of the foot with heavy syllables (i.e., Type B grammar): without resetting foot headedness to the left, the L2 learners would be forced to assume that word-initial light syllables are heavy and form a foot. This

incorrect generalization would prevent them from establishing what types of syllable are truly heavy in English, hence making it impossible to align the head of the iambic foot with heavy syllables. This means that Type B grammar should never be part of the developmental path that native speakers of iambic languages follow when acquiring English word stress. This is an empirical prediction that can easily be tested.

Given the present results, it is also necessary to specify why many French Canadian L2 learners of English fail to align the head of the foot with heavy syllables, a finding consistent with Pater's (1997) study. The analysis of the data excluded due to syllable weight changes suggested that the Type A L2 learners have at least some knowledge that heavy syllables are not licensed in unstressed positions. As mentioned above, one possible interpretation of the data is that the L2 learners persist in aligning the left edge of the trochaic foot with the left edge of the Prosodic Word.[8] This incorrect generalization about the prosodic structure of English is likely to be made, because stress has been shown to surface word-initially in the majority of disyllabic and trisyllabic English words, across morphemic structures and word classes (e.g., Clopper, 2002). This may even be the reason why the L2 learners do not seem to recover from this erroneous representation: the high frequency of word-initial stress prevents a possible restructuring of the interlanguage grammar. It may also be easier for native speakers of Canadian French to maintain such a grammar, because it parallels that of the L1 in that stress placement is the same across words and stress is realized at a word edge. This raises the question of why some L2 learners but not others are able to acquire a target-like grammar. The results presented in this paper do not provide a clear answer to this question, but acoustic analyses recently conducted on the participants' productions appear to solve this puzzle. These analyses will be presented in subsequent work.

One residual issue that deserves some attention is what can be claimed about the grammar of the participants who did not display consistent stress patterns. I would suggest that a large portion of the intra-speaker variation is due to the experiment itself, but prosodic indeterminacy cannot be completely ruled out, at least for the L2 learners.

7. Conclusion

This study investigated the acquisition of L2 prosodic representations and their development across proficiency levels by native speakers of Canadian French acquiring English word stress. A nonsense word production task was used to determine whether the L2 learners had reset foot headedness to the left and aligned the head of the foot with heavy syllables. A clear developmental path emerged from the results, with most L2 learners abandoning the L1 grammar and acquiring the trochaic foot as they became more proficient in English. Furthermore, only the L2 learners who had acquired the trochaic foot could align its head with heavy syllables, suggesting that the development of L2 prosodic representations is not random, but unfolds in a precise fashion. However, many L2 learners failed to align the head of the foot with heavy syllables, regardless of their proficiency level. These results were attributed to the properties of the input and to the prosodic structure of the L1. Further research is needed to determine if the present findings can be replicated with L2 learners from other iambic languages.

[8] Since this study was not designed to identify the alignment of the foot in the Prosodic Word, other interpretations of the results are possible. For example, it could be the case that the foot is not left-aligned, and that word-initial stress is instead a consequence of both the last syllable of the noun being extraprosodic and the head of the foot not aligning with the heavy syllable. It seems more likely, however, that L2 learners incorrectly align the left edge of the foot with the left edge of the Prosodic Word. In Pater's (1997) study, the L2 learners produced word-initial primary stress not only in the trisyllabic words, but also in the quadrisyllabic words. The analysis proposed here is consistent with these data.

Appendix

Experimental Nonsense Words

Disyllabic	Trisyllabic
[dʌʃm̩], [bʊfn̩], [ʃʊbl̩], [gɪʃl̩], [fʌgn̩], [sʊgm̩], [mʊʃl̩], [dɪsm̩], [gʌbn̩], [dɪfn̩], [sɪfl̩], [nʌsm̩]	[gɪdolʃm̩], [ʃʌmolfn̩], [mʊfælsm̩], [sɪmɛlʃl̩], [nʌʃoɹgm̩], [fʊmolgn̩], [dɪmɛlfl̩], [sʌdolbm̩], [bʊgɑɹfn̩], [ʃɪfoɹdm̩], [sʌgælʃm̩], [gʊfɛɹbl̩]

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