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THE CONTRIBUTION OF WORD STRESS AND VOWEL REDUCTION TO THE INTELLIGIBILITY OF THE SPEECH OF FRENCH CANADIAN SECOND LANGUAGE LEARNERS OF ENGLISH

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ABSTRACT

Some studies in L2 research claim that lexical stress misplacement most impairs intelligibility in L2 English speech; others claim that lack of vowel reduction is the cause. However, word stress and vowel reduction occur together in English and research has yet to tease apart the contribution of the two factors to intelligibility. To help resolve this issue, native English speaking judges evaluated Canadian French accented English speech consisting of 50 two-, three- and four-syllable words categorized according to the prosodic errors they contained. The judges' responses were evaluated to determine which error type, incorrect stress or incorrect vowel reduction has the biggest impact on intelligibility. It was found that both separately interfere with an L2 speaker's intelligibility, or lead to misinterpretations. However, when both prosodic errors are combined, it is more detrimental to intelligibility.

Keywords: intelligibility, prosody, lexical stress, vowel reduction.

1. INTRODUCTION

Notable aspects of a Canadian French (CF) accent in second language (L2) English speech are misplacement of word stress and absence of vowel reduction [13, 15, 25, 33-35]. Some studies claim that misplacing lexical stress most compromises intelligibility [2, 5, 18, 20, 22, 25, 27, 33-34, 36], and that intelligibility is more impaired when lexical stress is shifted to the right [11, 18]. Other studies claim that L2 misstressing has little effect on intelligibility as long as stressed vowels retain their quality and unstressed vowels are reduced [4, 6, 12, 17, 23, 30-31]. Research has yet to tease apart the two factors to determine the isolated effect of each, or to determine if it is the combination of the two errors that impairs intelligibility.

This pilot study sought to determine how each error, alone or in combination, impacts the intelligibility of French-accented English. The research addresses the following questions:

1) Do both stress and vowel reduction interfere with the intelligibility of L2 speech?

2) Does omission of vowel reduction have a lesser or greater effect on intelligibility than its misplacement?

3) Does rightward misplacement of stress have a greater impact than leftward misplacement?

French was chosen for this study because the phonetic realisation and the role stress plays in the language differ from English. For example, in French stress is realised predominantly with duration [5, 10, 14-15, 26, 29, 32], whereas in English it is with pitch [8, 19, 32-33]. In French, stress is predictable and serves a demarcative function in identifying words and phrase boundaries (e.g. *gouverne* [gu•ˈvɛʀn]; *gouvernemen*t [gu•vɛʀ•nə•ˈmɑ̃]; *bonjour monsieur* [bɔ̃•ʒuʁ•mœ•ˈsijø]) [6-7, 16, 28, 32]

[37]. In English, stress is not fixed to a given position and serves a contrastive function to help distinguish between semantically distinct words (e.g. *parliament* [ˈpɑɹ•lə•mənt]; *parliamentary* [pɑɹ•lə•ˈmɛn•tɹi]). In French, vowels are given their full quality, contrary to English where the stressing of vowels in one syllable is systematically accompanied by vowel reduction in one or more surrounding syllables [1, 9, 24, 35] (e.g. photograph [ˈfo•tə•gɹæph] vs photographer [fə•ˈtɑ•gɹə•fɚ] vs photographic [fo•tə•ˈgɹæ•fək]). Hence, stress and vowel reduction help in spoken word recognition in English, but not in French [6, 11, 20, 25].

2. TEST DESIGN AND APPLICATION

Data gathering took place in two phases and in different places. *Phase I* focused on creation of stimuli and *Phase II* focused on test application.

2.1. Phase I – Creation of stimuli

The goal of *Phase I* consisted of gathering CF accented English words which contain an array of prosodic errors to construct the perception test for *Phase II*. Quebec City was an ideal area for test-token collection because it is a predominantly French area and, as previously mentioned, incorrect word stress placement and vowel reduction are notable aspects of a French accent in L2 English.

To create the stimuli, 180 two-, three- and four syllable English content words (frequency-controlled) containing at least one reduced vowel were chosen. CF L2 speakers of English were recorded saying the carrier sentence *I say 'X' again*, 'X' being a different target word. The recordings were transferred to computer sound files and target words were extracted from the carrier sentences using Pratt acoustic analysis software [3] and categorized according to their prosodic errors found. The categories are listed in (1).

(1) Naturally occurring prosodic error patterns found in Phase I stimuli

Category 1(9 tokens): Correct stress and vowel reduction (i.e. native like prosody)

Category 2(9 tokens): Correct stress, no vowel reduction

Category 3 (5 tokens): Incorrect leftward stress placement, no vowel reduction

Category 4(9 tokens): Incorrect rightward stress placement, correct vowel reduction

Category 5(9 tokens): Incorrect rightward stress placement, incorrect vowel reduction

Category 6(9 tokens): Incorrect rightward stress placement, no vowel reduction

2.2. Phase II- Application of test

For *Phase II*, a total of 20 L1 English-speaking judges underwent the perception test (shadowing task). The judges consisted of 10 L1 English speakers (male and female) who live in the linguistically diverse city of Montreal, Québec, Canada and 10 L1 English speakers (male and female) who live in a more homogeneously English-speaking area, Kingston, Ontario.

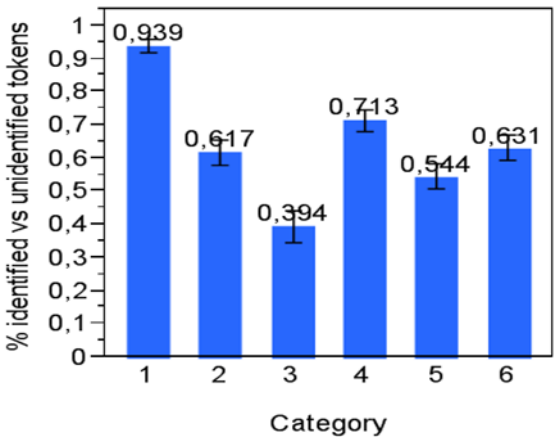
The stimuli consisted of 50 two-, three- and four-syllable CF accented words representing error-type categories found in *Phase I*. For the shadowing task, judges listened to and repeated each token as it 'should be' pronounced by a L1 English speaker. If they did not recognize a word they responded 'NO'. The participant went on to the next token by clicking on a button on the computer screen. Stimuli were presented to the judges in randomized order, so error types were randomly interspersed.

The statistical significance of the data was tested with Mann-Whitney analyses to compare 1) the number of tokens positively identified as opposed to those negatively identified, and 2) the mean reaction times between categories. Primary results are presented in the following section.

3. RESULTS AND DISCUSSION

Initially, judges' responses for each category were categorized as either positive (identified) or negative (un-identified or misidentified) and the percentage of correct identification for each error category was tabulated (qualitative analysis). The results are illustrated in Fig. (1).

Figure 1: Percentages of correctly identified tokens.



Preliminary results indicated a significant difference between Category 1, where tokens contained correct lexical stress and vowel reduction, and all the other categories ($p. > 0.001$). These results suggest that both prosodic errors have an impact on L2 intelligibility.

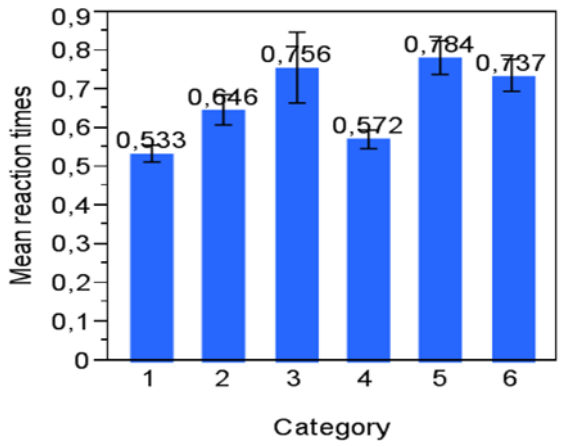
Additionally, results also showed that not all error types have an equally negative impact on intelligibility. For example, there was a significantly lesser amount of tokens positively identified for Category 3, where tokens contained incorrect leftward stress placement and incorrect vowel reduction, than all other prosodic error categories ($p < 0.001$). There was also a significant difference found among the categories that contained incorrect rightward stress placement (Categories 4, 5 and 6). For example, Category 4, where vowel reduction was correctly placed, had a significantly greater amount of correctly identified

tokens than Category 5, where vowel reduction was incorrectly placed ($p > 0.05$) but no significant difference with Category 6, where there was omission of vowel reduction. All these aforementioned results suggest several things. Firstly, misplaced leftward stress impairs intelligibility significantly more than all other prosodic error categories. Secondly, while previous results identify both incorrect vowel reduction and incorrect stress placement as separately impairing intelligibility, these results show that when put together, as in the case of Categories 3, 5 and 6, they have a more detrimental effect on word identification. Lastly, misplacement of vowel reduction, as in the case of Categories 3 and 5, impairs intelligibility to a greater extent than absence of vowel reduction, such as in Categories 2 and 6.

What was surprising was that incorrect leftward stress had a more negative impact on intelligibility than incorrect rightward stress placement, because the usual metrical stress rules in English allow leftward stress movement [21]. Therefore, one has to consider the theoretical implications of what has been found.

Further support for the preliminary qualitative analysis comes from the results of the reaction times (RT) of the correctly identified tokens (quantitative analysis). Reaction times were measured manually, using PRAAT software, from the end of the token word output to the initiation of speech (hesitation noises excluded) for the response. The mean RT for each category is illustrated in Fig. (2).

Figure 2: Mean reaction times per category.



Results were consistent with previous results in that they show that RTs were slower for the categories that contained the combination of both prosodic errors (Category 3, 5 and 6) and faster for the categories that contained only one of the two prosodic errors (Category 2 and 4) or no prosodic errors (Category 1).

An additional Mann-Whitney analysis was run on the judges' RTs to evaluate if there were any significant differences between prosodic error categories. Results are shown in Table (1).

Table 1: Comparison of RT between categories

Category (i)		Category (j)	p-Value	
1	>	2	0.000	***
1	>	3	0,000	***
1	>	4	0,000	***
1	>	5	0,000	***
1	>	6	0,000	***
2	>	3	0,000	***
2	<	4	0,030	*
2		5	1,000	
2		6	0.066	
3	<	4	0,000	***
3	<	5	0,000	***
3	<	6	0,000	***
4		5	0.165	
4		6	1.000	
5		6	0.176	

Results corroborate some of the previous findings. Mean RT for Category-1 is significantly faster than all other categories ($p > 0.001$) and, mean RT for Category 3, which contains tokens with incorrect leftward stress placement coupled with incorrect vowel reduction, is significantly worse than all other prosodic error categories. Again, the results support the previous observations that intelligibility is significantly better when stress and vowel reduction are correct and that leftward misplacement of stress has a greater impact on intelligibility than rightward misplacement.

4. CONCLUSIONS AND FUTURE WORK

Preliminary results suggest that both incorrect stress and vowel reduction interfere with L2 intelligibility. Results also show that the misplacing of vowel reduction has a greater negative effect on intelligibility its omission. As for stress, rightward and leftward misplacement is shown to impair intelligibility, but intelligibility seems to be more impaired by leftward misplacement. In addition to the questions sought, results also suggest that even though lexical stress is damaging to intelligibility, it is incorrect vowel reduction that is more detrimental.

To validate the interpretations of our results, the test should be reduplicated using a larger quantity of both CF accented English words and L1 English judges. With a larger quantity of accented words, cases of incorrect leftward stress placement coupled with correct vowel reduction, could be found. This would help confirm if incorrect

leftward stress placement is more problematic than incorrect right-handed placement in word identification. Moreover, an additional control of the metrical structure of the words could be done to evaluate if it is the placement of stress on weak syllables (schwa [ə] or a very short form of another vowel e.g. [ɪ]) that leads to cases of unintelligibility rather than the direction of stress misplacement.

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