THE EFFECT OF REGISTER VARIATION ON THE PERCEPTION OF THE FRENCH /w- ɥ/ DISTINCTION BY NATIVE SPEAKERS OF AMERICAN ENGLISH

Andrea Levitt
Wellesley College, Wellesley, MA, USA

ABSTRACT

The words *Louis* /lwi/ and *lui* /lɥi/ were produced by a female native speaker of French in three registers: Native Talk, Foreigner Talk and Child Talk. Perception of the /w-ɥ/ contrast by Americans who had never studied French was significantly worse in Child Talk than in the other two registers. Acoustic analyses of the stimuli suggest that these results may be due to significant F0 and formant differences in Child Talk as compared to the other two registers.

INTRODUCTION

Forms of speech that vary as a function of the addressee are frequently referred to as speech styles or registers. For example, speakers often modify their speech for listeners whose linguistic competence is in question. Such listeners include both young children learning their first language as well as older individuals learning a second language. Speakers frequently simplify grammar and vocabulary and also make prosodic and phonetic adjustments when addressing such listeners [1-4].

Although some researchers believe that such modifications can aid the language learner [5], few direct tests of the effects of register variation on language comprehension have been conducted [6], especially on the effects of register variation on the perception of phonetic contrasts, although there is at least one such study showing such an effect with infants [7].

The present study was thus designed to investigate the effects of speech style variation on a nonnative phonetic contrast that is normally difficult for adult Americans who are second-language learners of French. The phonetic contrast chosen was /w-ɥ/, as in the words *Louis* /lwi/ and *lui* /lɥi/. If, in fact, register variations do aid the language learner, then the discrimination of this contrast by nonnative adults ought to be better when the tokens tested are produced as Child Talk (CT) and as Foreigner Talk (FT) than when produced as Native Talk (NT). In Part I, we report the results of a perceptual test of this hypothesis. In Part II, we describe the results of an acoustic analysis that was undertaken in order to see which of the prosodic and/or formant features of the stimuli may have contributed to the outcome of the perceptual test.

PART I: PERCEPTUAL TEST

METHOD

Subjects

Twenty-four female native speakers of American English who had never studied French were paid $6 for their participation in the experiment.

Materials

Eight tokens each of the words *Louis* /lwi/ and *lui* /lɥi/ were embedded in a longer list of French words. These lists were read by a female native speaker of French three times, once as to another native speaker of French (Native Talk or NT), once as to a one-year-old child learner of French (Child Talk or CT) and once as to a nonnative, adult learner of French (Foreigner Talk or FT). The speaker was chosen from among a group of 10 talkers whose speech style variations on two read paragraphs had been acoustically analyzed previously [8].

All the tokens that were used to construct the three AXB tapes, one for each register, had been perfectly identified by three native speakers of French. In an AXB test, three stimuli are presented in sequence, the first (A) and the third (B) representing members of two different categories, here *Louis* and *lui*. The middle item (X) can be from either category, and the subject's task is to decide whether X is a member of category A or B. There were 48 AXB trials in each test, with an equal number of the four possible word orders: AAB, BBA, ABB, and BAA. The first two orders test for effects of primacy, which occurs when subjects perform better when X matches the initial item, whereas the latter two orders test for effects of recency, which occurs when subjects perform better when X matches the last item. The words in each trial were separated by 1 sec and trials were separated by 5 sec. There was a longer pause of 10 sec at the end of each block of sixteen trials.

Procedure

Subjects first filled out a language background questionnaire. Anyone with exposure to French was excluded from the study. Subjects were then told that the test had three parts. In each part, a speaker would pronounce sets of three words. In each set, the first and third words would always be different, even if they sounded very much alike. The middle word would be a member of the same category as either of the first or the last of the three words. The subjects were told to write a "1" on their answer sheets if they thought the middle word was a member of the same category as the first word and a "3" if they thought it was a member of the same category as the last word in the triplet.

The three tapes, CT, FT, and NT, were presented to subjects in a modified Latin square design to control for order effects. After subjects had listened to all three tapes, the experimenter then asked them which of the tapes they had found most difficult and why.

RESULTS

The data were analyzed in an ANOVA with one between group factor (Order) and two within group factors (Register and Primacy vs. Recency). The main effect of Register was significant [$F(2,42)=7.688$, $p=.0014$]. Subjects' responses were 86% correct for NT, 85% correct for FT, and 79% correct for CT. Post hoc tests (Newman-Keuls) showed that the results for CT were significantly different from those for the other two registers ($p<.01$), which did not in turn differ significantly from one another. There were no other significant main effects or interactions.

DISCUSSION

The results of the test of the effect of speech style variation on the perception of the /w-ɥ/ contrast by Americans who had never studied French indicate that, contrary to expectations, the CT tokens of *Louis* and *lui* were harder to categorize than the NT tokens. Furthermore, the FT tokens also did not improve subjects' ability to discriminate the contrast when compared with the results for NT tokens. The latter result suggests that the prosodic and phonetic modifications made in FT may not aid subjects' discrimination of difficult nonnative contrasts. However, the fact that subjects found the CT tokens significantly *more* difficult to identify is surprising. Subjects did comment that they found the CT tape more difficult because of the large F0 excursions associated with those tokens. An acoustic analysis of the prosodic and formant characteristics of all tokens used was conducted in order to verify subjects' impressions of the tokens and to see if there were other possible sources for their difficulty with the CT tape.

PART II: ACOUSTIC ANALYSIS

INTRODUCTION

Previous research has indicated that a major acoustic feature distinguishing /w-ɥ/ in French is F2 [9]. However, since it is nonetheless possible that concomitant prosodic and formant differences influenced the perception of this contrast by nonnative speakers, acoustic measurements were taken and submitted to statistical analysis. Our goal is to find a feature of the stimuli that is significantly different for *Louis* and *lui* in the native and FT registers, but not in the CT register.

METHOD

The prosodic measurements made on the stimuli included duration and mean, minimum and maximum F0. F0 range was calculated as the percent increase over minimum F0 represented by the difference in the minimum and maximum values. The first and second formant for each phonetic segment was also measured.

RESULTS

Separate Word (*Louis/lui*) by Register (NT, CT, FT) ANOVAs were run on the measurements for duration, mean F0 and percent increase in F0. (See Table 1). There was a significant main effect of Register in the duration analysis [$F(2,40)=41.39$, $p<.0001$]. Post hoc tests (Newman-Keuls,

p<.01) revealed that the duration of the words in NT was significantly shorter than in the other two registers, which did not differ from one another. There was also a significant main effect for Word [F(1,40)= 32.26, p<.0001], with *Louis* overall longer than *lui*. There were no significant effects or interactions in the mean F0 analysis. In the F0 range analysis, there was a significant main effect of Register [F(2,39)= 25.30, p<.0001]. Post hoc tests revealed that all registers were significantly different from one another (Newman-Keuls, p<.05).

Table 1. Mean values for prosodic measurements of Louis (1) and lui (2) in the three registers.

Register and Word	Duration in ms	Mean F0 in Hz	Percent increase in F0
NT 1	511	221	83
NT 2	417	212	71
FT 1	656	227	99
FT 2	571	209	111
CT 1	696	219	148
CT 2	585	220	166

Separate Word (*Louis/lui*) by Register (NT, CT, FT) ANOVA were run on the measurements for F1 for each segment. (See Table 2). For /l/, there was a significant Word effect, with the mean F1 for *Louis* higher than that for *lui* (240 vs. 224 Hz), [F(1,40) =5.047, p=.0303]. The values were somewhat lower than expected, perhaps because of the coarticulatory effects of the rounding of /w-ɥ/. For /i/, there was a significant effect of Register, with the means for CT, NT, and FT 330, 271, and 293 Hz respectively, [F(2,40)=5.79, p=.0064]. For the crucial /w-ɥ/, there was also a significant Word effect, with mean F1 again higher for *Louis* (346 vs. 269 Hz), [F(1,40)=34.086, p<.0001]. More interestingly, there was also a marginally significant Word by Register interaction [F(2,40)=2.854, p=.0694]. Post hoc simple effects indicated that the F1 for /w-ɥ/ was different for the two test words for NT and FT (p<.001), but not for CT, precisely the pattern that parallels the perceptual results.

Table 2. Mean F1 values in Hz for the three phonetic segments in Louis (1) and lui (2) in the three registers.

Register and Word	/l/	/w/ for 1 /ɥ/ for 2	/i/
NT 1	239	340	309
NT 2	214	253	278
FT 1	235	373	256
FT 2	233	266	287
CT 1	246	323	352
CT 2	226	289	307

For F2 for /l/, there was a significant effect of Register [F(2,40)=13.330, p<.0001] with means for CT, NT and FT 1900, 1997, 1793 Hz, all significantly different in Newman-Keuls post hoc tests (p<.05). There was also a significant effect of Word with F2 for *Louis* lower (1630 vs. 2163 Hz) [F(1,40)=271.223, p<.0001], and a significant interaction of Word and Register [F(2,40)=10.644, p=.0002]. But here, post hoc tests indicated that the F2 values for /l/ in *Louis* were different for the three registers but the same for *lui* (Newman-Keuls, p<.05). For /w-ɥ/, there was the expected significant main effect of Word with the F2 for *Louis* lower than for *lui* (1121 Hz vs. 2513 Hz) [F(1,40)=287.204, p<.0001]. The high values for F2, particularly for /ɥ/ (see Table 3), may have been due to the effect of the following /i/. There were no other significant main effects or interactions for /w-ɥ/ or /i/.

Table 3. Mean F2 in Hz for the three phonetic segments in Louis (1) and lui (2) in the three registers.

Register and Word	/l/	/w/ for 1 /ɥ/ for 2	/i/
NT 1	1831	1023	2645
NT 2	2164	2518	2589
FT 1	1445	1189	2706
FT 2	2139	2465	2598
CT 1	1614	1027	2691
CT 2	2185	2555	2706

DISCUSSION

It is not clear exactly what role each of the features showing a Word effect (duration, F1 and F2 for /l/, and F1 and F2 for /w-ɥ/) played in aiding subjects' discrimination of *Louis/lui*, although the F2 difference for /w-ɥ/, the traditional differentiating acoustic parameter [9], was undoubtedly important in contributing to subjects' above chance performance in all registers. Recall, however, that our goal is to find a parameter that shows a Word by Register interaction, with a significant difference for *Louis* and *lui* in NT and FT but not in CT, thus providing a possible explanation for subjects' lower performance with tokens from the CT register. Duration is not a good candidate for this parameter, because the main effects in the prosodic analyses for Register and Word do not explain the pattern of results across the three registers. Furthermore, although subjects claimed they were distracted by the F0 range in the CT tokens, and F0 variability is hard to ignore [10], the pattern of range differences also does not coincide with the register results.

In the F2 analyses, there was an expected significant main effect for Word for /w-ɥ/. The significant Word effect for /l/ was probably due to a coarticulatory influence of the F2 of /w-ɥ/. Neither effect, however, parallels the perceptual results across registers, which require a Word by Register interaction. Such an interaction was found for /l/, but post hoc tests showed that a pattern of significant differences emerged only for *Louis* across the three registers.

For F1, the Register effect for /i/, while it distinguishes CT from the other two registers, fails to discriminate between the words, and the significant F1 Word difference for /l/ is probably due again to the coarticulatory influence of the Word effect for /w-ɥ/, which in itself is not a traditional discriminating factor. Of particular interest, however, is the marginal interaction of Word and Register for F1, which in post hoc analysis fit our criterion of showing a significant difference for *Louis* and *lui* in the NT and FT, but not in CT. Thus, discrimination of the *Louis /lui* contrast, for which the F2 difference in /w/ and /ɥ/ is undoubtedly very important, may have been enhanced for nonnative listeners for the FT and NT tokens by a small concomitant difference in F1. Interestingly, this F1 formant difference for /w-ɥ/ led to a pattern in which the F1 transition for NT and FT was rising for /w/ into /i/ and falling for /ɥ/ into /i/, whereas in CT the F1 transition into /i/ rose for both /w/ and /ɥ/ (see Table 2). This transition pattern may also be relevant for explaining subjects' performance on the perceptual test, which, contrary to expectations, did not provide evidence for the hypothesis that speech styles addressed to language learners would increase the discriminability of this nonnative phonetic contrast.

ACKNOWLEDGMENT

Thanks to Doug Whalen for his comments and to Lana Makhanik for her help running subjects. This study was supported by grants from NIH (1 R15 HD28173-01) and NATO.

REFERENCES

[1] Ferguson, C. (1964), "Baby talk in six languages", *American Anthropologist*, vol. 66, pp. 103-114.

[2] Ferguson, C. (1975), "Towards a characterization of Foreigner Talk ", *Anthropological Linguistics*, vol. 17, pp. 1-14.

[3] Freed, B. (1981), "Foreigner talk, baby talk, native talk", *International Journal of the Sociology of Language*, vol. 28, pp. 19-39.

[4] DePaulo, B. and L. Coleman (1986), "Talking to children, foreigners, and retarded adults", *Journal of Personality and Social Psychology*, vol. 51, pp. 945-959.

[5] Krashen, S. (1980), "The Input Hypothesis", *Alatis*, pp. 168-180.

[6] Long, M. (1985), "Input and second language acquisition theory", In *Input in Second Language Acquisition*, ed. by S. Gass and G. Madden. Rowley, MA: Newbury House. pp. 377-393.

[7] Karzon, R. G. (1985), "Discrimination of polysyllabic sequences by one- to four-month-old infants", *Journal of Experimental Child Psychology*, vol. 39, pp. 326-342.

[8] Levitt, A. (in preparation), "An analysis of the prosodic characteristics of register variation in read speech in French."

[9] Chafcouloff, M. (1980), "Les caractéristiques acoustiques de /j,ɥ,w,l,ʀ/ en français, *Travaux de l'Institut Phonétique d'Aix*, vol. 7, pp. 7-56.

[10] Wood, C. (1974), "Parallel processing of auditory and phonetic information in speech discrimination", *Perception and Psychophysics*, vol. 15, pp. 501-508.