NATURALISTIC ELICITATION OF ACOUSTICAL PARAMETER SHIFT OF /r/ AND /l/ IN THE SPEECH OF JAPANESE ESL STUDENTS

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ABSTRACT

This study documents the utility of naturalistic elicitation for identifying shift in parameters of interlanguage phonetic variables. Pre- to post-test production of /r/ and /l/ increased. /l/ was produced incorrectly far more often than /r/. The difference in accuracy between /r/ and /l/ was greater pre-vocalically than post-vocalically. /r/ is heard as [l] and /l/ as [ɹ] only pre-vocalically. For /r/, rhoticization increases gradually over time, and for /l/, lateralization increases gradually.

INTRODUCTION

The difficulty that speakers of Japanese have in distinguishing between the English liquids /r/ and /l/ is due to a number of factors. Japanese has one liquid phoneme, represented as /r/ and found intervocalically and word-initially, whereas the English liquids are found also in consonant clusters and post-vocalically. The Japanese /r/ has several allophones, including [l] and [ɹ], which resemble the principle allophones of the English liquids. The distribution of allophones of /r/ is, according to Vance, not at all inflexible, with substantial variation in pronunciation (see Table 1). In word-initial position, the onset of the articulation of Japanese /r/ is typically characterized by the location of the blade of the tongue on the alveolar ridge, producing a sound acoustically more similar to English [ɫ] than [ɹ]. Intervocalically, Japanese /r/ is often pronounced as a flap, [r], an allophone of /r/ in some registers and dialects of English. Finally, Japanese /r/ assimilates to the following vowel, especially the high front vowel and semiconsonant.

Dickerson and Dickerson, in a study of Japanese accented-English, document the influence of phonetic environment on the articulation of /r/, noting accuracy of articulation depends on phonetic context, and higher accuracy before low vowels than high vowels, a phenomenon which reflects the assimilatory qualities of high and especially high front vowels in Japanese. Variability of pronunciation of /r/ is therefore conditioned by the phonetic context, as it is in Japanese.

Vance reports Japanese /r/ being labeled a variphone, a reference to the fluid nature of the sound. In English /r/ is also subject to variation, as are all vowel sounds. Labov notes that the range of variation in vowels can be represented on two dimensional formant displays as elliptical "envelopes" that partially overlap. The shape and size of the envelopes depend in part on the phonetic environment, as with Japanese /r/, and also on the sociolinguistic environment. The students in this study report being highly motivated to achieve native-like proficiency. They are likely to experience shifts in the shape and size of envelopes. It is this parameter shift which is ultimately of interest to the authors of the present study.

Table 1. Allophonic variants of /r/ and /l/ identified in the interlanguage of Japanese ESL students.

[r] voiced apico-alveolar trill

[ɾ] voiced alveolar flap

[l] voiced alveolar lateral approximant

[ɭ] voiced post-alveolar (retroflex) lateral approximant

[∅] omission of /r/ or /l/

[ɫ] voiced velarized alveolar lateral approximant

[ɹ] voiced alveolar frictionless continuant

[ɥ] excrescent vowel with /l/ or /r/

[ɹʷ] voiced labialized alveolar frictionless continuant

[ɚ] vocalized /r/

[uʷ] vocalized /l/

[ɖ] voiced retroflex stop

OBJECTIVES

One goal of this study was to identify phonetic variables that might be especially sensitive indicators of second language acquisition. The differentiation by native speakers of Japanese of the English phonemes /r/ and /l/ is a good focus for such a study because some of the allophones belonging to these phonemes are continuants or approximants, and it was felt that approximation of target-language norms could be incremental instead of segmental, and thus would be an appropriate target for acoustical analysis. A second goal was to determine the utility of naturalistic elicitation for carrying out second language phonetic analysis of an experimental variety. Specifically it was felt that naturalistic data, usually considered relatively uncontrolled, could be controlled sufficiently to allow for identification of the environments where pronunciation of these phonemes is most frequent, a pedagogical concern, and would allow for identification of the allophones which would most likely display "sensitivity" to the effects of target-language input to the phonological system.

SUBJECTS AND PROCEDURES

Subjects

This study involved 40 native Japanese ESL students, who were part of a larger study (originally 80 students) designed to measure changes in reading and speaking skills as well as attitudes as a result of their four-month study at Western Washington University. The subjects (ages 17 to 22) had had an average of seven years of English study in Japan.

Elicitation Procedures

The elicitation device required students to develop an oral composition about a series of pictures which depicted the past, present, and future of transportation. Students were requested to talk about the pictures for about one minute. They were assisted by the experimenter and assistants in carrying out the task of recording themselves in a laboratory setting equipped with high-quality Tandberg cassette recorders. The initial pre-test recordings were made in November, 1992 and repeated three months later as a post-test in February, 1993. The recordings varied in length between one and four minutes, with the average just over a minute. The complexity and sophistication of the morphological syntactic structures and accuracy varied considerably; however, the picture presentations elicited a number of repeated words, for example, virtually all subjects used words such as: *balloon, car, airplane, railroad, train, horse, shuttle,* etc.

The purpose for using such a technique is multifold. Speaking ability, commonly held to be the most critical language skill and the principle reason for students' study abroad, is not often tested. Interviewing techniques have been carefully refined over the years, but are still cumbersome, requiring highly trained personnel and a great deal of time. For experimental purposes they are also problematic because the interviewer actually intervenes in the procedure and contaminates the data. The current technique, however, affords several advantages over traditional oral proficiency measures: 1) it is non-interventionist, allowing the student to produce the narration; 2) many students can be tested at once; 3) vocabulary and verb tenses can be controlled by use of the pictures; and 4) no printed word interferes with the student's performance. The language thus elicited is more systematic.

For the object of study, i.e., parametric shifts of /r/ and /l/, specific phonetic environments ideally should be controlled to facilitate the precise study of the articulatory shifts. For the experimental phonetician the technique used may not afford sufficient control. This objection notwithstanding, the oral composition technique proved to be a reliable means of eliciting phonetic data in a variety of significant phonetic environments and that faithfully reflects the transitional linguistic competence of the speakers who produced it.

ANALYSIS PROCEDURE

A very broad transcription of the pre- and post test recordings was made by the authors. Each occurrence of /r/ and /l/ was noted with its environment. This stage of the analysis is presented in Table 2. Once environments were identified, phonemic distributions were tallied. These are presented in Table 3. Finally,

percentages of correct and incorrect responses were calculated, and major interlanguage allophonic variants of the phonemes along with their frequency of occurrence were identified. These data are presented in Table 4 and in Table 5.

RESULTS

Evidence for the limitations of the naturalistic elicitation method are documented in Table 2, where the seven of the original eleven environments are listed. Originally it was planned to examine the effect of the following vowel on the articulation of the liquids, but not enough tokens of liquids followed by different vowels were produced to enable a meaningful comparison. Consequently, post-vocalic environments were identified irrespective of phonetic features of vowels.

Table 2. Phonetic environments identified in the interlanguage of Japanese ESL students.

Formula	Description
# __ V	Word-initial, post-pausal
C + __ V	Syllable-initial, post-consonantal
V __ V	Intervocalic
C __ V	Consonant cluster, pre-vocalic
V __ C	Consonant cluster, post-vocalic
V __ #	Post-vocalic
C __ #	Syllabic

In Table 3, two more environments prove to have an insufficient number of tokens to allow for pre- and post-comparison of pronunciations of /r/ and /l/. Very few instances of either phoneme were found in syllable-initial position post-consonantally. Syllable and word-final consonant clusters consisting of obstruent plus liquid were underrepresented for the phoneme /l/. A successful analysis of /r/ and /l/ in these environments, as well as the pre-vocalic ones, would require a larger database of sounds elicited naturalistically, as many as 5,000 tokens of /r/ and /l/. Based on the current study, a total of 80 complete sets of data from subjects would be sufficient.

Across-the-board, but differential

quantitative increases in production of /r/ and /l/ are documented in Table 3. The post test yielded 28% more tokens than the pretest ((1474-1148)/1148)).

Table 3. Tokens of /r/ and /l/ identified in pre- and post-tests.

		/r/		/l/	
		pre-test	post-test	pre-test	post-test
#	V	25	33	44	55
C+	V	2	4	2	5
V	V	113	157	98	114
C	V	175	190	84	120
V	C	96	86	5	23
V	#	255	309	51	105
C	#	70	106	128	167
Total		736	885	412	589

There were 610, or 61% more /r/ tokens produced than /l/ tokens ((1621-1001)/1001). The difference between /r/ and /l/ expressed as percentage of /l/ was greater in the pre-tests than in post-tests (pre: (736-412)/:412=79%; post: (885-589)/589=50%)). Finally, whereas the pre- to post-test increase in production of the phoneme /r/ was 20%, the increase in the phoneme /l/ was 43%. Qualitative increases in and differences between pronunciation of /r/ and /l/ are also in evidence in Table 4. American /l/ was produced incorrectly far more often than /r/. The increase in correctness of /l/ went from 8% in the pre-test to 12% in the post-test. For /r/ these figures were 35% and 40%, respectively. Production of correct /r/ and /l/ variants improved in the post-test, /l/ by 53% and /r/ by 13%. Finally, the difference in accuracy

Table 4. Percentages of target-like /r/ and /l/ in pre- and post-tests.

		/r/		/l/	
		pre-test	post-test	pre-test	post-test
#	V	24	33	2	9
V	V	31	45	2	10
C	V	68	70	5	2
V	C	30	29	10	14
C	#	39	43	14	16
Total		35	40	8	12

Table 5. Principal non-target-like allophones of /r/ and /l/.

		/r/				/l/			
		Pre-test	%	Post-test	%	Pre-test	%	Post-test	%
#	V	[l]	36	[l]	12	[ɾ]	59	[ɾ]	65
		[ɾ]	16	[ɾ]	42	[l]	27	[l]	20
V	V	[ø]	41	[ø]	28	[ɾ]	54	[ɾ]	46
		[ɾ]	11	[ɾ]	14	[ɹ]	22	[ɹ]	27
C	V	[ɹʷ]	13	[ɹʷ]	15	[ɹ]	61	[ɹ]	64
		[ɾ]	12	[ɾ]	10	[ɾ]	29	[ɾ]	28
V	C	[ø]	61	[ø]	59	[l]	35	[l]	37
		[ɚ]	4	[ɚ]	6	[l]	33	[l]	29
C	#	[ø]	57	[ø]	53	[l]	42	[l]	47
		[ɹʷ]	1	[ɹʷ]	1	[l]	27	[l]	22

between /r/ and /l/ was much greater in pre-vocalic than in post-vocalic or syllabic environments.

Differential errors in pronunciation of /r/ and /l/ are illustrated Table 5. The pronunciation of /r/ as [l] and of /l/ as [ɹ] is only heard pre-vocalically. In post-vocalic and syllabic positions, /r/ and /l/, even when pronounced incorrectly, are realized with articulations roughly approximating the target-language norm. Evidence for parameter shift is also revealed in Table 5. Approximation of /r/ appears to occur in stages: [l] > [ɾ] > [ø] > [ɚ] > [ɹʷ] > [ɹ]. Approximation of /l/ appears to follow this sequence: [ɹ] > [ɾ] > [l] > [l] > [ɫ].

CONCLUSIONS

Naturalistic elicitation of /r/ and /l/ provided evidence of parameter shifting in the English interlanguage of native speakers of Japanese. Sufficient numbers of non-target-like allophones were produced to indicate that in approximating /r/, these subjects increase rhoticization gradually, and in approximating /l/, lateralization is increased. Syllable and word-final consonant clusters consisting of obstruent plus liquid were underrepresented for the phoneme /l/. A successful analysis of /r/ and /l/ in these environments, and pre-vocalic ones, would require a larger database of sounds elicited naturalistically, as many as 5,000. Based on the current study, a total of 80 sets of data would be sufficient.

The elicitation demonstrates that /r/ is produced with greater frequency than /l/. Use of /l/ increased dramatically from pre- to post-test, providing evidence for avoidance of /l/. Another sign that /l/ is the more difficult of the two phonemes is

the fact that /l/ is pronounced with far less accuracy than /r/, both pre- and post-test.

The analysis of phonetic environments of /r/ and /l/ errors revealed that the difference in accuracy between the two phonemes was greater pre-vocalically than post-vocalically. Switching of [ɹ] and [l] was observed only pre-vocalically. Post-vocalically, inaccurate pronunciation of both phonemes bore more of a resemblance to the target allophones.

Further study should focus on quantifying acoustic parameters of [ɹ] and less rhotacized variants. Similarly, variation between [l] > [l] > [ɫ] should be examined acoustically in order to document incremental shifts away from the rhotacized lateral to the velarized variety of American English.

REFERENCES
[1] Vance, Timothy J. (1987), *An Introduction to Japanese Phonology*, Albany NY: State University of New York Press.
[2] Dickerson, L. and Dickerson, W. (1977), "Interlanguage phonology: Current research and future directions", in S. Corder and E. Roulet (eds.), *The Notions of simplification, interlanguages and pidgins and their relation to second language learning* (Actes du 5ème Colloque de Linguistique Appliquée de Neufchatel, pp. 18-29), Paris: AIMAV/Didier.
[3] Labov, William (1972), *Socio-linguistic Patterns*, Philadelphia PA: University of Pennsylvania Press.
[4] Pullum, Geoffrey K. and William A. Ladusaw (1986), *Phonetic Symbol Guide*, Chicago IL: The University of Chicago Press.