



Present state analysis and measurement of pronunciation training effectiveness in English acquisition: Relationships between production patterns and English proficiencies

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Abstract

The present study investigated the English proficiencies of Japanese speakers and measured pronunciation training effectiveness in English acquisition. Junior high school teachers of English and college students in a teacher training course (JET) served as participants. After examining their English proficiencies, we carried out pronunciation training over a period of three months, and then measured training effectiveness. We analyzed the production patterns from the viewpoints of compensatory shortening of a stressed vowel, ISI durations, and weak vowel production. We also employed official TOEFL ITP and TOEIC® Speaking scores, in addition to reading rate and vocabulary size. The present state analysis showed strong correlations of all parameters examined in this study. JET participants showed a high degree of attainment regarding stressed vowel shortening. The results indicated that the degree of difficulty in acquiring durational control of stressed vowel is not so high, compared with the acquisition of ISI durational control. The stressed vowel shortening showed a strong correlation with reading rate and vocabulary. The measurement of training effectiveness showed a significant effect in the F1 frequencies of the weak vowel. The training indicated different degrees of effect on each of the parameters examined in this study.

Index Terms: English acquisition, ISI durational control, compensatory vowel shortening, weak vowel production, pronunciation training

1. Introduction

A variety of factors are involved in acquisition of English as a second language. The degrees of L2 attainment might vary depending on the features of L2 production and perception. In spite of the general belief that younger learners do better than older ones, various studies have reported that even late learners can achieve native-like pronunciation [1]-[5]. Even when learners cannot attain native-like pronunciation, it is crucial from the viewpoint of communication to achieve intelligible English.

Japanese learners' awareness that they are not good at English pronunciation has something to do with their not getting pronunciation training at junior high and senior high schools. More than 70% of Japanese college students reported that they did not receive English pronunciation training at junior high and senior high schools [6]. A survey conducted on junior and senior high English teachers revealed that they feel a

difficulty in teaching pronunciation, and their confidence in pronunciation is related to their pronunciation teaching in class [7]. The effects of pronunciation training on L2 acquisition were reported, and, especially, intelligibility was shown to be improved [8], [9].

In order to improve intelligibility, stress-related durational control is one of the essential factors in production. An interstress interval (ISI) has been shown to be a rhythmic unit in the production of English for native speakers of English, but not for non-proficient Japanese speakers [10]. The same study also reported a foot-level shortening for the native speakers of English, observing that the average percentage of stressed vowel shortening from a one-syllable ISI to a two-syllable ISI was 19%, while Japanese non-proficient speakers of English displayed very little foot-level shortening: an average of 7% shortening. The results of follow-up studies showed significant differences in the compensatory vowel shortening between Japanese learners of English who had studied English in Japan and Japanese returnees who had lived in the U.S [11], [12]. Further, it has been reported that two different teaching methods showed different degrees of effect on the acquisition of stress-related and focus-related durational control in English by Japanese college students [13].

The present study reported the English proficiencies of junior high school English teachers and college students in the teacher training course. The production experiments focused on compensatory stressed vowel shortening, ISI durational control, and weak vowel production. Also, we investigated the relationships among the above-mentioned production parameters and the other English proficiency parameters. The purposes of the present study were: 1) to analyze the present state of English proficiencies of Japanese teachers and college students in the teacher training course, and 2) to measure pronunciation training effectiveness. In this paper, we reported the effects of pronunciation training on two production parameters, ISI durations and the weak vowel production.

2. Present state analysis of English proficiencies and measurement of training effectiveness

2.1. Participants

Eleven participants, including junior high school English teachers and college students in the teacher training course (JET), participated in this study. There were six teachers (TCH: 2 males and 4 females) and five students (STD: 2 males and 3 females). For the purpose of comparing the production data, we

also tested 13 native American speakers (AMR: 8 males and 5 females) and 14 Japanese non-proficient learners of English (NJL: 7 males and 7 females). NJL participants were all college students with the average official TOEIC® Listening & Reading test score of 432.

2.2. Procedures

We used four tests to measure the English proficiencies of JET participants. They took the official TOEFL ITP and TOEIC® Speaking tests. They also took standardized tests: the “Rate Level Test” [14] for measuring their reading rate in English, and the “Accuracy Level Test” [15] for measuring vocabulary size.

For analyzing the attainment level of production patterns, we examined three parameters: compensatory shortening of a stressed vowel, ISI durational control, and weak vowel production.

Six English sentences were devised as the linguistic material for the production experiments (Table 1). The sentences differed in the number of nominally unstressed syllables that intervened between a target stressed syllable and the next stressed syllable. The number of unstressed syllables ranged from one to four. These sentences contained the ISIs within and between words (ISI1), except for the one-syllable ISI “Pete.” While the number of syllables in the ISI1 varied from sentence to sentence; the number of syllables in the following ISI (ISI2) was always 2 syllables. As shown in Table 1, the six sentences contained a target stressed vowel /i:/. The participants were instructed to produce their best English-like utterance at a comfortable speaking rate and to read each sentence through without pausing. Spectrograms and wave forms were made from these recordings. We measured the durations of the target stressed vowel, /i:/ in sentences 1 to 5 (Table 1), a total of 15 utterances, with three repetitions of each sentence for each participant. The onset of the vowels was defined as the instant a sharp rise appeared in the power of the first formant. Since the target vowel was followed by a stop /t/ or a flap /ɾ/, the offset of the vowel was defined as the abrupt decrease in power corresponding to the stop closure or the change in power and formant structure corresponding to the flap. Furthermore, we measured the durations of target ISIs (ISI1) and following ISIs (ISI2) in sentences 1 to 5 (Table 1), a total of 15 utterances, three repetitions of each sentence for each participant. The duration of ISI1 was defined as the interval between the onset of the vowel /i:/ in “Pete,” “Peter,” and “Peterson” and that of the next stressed vowel in “play,” while that of ISI2 was defined as the interval between the onsets of the vowel in “play” and the next stressed vowel. For the purpose of the normalization of the speaking rates, the ratio ISI1/ISI2 was obtained. Next, we measured the F1 and F2 frequencies of a weak vowel /ə/ of “Peter” and “Peterson” in sentences 3 to 6 (Table 1). Three repetitions of each sentence, a total of 12 utterances were measured for each participant.

Table 1: Linguistic materials.

	Number of syllables in ISI
1. P / <u>e</u> te pl / ays the p/ iano. ←ISI1→ ←ISI2→	1 /i:/
2. P / <u>e</u> te can pl / ay the p/ iano.	2 /i:/
3. P / <u>e</u> ter pl / ays the p/ iano.	2 /i:/ & final /ə/
4. P / <u>e</u> ter can pl / ay the p/ iano.	3 /i:/ & final /ə/
5. P / <u>e</u> terson pl / ays the p/ iano.	3 /i:/ & medial /ə/
6. P / <u>e</u> terson can pl / ay the p/ iano.	4 /i:/ & medial /ə/

After we carried out the production experiments and measured the present state of English proficiencies of JET participants, we conducted pronunciation training over a period of three months. The participants received lectures on how to make sounds, phrases, and sentences, as well as differences in segments (vowels and consonants), larger elements, rhythm and intonation between Japanese and English, and then they practiced pronunciation. The same instructor with knowledge of phonetics/speech science and long teaching experiences at college in addition to studying/teaching in the US for several years taught the participants throughout the training period. After the training period, we conducted the same production experiments.

2.3. Results of the present state of English proficiencies

The TOEFL ITP average score of JET was 487 (Min.: 353, Max.: 643). Their TOEIC Speaking average score was 125 (Min.: 50, Max.: 180). Their average reading rate was 148 word per minute (Min.: 105, Max.: 235), and they had an average vocabulary of 15,863 words (Min.: 6,250, Max.: 33,750). Table 2 shows statistically significant (* $p < .05$ ** $p < .01$) correlation coefficients for the above-mentioned parameters. Reading rate showed a strong correlation with both vocabulary size and TOEFL ITP score.

Table 2: Correlation coefficients for TOEFL ITP, TOEIC Speaking, reading rate, and vocabulary.

	TOEFL ITP	TOEIC Speaking	reading rate
TOEIC Speaking	0.468 *	—	
reading rate	0.787 *	0.641 *	—
vocabulary	0.786 **	0.468	0.908 **

* $p < .05$ ** $p < .01$

Turning to the target vowel shortening, the stressed vowels were shortened considerably when unstressed syllables were added to the ISIs in the case of AMR and JET, while NJL showed a much smaller percentage of shortening. The differences between NJL and AMR, and those between NJL and JET were statistically significant ($p < .01$), while those between JET and AMR were not significant. It is also noteworthy that the target vowel shortening of JET showed a positive correlation with the four English parameters. Especially the vowel shortening showed a strong correlation with reading rate and vocabulary (reading rate: $r = .652, p < .05$; vocabulary: $r = .641, p < .05$).

The increment of increase in the normalized ISI durations with the additional unstressed syllables differed among the three subject groups. The differences in the normalized between-word ISI durations among JET, NJL, and AMR were statistically significant ($p < .01$), regardless of the number of syllables in ISI1. Regarding the ISIs within a word, AMR and JET showed similar durational patterns in the case of 2 syllables. The differences between AMR and JET were not statistically significant, while the differences between NJL and AMR and those between NJL and JET were statistically significant in the case of 2 syllables ($p < .01$). The differences between AMR and NJL, those between AMR and JET, and those between JET and NJL were statistically significant in the case of 3 syllables ($p < .01$).

Turning to the weak vowel production, NJL showed significantly higher F1 frequencies and significantly lower F2 frequencies than those of the AMR ($p < .01$), as shown in Fig. 1 (pooled data of male speakers of four subject groups). JET and AMR participants showed similar frequencies, showing no statistically significant difference in the F1 frequencies. The F2 frequencies of JET were higher than those of NJL, although they were lower than the F2 frequencies of AMR ($p < .01$).

The teacher subgroup of JET (TCH) exhibited lower F1 frequencies and higher F2 frequencies than the student subgroup of JET (STD) (Fig. 1), indicating a higher acquisition attainment, although the differences between these two subgroups of JET were not statistically significant. The data of the female speakers showed a similar tendency regarding the F1 and F2 values.

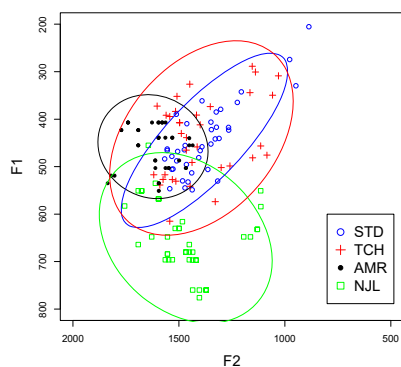


Figure 1: Formant frequencies of all tokens produced by male speakers of four groups.

2.4. Results of measurement of training effectiveness

The results of the present state regarding the compensatory stressed vowel shortening showed the high level of acquisition attainment by JET regarding this specific production parameter. Therefore, the effects of three-month pronunciation training on two production parameters—the ISI durational control and a weak vowel quality—are reported in the present study.

Fig. 2 shows the changes in normalized ISI durations after the training. A two-way ANOVA showed a significant effect of training ($p < .01$) and that of the subgroups between TCH and STD ($p < .01$). However, no different degrees of training effectiveness were shown for the subgroups.

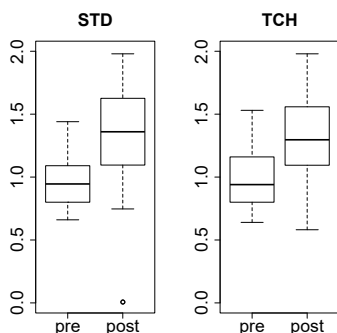


Figure 2: Changes in durations of ISI between words ($ISI1/ISI2$) for STD and TCH after pronunciation training.

Turning to another production parameter, the target weak vowel quality, Fig. 3 shows the F1 and F2 frequencies of all tokens produced by male speakers of AMR, STD, and TCH before and after the pronunciation training. We can observe that STD showed a narrower opening after the training, thus getting closer to native speakers' production. Fig. 4 shows the changes in formant frequencies after the training, indicating a significant effect of training ($p < .001$). Likewise, a significant effect of training ($p < .001$) was observed for F2 frequencies. Different degrees of training effectiveness were shown for the subgroups of JET, STD and TCH. TCH, but not STD, exhibited lower F2 values after the training ($p < .05$).

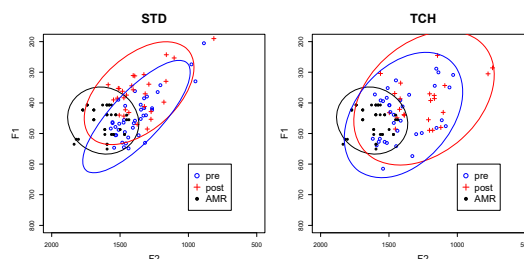


Figure 3: Formant frequencies of all tokens produced by male speakers of three subject groups before and after pronunciation training.

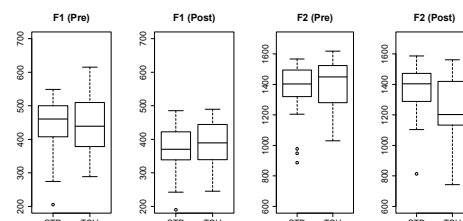


Figure 4: Changes in formant frequencies after pronunciation training.

2.5. Relationships among English parameters, ISI duration changes, and formant frequency changes

Table 3 shows correlation coefficients among normalized ISI duration changes, reading rate, vocabulary, TOEIC Speaking and TOEFL ITP scores. The result indicated that the JET participants with high English proficiency tended to show a higher degree of improvement in ISI durational control.

Table 3: Correlation coefficients among normalized ISI duration changes, reading rate, vocabulary, TOEIC Speaking and TOEFL ITP scores.

Reading Rate	Vocabulary	TOEIC Speaking	TOEFL ITP
-0.025	-0.033	-0.226	-0.091

Table 4 shows correlation coefficients among formant frequency changes, reading rate, vocabulary, TOEIC Speaking and TOEFL ITP scores. The results indicated that the JET

participants with high English proficiency tended to show a higher degree of improvement in F1 values.

Table 4: Correlation coefficients among formant frequency changes, reading rate, vocabulary, TOEIC Speaking and TOEFL ITP scores.

	Reading Rate	Vocabulary	TOEIC Speaking	TOEFL ITP
F1 diff.	0.537 *	0.455	0.612 *	0.123
F2 diff.	0.001	0.095	0.006	0.237

* $p < .05$

3. Discussion

We have observed conspicuous individual differences in all English parameters among the JET participants, and strong correlations among those parameters. Among the production parameters, we did not find any significant differences in compensatory vowel shortening between native speakers and JET participants, which indicates the high level of acquisition attainment regarding this specific production parameter. It is also noteworthy that ISI durational control was found to be more difficult to acquire, which is in accordance with the results of previous studies [11], [12]. The results of this study also suggested that the acquisition of the high-low place of articulation in vowels can be attained before that of the front-back place of articulation.

The present study showed the effects of pronunciation training on ISI durational control and weak vowel quality. The study showed that we need to produce weak syllables properly for making natural rhythm of English. The pronunciation training improved ISI durational control, regardless of the proficiency levels. No relationships between degree of ISI improvement and TOEIC scores were found, except for a weak correlation between improvement levels of ISI durational control and TOEIC speaking scores.

These results suggest that proficient learners are aware of the importance of speaking rhythm even in an early stage of learning, while low TOEIC-score learners cannot pay attention to the speaking rhythm in an early stage. Thus, they showed a greater improvement after training.

Also, these results suggest ISI durational control or speaking rhythm strongly affects the evaluation of speaking abilities. Learners who speak with more proper rhythm in a speaking test could be rated higher than the other learners.

The results showed that the degree of training effectiveness was higher for proficient speakers both in ISI durational control and weak vowel quality.

The F1 value of the weak vowel of the teacher group after training indicated a higher place of articulation, which indicates a more similar place of articulation by native speakers. Regarding the F2 value after training, the teacher participants exhibited lower F2 value, indicating backward articulation. Since the weak vowel in this study was an r-colored schwa, it seems to be the case that the teachers acquire the retroflex articulation which causes the backward articulation.

4. Conclusions

This study attempted to examine the present state of the English proficiencies of Japanese teachers and college students in the teacher training course, and to measure the training effectiveness in production patterns. The production parameters were shown to have different degrees of training effectiveness. The present study suggests that pronunciation training is an effective method to improve production patterns for a short period of time.

5. Acknowledgements

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6. References

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