Effects of HVPT on perception and production of English fricatives by Japanese learners of English

Atsushi Iino[1]

Abstract. This study investigated the effects of High Variability Phonetic Training (HVPT) on beginner level English as a Foreign Language (EFL) Japanese learners' perceptions and productions of the English fricatives /f/, /v/ and /θ/. With the use of the computer program 'English Accent Coach' (EAC, Thomson, 2017), two groups of participants were engaged in learning the sounds in a two-syllable environment: target consonant + vowels (CV) and target consonant + vowels + consonant (CVC). The perception training with EAC was conducted for five weeks between a pre-test and a post-test in perception and production. Production was measured in the form of recorded reading aloud and was evaluated by native English speakers and a Japanese teacher of English. The results indicated the advantageous effects of CVC environments on perception as well as on production.

Keywords: pronunciation, HVPT, fricatives, perception, production.

1. Introduction

Training foreign language learners to perceive and produce sounds which have no equivalent sounds in their first language has always been an issue in pronunciation instruction. Particularly, HVPT has been regarded as an effective computer assisted pronunciation training which enriches robust sound images for L2 learners' perceptions, and hence intelligibility in production (Thomson, 2018).

Previous studies uniquely focus on /l/ and /r/ sounds for Japanese learners of English and suggest HVPT based on how perception affects production (Bradlow, Akahane-Yamada, Pisoni, & Tohkura, 1999, among others). Iino and Thomson

1. Hosei University, Tokyo, Japan; iino@hosei.ac.jp

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(2018) also focused on /l/, /r/, and /w/, and found computer assisted HPVT, namely EAC (Thomson, 2017), brought about progress in perception as well as progress in production.

However, there are few research studies that have investigated other consonants that Japanese learners have difficulty perceiving and producing. Lambacher, Martens, Nelson, and Bermen (2001) investigated the perception of voiceless fricatives for Japanese learners in a HVPT condition. They found /θ/ was the hardest to distinguish among other fricatives and the vowel environment had a strong influence. In the research, however, the variation of talkers seems to be limited. Iino (2018) investigated English sounds that are challenging for Japanese learners by using EAC. Among all the English consonants, fricatives such as /f/, /v/, and /θ/, were regarded as difficult sounds to perceive.

Thus, this paper focuses on the three fricative sounds: /f/, /v/, and /θ/, and I examined the effects of using computer assisted HVPT (i.e. EAC) under two different training environments: CV and CVC. My research questions are as follows.

> RQ1. What are the effects of HVPT on Japanese students' perceptions of the English /f/, /v/, and/θ/ over time depending on training environments?
>
> RQ2. What are the effects of HVPT on production of the target sounds over time depending on training environments?

2. Method

2.1. Participants

The learners who agreed to participate in this research were freshman students who were non-English majors in a university in Tokyo. They were enrolled in compulsory English courses consisting of two classes: Class A and Class B. By eliminating those who missed any of the assignments, pre-test, or post-tests, 33 students were eligible for data analysis as shown in Table 1. Their Test of English for International Communication (TOEIC) scores indicated they were categorized in the Common European Framework of Reference for languages (CEFR) A2 level (Class A: Mean (*M*)=342.5, Standard Deviation(*SD*)=11.5; Class B: *M*=265.4, *SD*=48.5).

2.2. Treatment

EAC (Thomson, 2017) was used for testing perception and training in two phonetic environments. In the program, users listened to randomly provided target sounds and chose one of the target phonetic symbols. The sound combinations were also randomized as were the 30 talkers' stimuli.

Treatment comprised three 100-item perceptual training sessions per week during the fall semester in 2018. Over five weeks, Class A received training in the CV phonetic environment in which the three target consonants were randomly provided as one syllable such as /fi /, /ve / or /θɑ/. Class B received the training in the CVC environment in single syllable words and word-like stimuli. The target sounds were always in syllable-onset position in both of the environments.

The participants practiced the first session of the training in class, and did the second and third sessions outside of class on their own within a week. They submitted three PDF feedback forms through Sakai, a course management system, every week. They could not do multiple sessions back-to-back in a day.

A pre-test and post-test design was adopted. The results of the first-week EAC training were used as a perception pre-test, and the ones in the fifth week were used as post-tests. In the first and the fifth week, the participants' productions were recorded by having them produce target items repeating the carrier phrases such as "The train runs valley to valley" and "Thirty-three people are thirsty" (see Table 1).

A total of five sentences included three assessment points for the target phonemes. The produced sounds were judged by two native speakers of English and one Japanese experienced English teacher. The raters listened to the data and rated together. When they disagreed on whether the sounds were correctly pronounced or not, they listened again, discussed, and decided on the judgment: correct (one point) or incorrect (zero).

Table 1. Sentences for production in reading aloud

The train runs valley to valley.
Let's face the facts.
Turn on Voice of America.
Fourteen friends follow my site.
Thirty-three people are thirsty.

*the underlined parts are the assessment points for the target sounds

3. Results

3.1. Perception

Progress was observed in all the sounds in more or less between 67% and 95% in the two training environments. Especially significant progress was found in /f/ in CV ($t(13)=2.58$, $p<.05$, $d=.90$) and /v/ ($t(18)=9.59$, $p<.01$, $d=3.36$), and /θ/ ($t(18)=3.42$, $p<.01$, $d=.95$) in CVC (Figure 1, Table 2).

Figure 1. **Left**: perception rate in CV training. **Right**: perception rate in CVC training

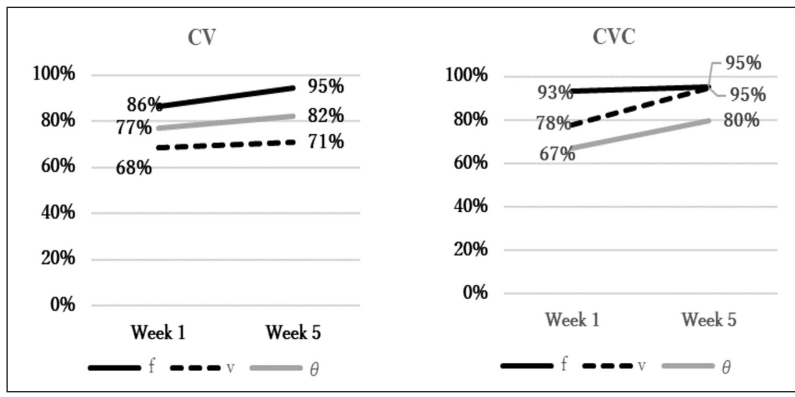

Table 2. Means of correct percentages in perception

		Week 1		Week 5		Progress	
		M	**(SD)**	**M**	**(SD)**	**M**	**(SD)**
CV (Class A) n=14	f	86.4	(12.3)	94.6	(4.8)	8.1*	(11.8)
	v	68.4	(11.4)	70.9	(9.7)	2.6	(11.9)
	θ	76.6	(8.6)	82.0	(6.3)	5.4	(9.6)
CVC (Class B) n=19	f	93.3	(3.8)	95.4	(4.4)	2.1	(5.8)
	v	77.6	(6.8)	94.8	(3.1)	17.3**	(7.9)
	θ	67.1	(13.8)	79.6	(13.2)	12.4**	(15.9)

** p<.01, * p<.05

3.2. Production

Statistically significant progress was found in /θ/ in CV ($t(13)=2.19$, $p<.05$, $d=.86$), /f/ ($t(18)=3.99$, $p<.01$, $d=.70$) and /v/ ($t(18)=2.47$, $p<.05$, $d=.60$) in CVC (Figure 2).

By overviewing the means, the majority of them remained as in low percentages, though the means in CVC were comparatively higher than those in CV (Figure 2, Table 3).

Figure 2. **Left**: production rate in CV training. **Right**: production rate in CVC training

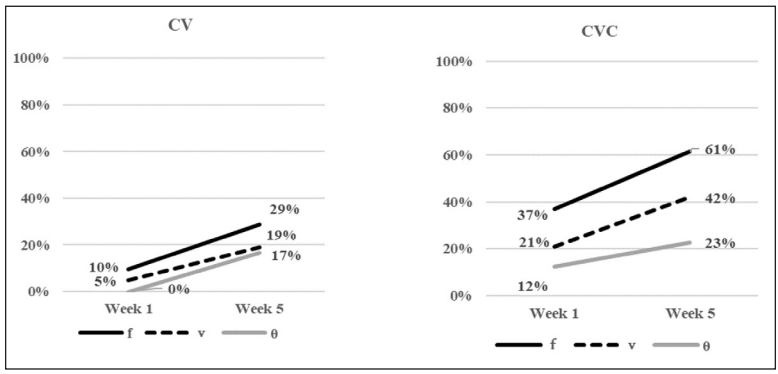

Table 3. Mean number of phonemes accurately produced

		Week 1 (3pts)		Week 5 (3pts)		Progress	
		M	**(SD)**	**M**	**(SD)**	**M**	**(SD)**
CV (Class A) n=14	f	9.5	(24.2)	28.6	(38.9)	19.0	(40.7)
	v	4.8	(17.8)	19.0	(33.9)	14.3	(31.3)
	θ	2.4	(8.9)	16.7	(28.5)	14.3*	(25.2)
CVC (Class B) n=19	f	36.8	(33.1)	61.4	(38.9)	24.6**	(26.9)
	v	21.1	(33.7)	42.1	(38.2)	21.1*	(37.2)
	θ	12.3	(27.7)	22.8	(29.5)	10.5	(25.0)

** p <.01, * p <.05

4. Discussion

4.1. Effects of HVPT on perception over time

The results in perception partially follow Lambacher et al. (2001) because perception of fricatives showed a high accuracy rate of over approximately 70%. Regarding the improvement in perception, /θ/ and /v/ showed significant progress in CVC, while they did not in CV. These results indicate the CVC environment helped improve perception more than the CV environment. Considering the ceiling

effects in /f/ from the beginning, the CVC environment might have given more redundancy in perception potentially due to the length of stimuli and vocabulary knowledge the learners might have drawn on.

4.2. Effects of HVPT on production over time

HVPT was effective for improving all the sound articulations, particularly /θ/ in CV, and /v/ and /f/ in CVC. However, considering the fact that the majority of the scores were relatively low percentages particularly in the CV environment, the participants seemed to have struggled to articulate the target sounds. The gap between perception progress and production progress was also seen in different degrees in Iino and Thomson (2018). However, the gap in this study was larger, which indicates learning the articulation of those fricatives is quite challenging for Japanese learners of English in spite of the higher perception rates.

5. Conclusions

This study found positive effects of computer assisted HVPT on improving Japanese English learners' perception of English fricatives to some extent regardless of the training environments. The HVPT training was also effective in production in different levels to different degrees depending on target sounds and the training environments. Considering the participants' levels of proficiency (i.e. CEFR A2), these findings suggest that using the CVC environment, which provides single syllable words and word-like stimuli, leads to a better production rate.

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