Improving the Perception of English Vowels
with High Variability Phonetic Training

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Abstract

Adult second language learners often have difficulty perceiving individual phonemes. This classroom study reports on university-aged Japanese students' ability to perceive a difficult vocalic contrast after 14 weeks of High Variability Phonetic Training (HVPT). Importantly, these activities never took more than 10 minutes of class time. A statistical analysis of the participants test scores showed HVPT to produce a significant improvement over the course of a semester. In concluding this paper, the authors will offer some thoughts on the implications of this study.

It is well known that learners of a second or a foreign language (L2) have difficulty perceiving certain phonemes of the language being learned. Over the last couple of decades several studies have shown that High Variability Phonetic Training (HVPT) can lead to improvement in the discrimination of non-native contrasts (Strange & Dittmann, 1984; Logan, Lively, & Pisoni, 1991; Bradlow, Akahane-Yamada, 1999; Zhang et al., 2009). This study builds upon previous research by the authors (Donnellan, Jensen & Greco, 2016). One of the goals of the training reported here is to make these results more readily applicable to a classroom by looking at whether HVPT techniques will be effective in short but intense, classroom-training sessions. In this paper, we report on a classroom HVPT study that focused on the/ʌ-æ/contrast. Some English vowels, and particularly the/ʌ-æ/contrast, are difficult for Japanese speakers (Nishi & Kewley-Port, 2007), so the aim was to see if a

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few minutes of HVPT every week for 14 weeks would improve university-aged learners' perception. A second research goal was to test the influence of co-articulation information on the perception of the/ʌ-æ/contrast. That is, we investigated how the phonemic context, the preceding or following consonants, effect the perception.

PHONEMIC TRAINING

One of the most influential models of L2 perception, Kuhl's Native Language Magnet Theory (NLM), (Kuhl et al., 2008), explains the perception of L2 phoneme categories in relation to the categories found in the learners' native language. A fact arising from NLM's account of speech perception is that explicit teaching, or at least some type of signal enhancement, is the best way to train EFL learners to perceive difficult L2 phonemes (Zhang et al., 2009). In short, if learners cannot hear the sounds, they will not acquire them. The target contrast must be made salient through some kind of enhancement. In addition, exposure to multiple speakers, "high variability," as it is called, has been proven to be an effective way to increase perceptual learning and to ensure that the learning generalizes to novel (never before heard) listeners.

An early study (Strange & Dittmann, 1984) showed success in improving learners' ability to distinguish difficult contrasts but could not provide evidence that the training improved recognition of stimuli beyond that provided in the study itself. Logan, Lively and Pisoni (1991) used the same words as Strange and Dittman, but produced by multiple talkers. The results showed that the subjects exposed to numerous speakers improved significantly in minimal pair identification when compared to subjects who only heard one speaker. Their claim is that the "modification of attention is . . . promoted by stimulus variability [which] provide[s] a representative sample of possible exemplars so that changes in the relative weightings of different acoustic cues appropriate to the novel categories can take place" (p.883).

Importantly, training on vowels has been shown to be more effective if the set of tokens is large. Kewley-Port et al. (1996) showed that training with a set of nine vowels improved average identification by 25% over a group that only trained on three vowel contrasts. HVPT protocols for vowels, then, should present a large set of vowels and not focus only on the more difficult vowels. For this reason, the training described here included a wider range than the focused on/ʌ-æ/contrast.

ENGLISH AND JAPANESE VOWELS

Although the number of vowels identified in both English and Japanese differs

depending on how fine-grained a linguist's or phonetician's analysis is, English clearly has more vowels than Japanese. It is common to claim that Japanese uses five vowels while English uses 11 (excluding diphthongs and rhotic vowels) with a tense and lax distinction. The tense vowels in English are those with more muscle tension:/aː/of "day,"/eː/of "free,"/uː/of "shoe,"/o/of "go,"/ɔ/of "law." These contrast with lax counterparts, the/ɪ/of "bit,"/ɜ/of "bet,"/æ/of "man,"/ʊ/of "book," and the/ʌ/ of "buck."

The difficulty the English vowels present to Japanese speakers is well documented. Yamada, Yamada and Strange (1995) tested Japanese listeners on their perception of English vowels and found they were correctly identified only 49% of the time. The reasons for this difficulty have also been discussed. Ohata (2004), for example, describes the difficulty Japanese speakers have with the tense/lax distinction made in English and Nishi (2008) points out that English vowels are pronounced using five different tongue heights, while Japanese vowels are produced using three tongue heights. Kewley-Port et al. (1996) estimated that Japanese speakers of English need to acquire six or more vowels and actually need to redistribute their existing vowels because Japanese vowels fall between the English tense and lax vowels.

The difficulties Japanese speakers have with the contrast investigated in this study are also well-documented. Bada (2001) showed that Japanese learners may perceive both/æ/and/ʌ/as their closest counterparts in Japanese, a sound closer to the Japanese/a/. Lambacher et al. (2005) also showed the difficulty Japanese speakers have with the English/ʌ-æ/contrast. Specifically, they demonstrated how the Japanese lack of a mid-central vowel/ʌ/and a low front vowel/æ/can confuse Japanese students and cause them to confuse words like "hut," "hat and "putt," "pat."

THE STUDY

Two questions were asked: 1) Will HVPT improve students' perception of English's/ʌ-æ/phonemic contrast with short, weekly exposures over 14 weeks? 2) What difference will the phonemic context make on learner's ability to perceive the contrasting phonemes?

Participants

The subjects of this study were 68 Japanese university students. They were all first-year students, non-English majors, and had been streamed to the same level. They made up two classes. One class of 34 students were subjects of the study. One class of 34 students was the control group. The classes met once a week.

METHOD

Pre-test

This was a phoneme identification test and the vowel contrast/ʌ-æ/was tested. The pre-test was conducted by writing ten word-pairs in two columns, one column under A and the other column under B. Five of the pairs contained the/ʌ-æ/contrast. The other five were distractors. The list contained monosyllabic words where both/ʌ/and/æ/occurred between varied sets of voiced or unvoiced consonants. The tester pronounced one of the words and the students wrote either A or B depending on which column the word they heard was listed.

The tester spoke American English and covered his mouth, taking care not to muffle his speech, so as not to give visual hints. The test was given the first day of class and all students were present. It was anonymous.

Training

The students were exposed to HVPT training, but importantly, the training was not limited to the/ʌ-æ/contrast. Students were given instruction on the entire English vowel inventory, albeit with focus on/ʌ/and/æ/. The tongue heights of all the English vowels were diagrammed,/ʌ/and/æ/were contrasted with other vowels sounds, as well as with each other. Usually the teacher used his voice, but the high variability threshold was reached by using a DVD produced specifically to give listeners exposure to contrastive minimal pairs. On this DVD, a number of speakers pronounce different examples of a given contrast. At times, the normal tools of pronunciation practice, tongue twisters, dictations and such, were also utilized.

Importantly, these activities never took more than 10 minutes of class time. The activities were not measured, timed, or even scheduled into specific classes. The teacher simply had a number of tools in his repertoire and used them as time allowed. This might have involved taking 10 minutes to diagram tongue heights and practice minimal pairs, or it might have been, with under 10 minutes left in the class, writing a tongue twister on the board and allowing those students willing to stand up and repeat the pronunciation after the teacher to leave a few minutes early.

Much of the exposure the students received came during more communicative activities. That is to say,/ʌ-æ/, would be exaggerated (not always of course) during normal classroom administration. While giving instructions, explaining meaning-based activities, or during any other classroom discussion, the contrast might be enhanced, which can be taken to the absurd for comical effect. The contrasts also became part of the teacher's error correction repertoire. Applying the tenets of a form-focused approach (Long & Robinson, 1998), explicit error correction was considered appropriate in meaning-based contexts. Given the appropriate circumstances, an er-

ror was indicated.

Post-training test

The post-training test was exactly like the pre-training test. The same contrasts were used and spoken by the same tester. The students knew the test had nothing to do with their final course grades. They were never given the results of the pre-test, so there is no reason to assume they were responding to the word pairs from memory. The assumption is they were responding in the post-test, just as they did in the pre-test, according to what they perceived. There was, then, no benefit from prior test exposure. The hope is, and the results showed, they were responding with sharpened perception skills. The post-test was carried out the last day of class and all students were present.

RESULTS

Substantial improvement in phoneme discrimination was made. Table 1 shows the subject group results and Table 2 shows the control group results.

Table 1 *Summary of pre/post-test errors for the subject group (n: 34).*

Errors/Contrast	Pre- test errors	Post-test errors	Increase in correct responses
1. putt-pat	17	13	4
2. tag-tug	15	2	17
3. dab-dub	13	4	14
4. back-buck	20	7	7
5. cat-cut	0	1	−1

Table 2 *Summary of pre/post-test scores for the control group (n:34).*

Errors/Contrast	Pre- test errors	Post-test errors	Increase in correct responses
1. putt-pat	18	17	1
2. tag-tug	13	9	4
3. dab-dub	11	6	5
4. back-buck	18	24	−6
5. cat-cut	3	2	1

Table 1 and 2 above show the increase in the number of correct responses for the subject and control groups. The subject group had a total increase of 41 correct responses while the control group's total was only an increase of 6 responses.

Table 3 *Paired t-test of the pre/post-test scores of the control and subject groups.*

Outcome	Pre-test		Post-test		n	95% CI for Mean Difference	Sig. (2 tailed)	t	df
	M	SD	M	SD					
Control	3.20	1.25	3.23	1.02	34	−0.48,−0.42	.895	−0.13	33
Subject	2.94	1.13	4.03	.90	34	−1.5,−0.67	.000*	−5.33	33

As displayed in Table 3, there are statistically significant differences, at the .05 significance level, in pretest to posttest scores for the subject group, but not for the control group. Results show that student's ability to recognize different phonemes increased after experience with HVPT.

DISCUSSION

This study confirms what other studies have found: High Variability Phonetic Training (natural words from multiple talkers) improves learner's ability to discriminate non-native phonemes. Our first research question was whether short, intense HVPT would improve university-aged students' perception of a difficult phonemic contrast. The results confirm that such training on the AE vowels/ʌ/and/æ/can lead to improved discrimination.

Our second research question was: What difference will the phonemic context make on the learner's ability to perceive the contrasting phonemes? In this regard, perhaps more questions have been created than have been answered. The results indicate that the greatest improvement was made when the vowel was placed before a voiced consonant. This could be the result of the lengthening of the vowel sound due to the voicing of the following consonant. The preceding consonant seemed to have no effect. Also, there was little improvement when the vowels were between unvoiced consonants, yet the contrast with "cat" and "cut," two unvoiced consonants, was almost perfectly understood by both groups in both the pre-test and the post-test. Overall, the results failed to give any clear information regarding the influence of the phonemic environment. This failure may be due to the size of the study, the small number of tokens, or perhaps the familiarity of the words used as tokens.

LIMITATIONS

Clearly, caution must be exercised when drawing conclusion about a study the size of this one. Nonetheless, this study is noteworthy because it was conducted in a classroom. Perhaps it was too small to add information about phoneme acquisition to the fields of linguistics or phonology, but that was not the point. This was a

classroom study carried out to inform teachers about classroom activities that work. This study demonstrates an easy to use technique that has beneficial effects. Namely, short, explicit HVPT training can improve students' perception in a period of 14 weeks, which brings us to the conclusion.

CONCLUDING THOUGHTS

It is suggested that pronunciation instruction has been marginalized in language teaching (Gilbert, 2010). Explaining the veracity of this claim is well beyond the scope of this paper, as is the connection between perception and production. One aim of this study, in any case, was to show that perception training, and presumably pronunciation training, need not take up a lot of class time. We are not so interested in the specific details of what brought about the training's success. We have not tried to tease out to what degree the various elements of the training were effective. We wanted to see if HVPT, along with other traditional techniques, inserted into classes as time allowed, would have an impact on the student's ability to perceive, and presumably pronounce, difficult English phonemes. In doing this, we hope to help bring pronunciation training back from the margins. We are encouraging teachers to work on their students' listening and pronunciation problems. And, we are demonstrating a technique that teachers can use towards that end.

Of course, when designing a strategy for teaching, it is important to consider the nature of the task in terms of its difficulty and the chances for its successful accomplishment. Teachers should consider the time available and set their goals accordingly. The training demonstrated in this study, over the course of a semester, could turn a group's *sank you* into *thank you.* If incorporated into a departmental curriculum, over years this training could have substantial results. If incorporated into a national curriculum beginning in elementary school, the results might be staggering.

Lastly, and most encouragingly, the teacher gathered informal feedback from the students about the training. The vast majority of the students reported that they found the training to be both useful and enjoyable.

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