



The Effectiveness of Using IPA in Early English Phonetic Education to Japanese Preschoolers

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Abstract

This study examines the effectiveness of using the International Phonetic Alphabet (IPA) as a teaching tool in improving the English vowels produced by the Japanese preschoolers aged 4 and 5. Based on the assessments on vowel production of the same target groups in the previous study in Ma (2016), 10 lessons were given in attempt to address their common weakness at pronouncing English back vowels including /u:/, /ʊ/, /ɔ:/, and /ɒ/ in monosyllabic words. IPA is used to teach pronunciation in the experimental group, whereas the children of a control group are given the common teaching practice by using spelling. Individual pronunciation performances are collected before and after the education program is given. An acoustic analysis is conducted by SUGI Speech Analyzer to measure the learners' formant frequencies and plot the vowel spaces. After that, the native children's data collected by Hillenbrand et al was employed as a standard to compare changes in vowel quality between the two groups. The results show the improvements of back vowels in the majority of IPA group, while the decent changes in the spelling group are relatively minimal.

Keywords: early English education, phonetic education, IPA, formant frequencies, vowel space.

1. Introduction

Contrastive analysis has long been adopted by researchers as a common framework to predict potential learning difficulties in L2 phonology education. Based on this theoretical basis, Japanese learners of English are predicted to have difficulties in acquiring the English vowels that are not in the Japanese sound system. The sounds are described by Misono [1] as "lacking places" which include low front vowels, mid central vowels and low back vowels. Other studies have paid attention to the intelligibility of English pronunciation by Japanese adults. In Yamane [2], it can be noted that Japanese college students tend to make mistakes in the vowel of /ɜ:/, where they substitute the vowel /ɑ:/ for /ɜ:/ in

the pronunciation of "bird", and /ɔ:/ for /ɜ:/ in the pronunciation of "work". In Saito [3], eight English-specific segmental sounds, /æ, f, v, θ, ð, w, l, ɹ/, were identified as the most problematic for Japanese speakers. These findings give some hint to English teachers on the teaching priority of vowels to Japanese adults. However, little has been known about the English vowel production by Japanese children. As suggested in Ma [4], contrastive analysis is of limited use to generalize children's L2 phonological performances, in terms of L2 vowel production. On the other hand, study by Oh, et al [5] proposes that Japanese children were able to learn English vowels faster and more accurate than Japanese adults. The native Japanese children were able to create new English vowel categories in a year's time. Consequently, it implies the need for early pronunciation teaching on vowels which is significantly affected by age of acquisition.

In Japan, the use of IPA to teach English pronunciation was first initiated by Okakura Yoshizaburo in 1906. Nevertheless, it is reported in Imanaka [6] that 70% of the Japanese college students can understand only a limited number of the phonetic symbols. According to Ohtaka [7], the application of IPA in Japan's education context can be examined by reviewing the Course of Study released by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). In the Course of Study (1958), MEXT made it obligatory to teach the phonetic alphabets. However, a critical change was made in the Third Revised Course of Study (1969), by allowing teachers to choose to teach IPA where necessary. Since then, similar statements were repeated, and the teaching of IPA became a selective supplementary tool for teaching pronunciation. Since the actual implementation of phonetic education by using IPA was unascertained, it is worthy to explore the possible use of IPA in pronunciation teaching.

As a type of universal phonetic representation, the merits of IPA have been summarized in Imanaka [8]. Another merit of IPA method can be seen in its clarity and consistency in indicating the vowel

sounds that are not in Japanese sound system. The following table will show how IPA and katakana transcribe the pronunciation differently:

Table 1: Merit of IPA over Katakana Transcription

Examples (Alphabets)	Katakana	IPA	Vowels
<u>earth</u>	アース	ɜ:θ	/ɜ:/
<u>bird</u>	バード	bɜ:d	
<u>shirt</u>	シャツ	ʃɜ:t	
<u>fur</u>	ファー	fɜ:	
<u>teacher</u>	ティーチャー	'ti:tʃə	/ə/
<u>worker</u>	ワーカー	'wɜ:kə	
<u>river</u>	リバー	'rɪvə	
<u>cover</u>	カバー	'kʌvə	/ʌ/
<u>money</u>	マネー	'mʌni	

From Table 1, we can notice that the frequent use of ‘—’, i.e. a prolonged sound worth two moras as the main feature, with the occasional use of ‘ャ’, i.e. a palatalized sound, in the katakana transcriptions. When the Japanese children keep relying on the katakana to utter English pronunciation, they will never master the different vowel quality of /ɜ:/, /ə/ and /ʌ/. In the IPA transcription, those prolonged and palatalized sounds are clearly indicated by the consistent symbols. Teaching the IPA symbols of /ɜ:/, /ə/ and /ʌ/ to Japanese learners of English not only allow them to correct the pronunciations of the words they currently learn, but also to attend to other new words with similar sounds in the future.

A preliminary study has been carried out by the author [4] to locate the learning needs of native Japanese children (NJC) in terms of their pronunciation of English vowels. Compared the 11 English monophthongs produced by NJC with those of the native children data in Hillenbrand et al. [9], it has been found that Japanese young learners are weaker in particular at pronouncing the English back vowels including /u:/, /ʊ/, /ɔ:/, /ɒ/. Based on the assessment of learning needs, this paper further examines the effectiveness of the International Phonetic Alphabet (IPA) as a teaching tool in pronunciation teaching.

2. Method

The present study has adopted an educational experimental approach by which pronunciation lessons were carried out in the Japanese preschool for 3 months. Ten lessons were given to 12 young NJC aged 4 to 5.

2.1. Participants

Twelve NJC pupils, who were born in Japan and whose native language is Japanese, were

recruited from a preschool located in Nishinomiya City of Japan. Pronunciation lessons were delivered to them on top of the regular English lessons. Based on the differences in ages and span of English learning experiences, 12 NJC were divided into 2 subgroups: 4-year-old Group including 5 NJC (Boy=2; Girl=3) who received English lessons for 1 year, and 5-year-old Group composed of 7 NJC (Boy=3; Girl=4) who took English lessons for 2 years. The 5-year-old preschoolers were set as an experimental group in which IPA symbols were introduced as supplementary teaching tools with pictures. The 4-year-old preschoolers were assigned as a control group in which the pronunciation teaching followed simply the general use of pictures and spellings.

2.2. Stimuli (Teaching Materials)

A total of 46 target vowel words were selected in the 3-month teaching program. The teaching materials were divided into 4 categories:

- Animal Pictorial Words consisted of 12 English monophthongs in the words *beetle, pig, pet, ant, bird, duck, tiger, goose, wolf, horse, dog and shark*. The animal pictorial words were introduced as mnemonic for the ease of retrievals of IPA symbols.
- Wordlist Set 1 included a total of 13 words that were mostly in /b-v-t/ consonant environment, namely *beet, bit, bet, bat, Bert, butter, but, bus, boot, put, bought, bot and bar*.
- Wordlist Set 2 composed of 13 target vowel words mostly in /b-v-d/, such as *bead, bid, bed and bad*.
- Wordlist Set 3 and Set 4 provided more practices on back vowels as in the words *fruit, foot, fork, frog, farm, hoot, hook, horse, hot and heart*.

There are two differences in teaching two groups. First, the use of texts on the flashcards is different. Flashcards with IPA symbols are used in the experimental group, while flashcards with spelling are used in the control group. Besides, only the experimental group has the blending exercise to practice the segmental sounds, while the control group follows the normal practice to repeat the words after the teacher.

2.3. Procedures

2.3.1. Data Collection

Eleven English vowels, namely /i:/, /ɪ/, /e/, /æ/, /ɜ:/, /ə/, /ʌ/, /u:/, /ʊ/, /ɔ:/, /ɒ/, /ɑ:/, produced by NJC were measured in monosyllables mostly in the /b-V-t/ consonantal environment. Individual pronunciation

data based on the same words on the list were collected before and after the pronunciation lessons were given. Identical to the pretest design, NJC were instructed to look at the slides in which the pictures (word meaning) and either the IPA symbols or the orthography were provided for the experimental group and the control group respectively. A model pronunciation elicited by a Canadian child was enclosed. A SONY IC recorder was used for recording.

2.3.2. Data Analysis

An acoustic analysis was conducted by SUGI Speech Analyzer [10] to extract the learners' formant frequencies (F1 and F2) individually and the English vowel space (EVS) were plotted by the average values between the two groups. NJC5's data were treated as outlier and thus excluded in the upcoming group analysis due to its extreme difference from the average data.

Then, for the sake of comparison of educational effects in group level, "differences from native pronunciation" in terms of formant frequencies are calculated. In the present research, the studies by Hillenbrand et al [9] for the 46 native children's average vowel formant frequencies have been adopted as the standard values to evaluate NJC's changes in vowel productions. NJC's pre educational data were once compared with those values to find out the learning needs. Similarly, NJC's post educational data (i.e. NJC's individual formants extracted from each of the vowel productions) are compared with the standard values again by using the same method of calculation as shown below:

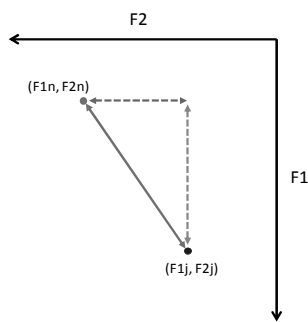


Figure 1: Concept graph to calculate the differences between the Japanese child and native pronunciations

$$|F_j - F_n| = \sqrt{(F1_j - F1_n)^2 + (F2_j - F2_n)^2} \quad (1)$$

where F_j and F_n are the pronunciation of Japanese child and the pronunciation of native children respectively, and $F1_j$, $F1_n$, $F2_j$, $F2_n$ are formant 1 of Japanese child, formant 1 of native children, formant 2 of Japanese child and formant 2 of native children respectively.

Thus, clearer figures to represent the "differences from native pronunciation" can be formed. Individual differences from native pronunciation on specific vowel sounds are then added up to demonstrate the group performance by using column graphs.

3. Results

This section will report the general changes in English vowel space. Then, column graphs are used to compare changes on specific vowel performance.

3.1. Group Changes in English Vowel Spaces

The following plots of English vowel space indicate the pre and post educational changes in the students' categorical perceptions of target vowels. Firstly, the size and shape of EVS can be observed by referring to the four edging points shown in square marks, namely the pronunciations of *beet*, *bat*, *boot* and *bar*. In general, EVS are inclined to be smaller in size, unbalanced in shape (i.e. not quadrilateral), and more narrow in length or width before the education program. Except for *boot* and *bar*, other back vowels including *put*, *bought* and *bot* shown in triangle marks are condensed horizontally in both groups before education. The location of these back vowels in the IPA group became vertically apart after education.

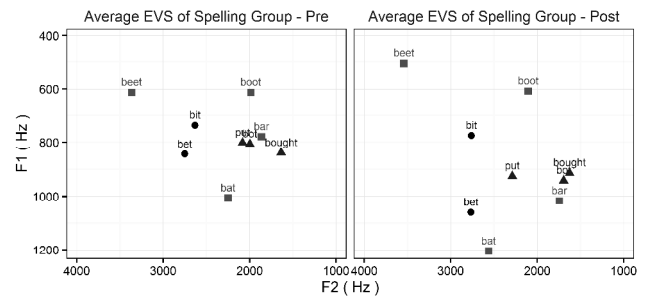


Figure 2: Pre and Post Education Changes in Average English Vowel Space, Spelling Group

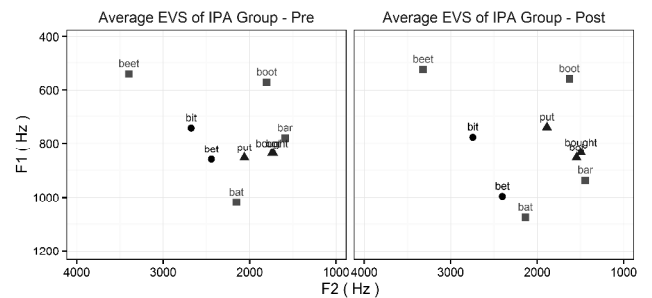


Figure 3: Pre and Post Education Changes in Average English Vowel Space, IPA Group

3.2. Differences from Native Pronunciation

The changes in differences from native pronunciation, in terms of formant frequencies,

shown in Figure 4 and Figure 5 are set up to 5000 Hz. First of all, it is noted that the differences from native pronunciation are generally shorter (i.e. at an approximate level of 2000 Hz) in the spelling group, but longer (i.e. at an approximate level around 3000 Hz or over) in the IPA group before receiving the education.

Comparing the differences from native pronunciation before and after the education is used as a way to observe changes in specific vowel production. When the differences in post education data are shorter than that of pre education, it denotes that the pronunciations by NJCs are getting closer to the native model in vowel quality, and vice versa.

As a result, the IPA group (Figure 5) shows a more positive change by shortening the differences from native pronunciation, in seven of the vowel sounds, namely *beet*, *bat*, *but*, *boot*, *put*, *bought* and *bot*, while the Spelling group (Figure 4) only shows three shortened differences for the vowels of *bert*, *bot* and *bar*.

Besides, the located weakness of back vowels (found in the pretest) as in the pronunciation of *boot*, *put*, and *bought*, have been greatly improved in the IPA group only. Therefore, at this stage of analysis, these results may suggest that pronunciation teaching with the use of IPA can facilitate more favorable changes in the production of some vowels.

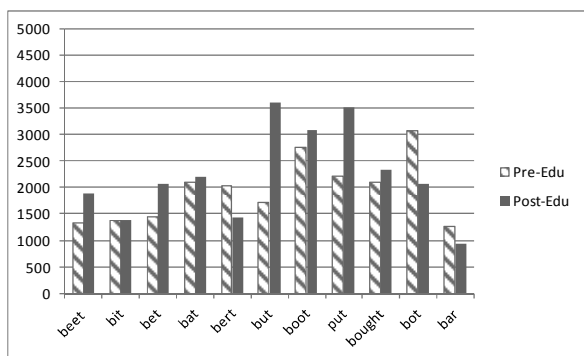


Figure 4: Pre and Post Education Changes in Differences from Native Pronunciation, Spelling Group

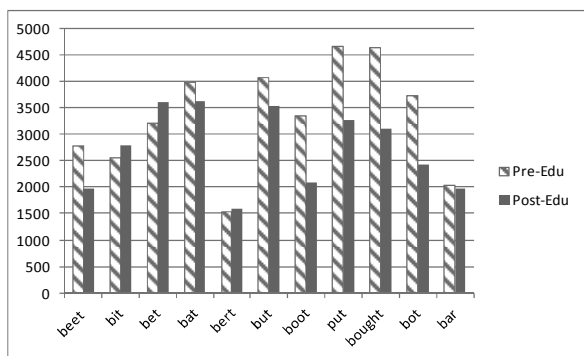


Figure 5: Pre and Post Education Changes in Differences from Native Pronunciation, IPA Group

4. Discussion

In this section, the author will evaluate the validity of the results in support for the hypothesis that IPA transcription is a superior system than orthography in pronunciation teaching. Besides, the implication and limitation of the findings are examined.

4.1. Generalizability of the Effectiveness of IPA

The group comparison of education outcomes was attempted to assess the effectiveness of IPA in pronunciation teaching. The column graphs (Figure 4 and 5) indicated that the IPA group made more improvement by narrowing the differences from native pronunciation in seven vowel sounds, compared to that of the Spelling group in which only three vowel sounds were improved. However, the group analysis may have omitted the effects of dispersed data. In other words, when well-improved individual data and regressive individual data were possibly mixed within a group, a meaningful comparison at group level became difficult. To avoid this potential bias, the following analysis investigates individual changes in specific vowel productions:

NJC	be et	bit	bet	bat	be rt	but	boot	put	bought	bot	bar	Progress
NJC1	▼	▼	△	△	□	△	△	△	△	△	△	3
NJC2	△	▼	△	△	□	△	□	□	□	□	▼	4
NJC3	△	□	△	△	▼	△	△	△	△	△	▼	3
NJC4	△	△	△	△	△	▼	△	▼	▼	▼	▼	6

NJC	be et	bit	bet	bat	be rt	but	boot	put	bought	bot	bar	Progress
NJC6	▼	△	▼	□	▼	△	□	△	▼	▼	△	5
NJC7	▼	△	▼	△	△	△	△	△	▼	▼	▼	7
NJC8	▼	▼	△	△	△	▼	□	▼	▼	▼	▼	7
NJC9	△	△	△	△	△	▼	△	▼	▼	▼	▼	7
NJC10	△	△	△	△	△	▼	▼	▼	▼	▼	△	9
NJC11	△	▼	△	▼	▼	▼	▼	▼	▼	▼	▼	9
NJC12	▼	△	□	▼	△	△	△	△	△	△	▼	4

Figure 6: Individual changes in vowel productions after education, where ▼ means progress (narrowing the differences); △ means regress (broadening the differences) and □ means unchanged (differences are less than 20 Hz)

Figure 6 shows that individual performances on specific vowel sounds are seen scattered on the chart. That implies that the differences drawn from the group level (Figure 4 and 5) may not truly reflect the uneven individual changes. For instance, the progress made by NJC4 in six specific vowels is offset by the regress of NJC1 and NJC3, who are especially weak in pronouncing “boot”, “put”, “bought”. Similarly in the IPA group, the improvements (9 out of 11 vowels) made by NJC10 and NJC11 are so distinguished that they can cover the regress of NJC6 and NJC12, which finally overrates the group performances.

Besides, drastic regression in an individual could bring a huge negative effect on the group. In the Spelling group, obvious regress can be observed in the production of “but” and “put” (Figure 4). The sources of regression in “but” can be traced from

NJC1, NJC3 and NJC4; and regression in “put” from NJC2 and NJC3.

Consequently, after we look into the individual changes behind the group performance, it must be admitted that the dispersed data make the group results not strong enough to fully establish the hypothesis that IPA is superior to spelling in teaching English sounds. More importantly, considering the limited number of participants, the amount of data (size effect) is statistically not enough to generalize the effectiveness of IPA. After all, as an initial educational experiment, it is plausible to suggest that some Japanese young learners, such as NJC 7, NJC8 and NJC9 can benefit from using IPA to assist their learning of English pronunciation (i.e. improved 7 out of 11 English vowels), while the improvement in NJC 10 and NJC11 are particularly obvious (i.e. improved 9 out of 11 English vowels).

4.2. Visible Improvements in Back Vowels

Since the pre-educational assessment, it has been noted that NJC’s learning needs lie specifically in the back vowels. Adjustments, both in time allocation and target words, were then made to the education program. On top of the two target wordlists (Set 1 and Set 2), 10 target words (Set 3 and Set 4) were added to give the learners a practice for back vowels. Four teaching sessions were used to have them practice back vowels. The effects of extra training on back vowels are manifested in the results (Figure 6), where progress in back vowels is obvious and commonly shared by the majority (an average 5 out of 7) of the IPA Group.

4.3. Implication and Limitation of the Study

The findings can be taken into consideration when designing the teaching contents and the allocation of teaching time for English monophthongs to young learners in Japan. As revealed in the study by Ueda & Otsuka [11], the cover rate of English phonemes among six English textbooks series in Japanese Junior high school vary, especially two English textbooks series cover only less than 60% of the English vowels. The inclusion of the monophthongs /ɜ:/ and /ɑ:/ is omitted by three textbooks series. It is impossible for the Japanese students to acquire the English sounds when they are not all included and practiced in the classroom.

In theory, as shown in the pilot study in Hong Kong [4], pupils who have learnt the IPA should be able to decode the IPA symbols for spontaneous pronunciation. Since the education time spent on decoding IPA symbols was not enough for NJC, post-educational assessment merely returned to the same format of the pretest. In both pretest and

posttest, images (meaning) and the IPA symbols appeared at the PowerPoint at first, and model pronunciations were simultaneously provided. In this way, the application of IPA symbols depended on the NJC’s willingness and readiness. As noted in the short interviews after the recording sessions, the degree of referring to the IPA as a hint for pronunciation varied among the NJC. Interestingly, the general trend is that Japanese girls, who achieved better performances, are more ready than Japanese boys to read the IPA symbols.

5. Conclusion

Taking the limitations on the amount of data (size effect) into consideration, the present study is not adequate to fully support the superiority of IPA symbols over orthography in pronunciation teaching. However, as an initial educational experiment, some encouraging results are observed: the improvements of back vowels in the IPA group are shared by a majority (an average 5 out of 7) of the pupils. Besides, two girls in the IPA group, i.e. NJC10 and NJC11, greatly improved their vowel productions (9 out of 11 vowels). These results support that IPA serves its function as a visual representation of speech sounds to assist more accurate vowel productions. Common practice of whole word repetitions based on spelling is insufficient in helping L2 learners to notice the segmental sounds. As a post hoc hypothesis, it can be claimed that the effectiveness of IPA depends on the readiness of the young learners to utilize the IPA symbols. It was briefly observed that Japanese girls are more ready to read the IPA symbols than Japanese boys, who somehow seem to prefer pictures.

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