AN EXPERIMENTAL STUDY ON THE SEGMENTATION OF TAIWANESE SYLLABLES

H. Samuel Wang
National Tsing Hua University, Taiwan

ABSTRACT

This paper explores whether the syllable in Taiwanese, a language with about 800 distinct syllable types, is divided into phoneme-sized units. An experiment was conducted in which the subjects were asked to delete a segment of a syllable, to add a segment to a syllable, and to replace a segment of a syllable with another. It was found that the subjects who were less exposed to an alphabetic language were poor in performing the task, while those who were explicitly taught to use alphabet to spell the language performed excellently. It was thus concluded that the ability to segment the syllable into phoneme sized units arose through training in alphabetic orthography.

THE PHONEMIC ANALYSIS

Traditional linguistic analyses have proceeded with the assumption that the speech stream is analyzable into phoneme-sized units. However, such an assumption has been seriously questioned in recent years. Experiments in segmentation have shown that such ability is achieved mostly via training in orthography [1], [2].

Read et al.'s study [2] found that Mandarin speakers were not able to add or delete segments in the syllable if they were not trained in alphabetic writing. In this study we ask the same question of another Chinese language, viz. Taiwanese. Because Taiwanese is normally not used as a means of education, the native speakers' phonological knowledge is typically not influenced by orthography. On the other hand, most of the native speakers are educated in Mandarin and English. This gives us a chance to see whether their phonological knowledge is influence by Mandarin and/or English. In this study we are interested in finding out whether phoneme-sized segments are operating units in Taiwanese, and if they are, whether such ability is influenced by the alphabetic language, i.e. English.

THE EXPERIMENT

Three groups of subjects were tested in this experiment. The first group of subjects (N=21) were vocational high school students who worked at daytime and went to school at night. These students spoke a lot of Taiwanese at work, and because of the nature of their study, they did not have as much experience in English as the normal high school students. The language ability of this group of subjects is regarded as representative of ordinary Taiwanese speakers. The second group of subjects (N=20) comprised university students. Because they were going to the university, and because most of the university textbooks are in English, they were more exposed to English than the first group subjects. We are interested in seeing whether their ability to manipulate the Taiwanese syllables in terms of phoneme-sized segments is influenced by their training in English. The third group of subjects (N=19) were also university students, but these students had been self-taught to read, and sometimes to write, Taiwanese using Roman alphabet (the so-called Church Romanization). It is expected that because of their experience in using Roman letters for Taiwanese, the third group subjects will perform much better than the other two groups.

The Procedures

The subjects were first introduced to the concept of sound similarities

through a popular Taiwanese folk song. The subjects were shown that a word can be converted to another word by adding, deleting or changing part of the sound of the word. Then the subjects were presented with pairs of words showing different phonetic relationships. Specifically, the following relationships were shown:

(1) Initial consonant deletion
e.g. tun33 → un33
(2) Initial consonant addition
e.g. an24 → tan24
(3) Final consonant deletion
e.g. kim55 → ki55
(4) Final consonant addition
e.g. ca51 → can51
(5) Initial consonant replacement
e.g. pi51 → ki51
(6) Vowel replacement
e.g. si55 → su55
(7) Final consonant replacement
e.g. t'an55 → t'am55

In each case, four examples were given to the subject to show that by adding (such as [t] in (2)), deleting ([t] in (1)) or replacing ([k] in (5)) a particular segment in the syllable, one can derive another syllable. Then in each category, two test items followed these examples to see whether the subjects could perform the task as exemplified. Among these two test items, one of the predicted correct answer would be a real word while the other would be a nonce word.

Results

Correct scores were tabulated for each subject. Mean percentages were calculated for each group (Group 1=6.89%, Group 2=49.17%, Group 3=71.67%). Mann-Whitney *U* tests were run comparing the ranks of correct scores among the groups. The results showed that the differences were all great. The percentages of correct answers in each item by groups are shown in Table 1.

A second set of the same tests was run. This time all answers containing expected changes were considered correct, with or

Table 1. Percentages of correct answers (r and n in item numbers refer to real word and nonce word correct responses)

	Grp1	Grp2	Grp3
1r.	19.0	15.0	63.0
1n.	4.8	45.0	100.0
2r.	4.8	80.0	94.7
2n.	9.5	90.0	78.9
3r.	4.8	35.0	57.9
3n.	0.0	10.0	36.8
4r.	4.8	60.0	78.9
4n.	9.5	55.0	84.2
5r.[1]	9.5	45.0	68.4
5n.[1]	4.8	35.0	57.9
6r.[1]	4.8	55.0	84.2
6n.[1]	19.0	65.0	89.5
5r.[2]	0.0	70.0	78.9
5n.[2]	0.0	20.0	68.4
6r.[2]	4.8	20.0	31.6
6n.[2]	0.0	35.0	36.8
7r.	23.8	85.0	94.7
7n.	4.8	65.0	84.2

without concomitant other changes; that is, when the subject made the correct change but at the same time made changes in other parts of the syllable, the answer was still considered correct. Gradations of group means were as above (Group 1=12.17%, Group 2=61.39%, Group 3=81%), and Mann-Whitney tests were significant. Table 2 shows the percentages of correct answers under such considerations.

As can be seen from Table 1, Group 3 subjects did the best in every item except in (2n), and Group 2 did better than Group 1 in every item except (1r). No such exceptions were found in Table 2.

If we list these percentages by their magnitudes, we find more consistency between two items in a category in Table 2, which we do not find in Table 1. Still, no obvious patterns emerge. Category (3), which required the subjects to delete

[1] These replacement items are with CV syllables.
[2] These replacement items are with CVC syllables.

Table 2. Percentages of correct answers with concomitant changes (r and n in item numbers refer to real and nonce word correct responses)

	Grp1	Grp2	Grp3
1r	28.5	65.0	100.0
1n	33.4	75.0	100.0
2r.	4.8	90.0	94.7
2n.	14.3	90.0	94.7
3r.	9.6	40.0	63.2
3n.	0.0	10.0	47.4
4r.	4.8	75.0	84.2
4n.	9.5	55.0	84.2
5r.[1]	9.5	55.0	68.4
5n.[1]	4.8	40.0	57.9
6r.[1]	9.6	60.0	94.1
6n.[1]	19.0	65.0	89.5
5r.[2]	0.0	70.0	78.9
5n.[2]	0.0	45.0	84.2
6r.[2]	23.9	55.0	63.2
6n.[2]	0.0	45.0	63.2
7r.	33.3	85.0	100.0
7n.	14.3	75.0	100.0

the final consonants, scored the lowest. This is expected if we consider the final consonant as part of the rhyme. But Category (7), which required the subjects to replace the final consonants, was among the easiest. It is rather difficult to understand why a segment is hard to delete but easy to replace in the same position. It is not that segments are easier to replace than to delete, for Category (1) was to delete the initial consonant, and was among the easiest categories, while its replacement counterpart, Category (5), was rather hard.

In the case of real vs. nonce word responses, none of the comparisons (correct only or with concomitant changes) showed significant differences except for Group 2, where the comparison of correct answers with concomitant changes between real and nonce words showed significant difference (Wilcoxon z=2.79, p< .01).

DISCUSSION

From these results, it is clear that education played an important role in making the speakers aware of the segments. Group 1 subjects did not have as much contact with alphabetic language as Group 2 subjects, and as expected, their performances were much poorer than Group 2 subjects. Group 2 subjects and Group 3 subjects were all university students, and had similar education backgrounds except that Group 3 subjects explicitly learned to read Taiwanese in Roman letters. Presumably they were more able to manipulate speech sounds in terms of the orthography based on Roman alphabet. This is evident when we consider the answers given to item (1r) by some Group 3 subjects, where they were required to change [mĩ33] into [ĩ33]. The subjects made 37% expected answers with concomitant changes, and the concomitant changes were all [i33] instead of the expected [ĩ33]. One of the reasons for such response is the fact that in Church Romanization, the stimulus [mĩ] is written as *mi*, with the nasalization in the vowel left unspecified, while in other cases the nasal vowel is marked with a raised 'n', as in [ti^{n}55] 'sweet'. This is because in Taiwanese nasal consonants occur only before nasal vowels [3]. When the initial consonant *m* is taken away, there is only *i* left in the orthography. In fact this is precisely what was pointed out to the experimenter by one of the subjects in Group 3.

As reported by the subjects after the experiment, many of the Group 2 and Group 3 subjects explicitly made use of the orthographic symbols. Some Group 2 subjects reported that they used the Mandarin Phonetic Alphabet (*Juyin Fuhao*), as did some Group 3 subjects. Some other Group 3 subjects reported that they used Church Romanization. It is interesting to find that there was not much evidence that Group 1 subjects made use of Mandarin Phonetic Alphabet, although they also learned it in school. One of the possibilities for such difference may be that Group 2 subjects use Taiwanese a lot more frequently than the other two groups. They are more used to operating the language without recourse to Mandarin, unlike the other two groups (especially Group 2). Perhaps primarily because of this, they were not inclined to use the Mandarin Phonetic Alphabet in doing the task.

As mentioned above, even if we admit concomitant changes, Group 1 subjects only achieved around 12%. With this percentage we can hardly say that the subjects could operate the language in terms of segments. The success with the other two groups was mostly based on their familiarity with alphabetic writing. Since the education backgrounds of the second and the third groups were similar except that the third group learned to read Taiwanese in Roman alphabet, the better performances by the third group subjects ought to have been due to their explicitly applying this knowledge in the segmentation tasks.

We have also noted above that final consonants are hard to delete but easy to replace, while initial consonants are easy to delete but hard to replace. These facts are hard to explain if these elements are individually considered. However, there is a possible explanation from the point of view of the distinguishability of the syllables. There are only three possible final consonants in non-entering tone syllables, but there are 14 possible consonants in the syllable initial position. Final consonants contribute a lot less than the initial consonants in distinguishing syllables.[4] Replacing a final consonant only means replacing a nasal consonant with another nasal consonant. The distance between these two syllables is rather small. But replacing an initial consonant can be a major operation, as replacing it would result in a rather different syllable type. On the other hand, deleting a final consonant would also result in a very different syllable type. It is a change from a closed syllable to an open syllable, and the syllable types are completely different. In the case of initial consonant deletion, the two syllables still rhyme after the deletion, and the contrast between the two syllables is not as great as that in initial consonant replacement, because in this case one syllable is with initial consonant while the other is without. What this indicates is that the subjects evaluated the effect the changes had on the whole syllable, rather than just changing part of the syllable.

We therefore conclude that explicit orthographic knowledge plays a significant role in realizing the segmental relationships among Taiwanese syllables. It seems that segmenting the Taiwanese syllable is a superfluous operation.

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