

## An Acoustic Study of English Non-Phoneme Schwa and the Korean Full Vowel /ə/

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### ABSTRACT

The English schwa sound has special characteristics which are distinct from other vowels. It is non-phonemic and occurs only in an unstressed syllable. Compared with the English schwa, the Korean /ə/ is a full vowel which has phonemic contrast. This paper had three aims. One was to see whether there is any relationship between English full vowels and their reduced vowel schwas. Second was to see whether there is any possible target in the English schwa sounds which are derived from different full vowels. The third was to compare the English non-phoneme vowel schwa and the Korean full vowel /ə/ in terms of articulatory positions and duration. The study results showed that there is no relationship between each of the full vowels and its schwa. The schwa tended to converge into a possible target which was F1 456 and F2 1560. The Korean vowel /ə/ seemed to have its distinct position speaker-individual which is different from the neutral tongue position. The evidence that the Korean /ə/ is a back vowel was supported by the Seoul dialect speaker. In duration, the English schwa was much shorter than the full vowels, but there was no significant difference in length between the Korean /ə/ and other Korean vowels.

**Keywords :** schwa, plotformant, formant chart, duration, Korean /ə/

### 1. Introduction

Many learners of English are likely to think that the English schwa and the Korean /ə/ would be the same or similar. But the acoustic evidence shows that the two sounds are completely different in their behaviors i.e., articulatory positions and duration. The misunderstanding of the characteristics of the two vowels causes mispronunciation of English vowels and makes most Korean learners' English sound strange or stilted. The acoustic study is necessary to clarify the characteristics of these two seemingly similar sounds.

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The English schwa sound has special characteristics: 1) It is non-phonemic in English (Giegerich, 1992, p.69); 2) it never occurs in a monosyllable word; 3) it never occurs in a stressed syllable; 4) schwa is a reduced vowel of a full vowel when it loses its contrast in an unstressed syllable; 5) there is no minimal pair with the schwa sound in English; 6) its duration is much shorter than the full vowels. In many phonetics books, the schwa is not on the list of English vowels. Kreidler puts /ʌ/ in the vowel list, but not /ə/ (1989, p.50f). Wells includes /ɜ:/ and /ʌ/ in the RP vowel list, but not /ə/ (1982, p.119). On the General American Vowel lists, he puts /ɜ/ and /ʌ/, but not /ə/ (1982, p.120). Ladefoged does not put /ə/ on the vowel list (1993, p.31, 76).

Schwa is understood by most to be a reduced vowel in unstressed positions with a relaxed and neutral tongue position. But this has not been proven yet phonetically. There is a contradictory argument that each unstressed vowel is still psychologically related to a full vowel, even in the minds of illiterate speakers who are not influenced by orthography (Caffee, 1951). Evidence of this is the ability of a speaker to pronounce an unstressed vowel as stressed for emphasis. This point needs clarification.

In contrast to the English schwa, the Korean vowel /ə/ is a full vowel which is phonemic and as long as other vowels. This paper purports to compare the English schwa and the Korean full vowel /ə/ in terms of relative articulatory positions with other vowels and their durations.

This research had three questions: The first question was to see whether there is any relationship between each of the English full vowels and its reduced vowel (schwa) in the articulatory position. The second question was to see whether schwa sounds have one target. The third question was to see what the characteristic difference is between the English schwa sound and Korean full vowel /ə/ in terms of articulatory positions and durations.

## 2. Experiment

For question 1 and 2, words that contain English full vowels and their derived words that contain the reduced vowels were pronounced ten times by a Midwestern-born American. The English schwa sound was compared with other full vowels in terms of the relative articulatory positions and durations. After measuring F1 and F2 of each vowel, it attained the formant chart of all vowels and their reduced vowels named t,v,w,x,y,z as shown in Table 1. The plotformant program was used to get the formant chart. The words are shown in Table 1.

Table 1. English Full Vowels and their Reduced Vowels with Symbols for Each Derived Schwa

Full vowels in stressed syllables	The reduced vowels in unstressed syllables in the derived words with symbols for each schwa
civil /ɪ/	civility /ə/ - t
stable /e/	stability /ə/ - v
definite /ɛ/	definitive /ə/ - w
battle /æ/	battalion /ə/ - x
revoke /o/	revocable /ə/ - y
botony /ɑ/	botanical /ə/ - z

For question 3, two Koreans, one male Seoul dialect speaker named Thong and the other male Kyongsangdo dialect speaker named Sahn, pronounced Korean words which contain the simple vowels ten times each. To see the relative articulatory positions of the Korean /ə/ sound with other vowels, a formant chart was attained by measuring the F1 and F2 of each vowel. The plotformant program was used to get the formant chart. The Korean words were carefully chosen to minimize both the measuring difficulties and the influence of neighboring vowels. The best environments to get the true formant value were found to be when the target vowels were between voiced stops such as kVt, pVt, tVt and when the preceding or following vowels were the same or similar as shown in Table 2.

Table 2. Korean Vowels in the kVt, pVt, tVt Environments

kVt	pVt	tVt
/i/ kido (pray)	pidan (silk)	tidida (step)
/ɛ/ padagedari (crabs leg)	puleulpeda (cut the grass)	puleteda (burnt)
/æ/ ibuleulgaeda (fold sheet)	paedal (delivery)	taetaejang (captain)
/u/ kudu (shoes)	pudu (pier)	tutunhada (support)
/i/ keudaji (not very)	kippeuda (pleased)	teudioe (finally)
/o/ kodo (high level)	podo (report)	todohi (boldly)
/a/ kada (go)	pada (sea)	tadami (mattress)
/ə/ keodaetosi (big city)	peodeunamu (willow tree)	teoteouk (even more)

### 3. Analysis

The formant charts, Figure 1 and 2, were attained to test the hypothesis that there is some relationship between each of the full vowels and its reduced vowel in the derived word. Figure 3 and 4 were gotten to see whether the English schwa has its own target. Figures 5 to 12 were attained to see the relative articulatory position of

the Korean /ə/ with other vowels and its duration.

### 3.1 Relative Positions of the English Full Vowels and their Schwas

Except for /ɪ/ and *t* which are the full vowel in the word *civil* and the reduced vowel in the unstressed position in the derived word *civility*, no evidence was found that there is any relationship between the full vowels and their reduced vowel schwas, /e/ and *v*, /ɛ/ and *w*, /æ/ and *x*, /o/ and *y*, and /ɑ/ and *z* (Figure 2).

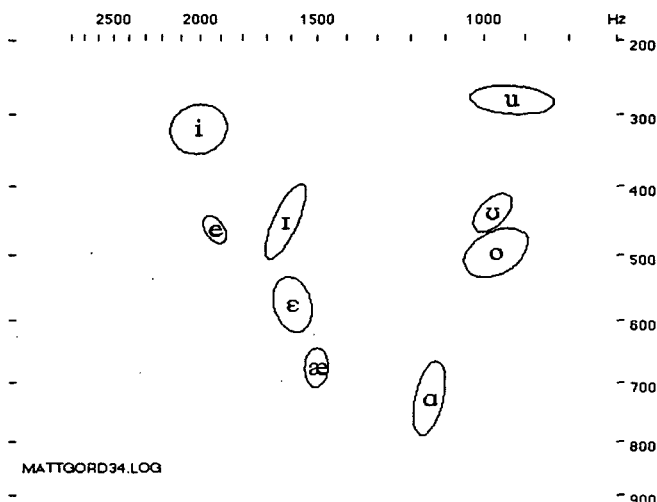


Figure 1. A formant chart of English full vowels

Figure 2 projects the reduced vowels *t,v,w,x,y,z* on the full vowel chart.

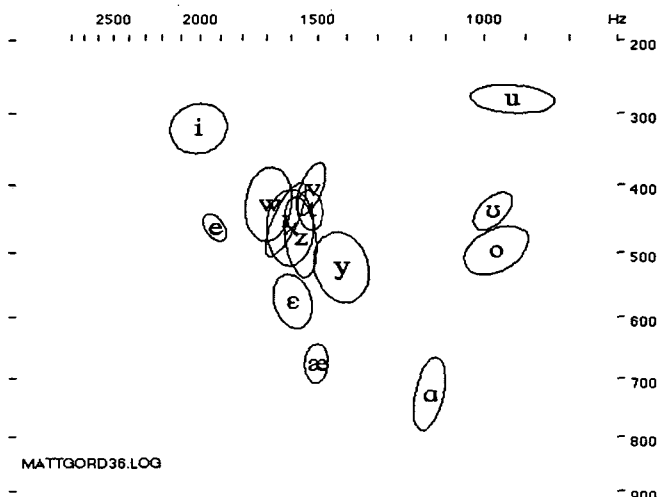


Figure 2. A formant chart of English full vowels *i, e, ɛ, æ, o, ɑ* and their derived schwa sounds symbolized *t, v, w, x, y, z* respectively

### 3.2 A Possible Target of the Schwas

In Figure 3, the schwas t,v,w,x,y,z were replaced with the schwa symbol /ə/ on the formant chart. Figure 4 seems to show that there is a possible target in the schwas. The mean point of the schwas was F1 456 and F2 1560. This point is close to the neutral tongue position which is F1 500 and F2 1500.

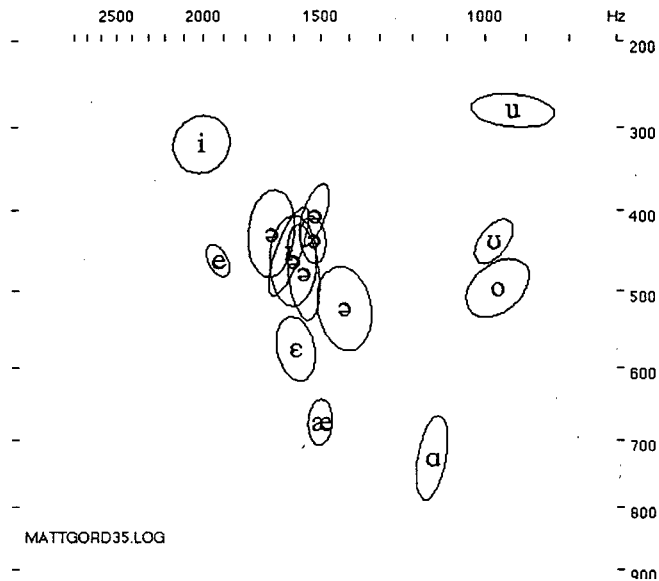


Figure 3. A formant chart of English full vowels and their derived schwas

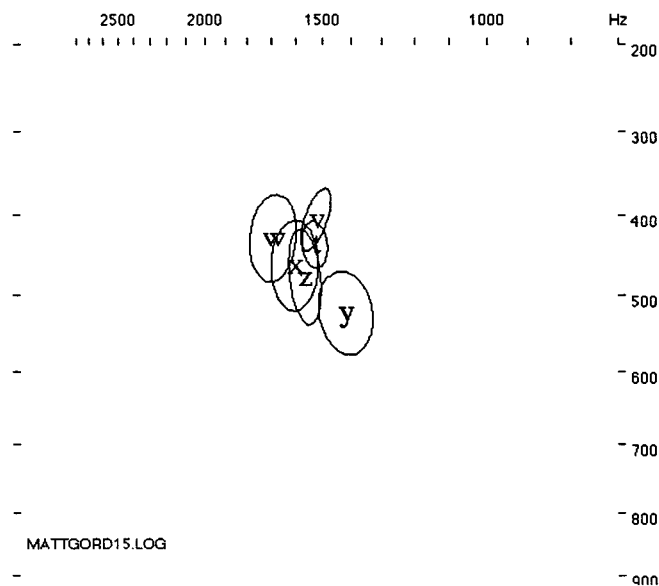


Figure 4. A formant chart of English schwa only

### 3.3 Relative Positions of Korean Vowels

Korean vowels had consistent articulatory positions in the kVt, pVt, tVt environments speaker-individually. In speaker Thong's case, Figures 5 (kVt), 6 (pVt) and 7 (tVt) show identical vowel positions, the combined figure of which nicely shows consistency of the vowel positions as shown in Figure 8. The other speaker Sahn's case also shows identical vowel positions in different environments, kVt, pVt and tVt, which are shown in Figure 9, 10 and 11 respectively. The combined figure of these (Figure 12) proves the consistency in the vowel positions among those different environments. The comparison of the two speakers' combined formant charts, Figure 8 and Figure 12, also shows the almost identical positions of each vowel except /ə/. It seems that the Korean /ə/ sound behaves differently from the English schwa in that it is not centralized into the neutral tongue position.

The position of Thong's /ə/ (F1 548 and F2 998) in Figure 8 agrees with Kang's study (1996) in which /ə/ was closer to /o/. The same phenomenon is seen in Thong's /ə/ and /o/ in Figure 8. This supports the theory that Korean /ə/ is a back vowel. But Sahn's /ə/ (F1 357, F2 1373) behaves differently from Thong's as seen in Figure 12. It was rather closer to /i/. The difference may be either due to Sahn's individual difference or to the fact that Thong was a Seoul dialect speaker and Sahn was a Kyongsang dialect speaker. This gains some logical support in that both Thong and Kang's subjects were Seoul dialect speakers. This necessitates further studies with Kyongsang dialect speakers.

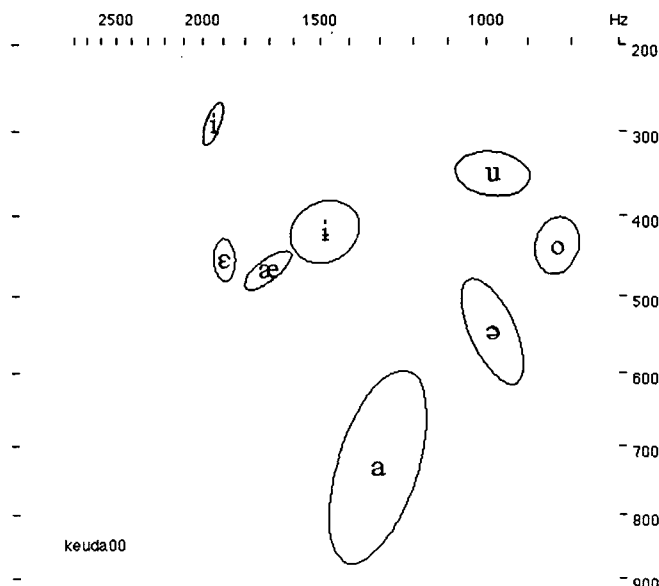


Figure 5. A formant chart of Korean vowels in the kVt environment (Thong)

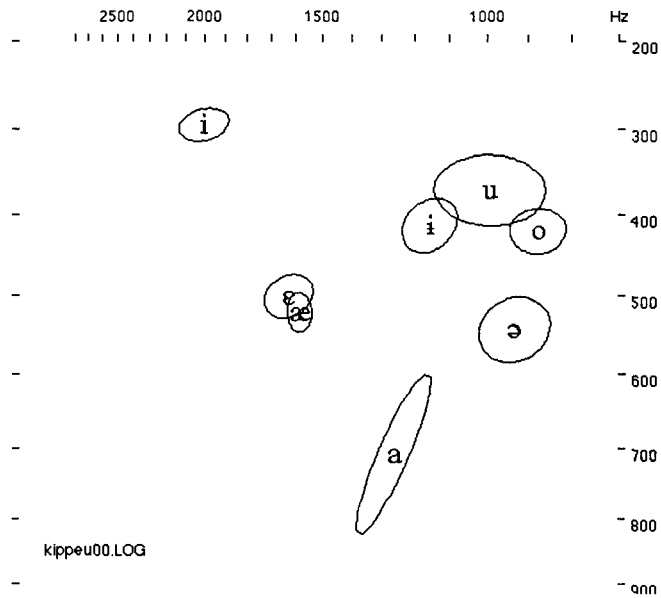


Figure 6. A formant chart of Korean vowels in the pVt environment (Thong)

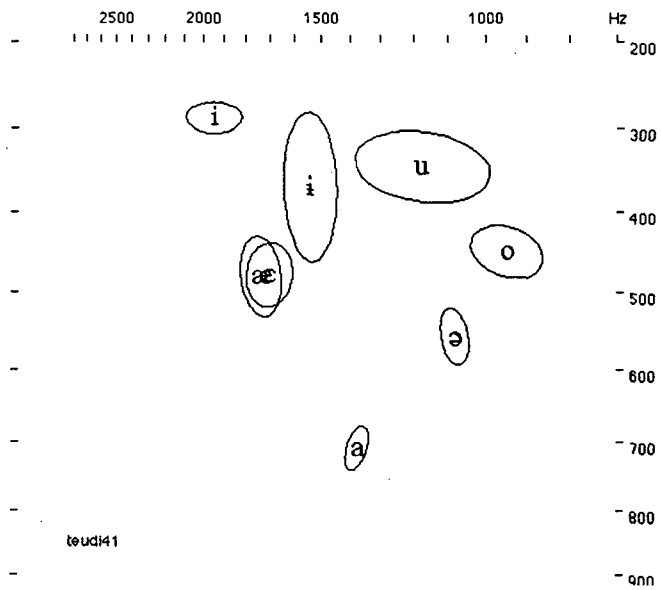


Figure 7. A formant chart of Korean vowels in the tVt environment (Thong)

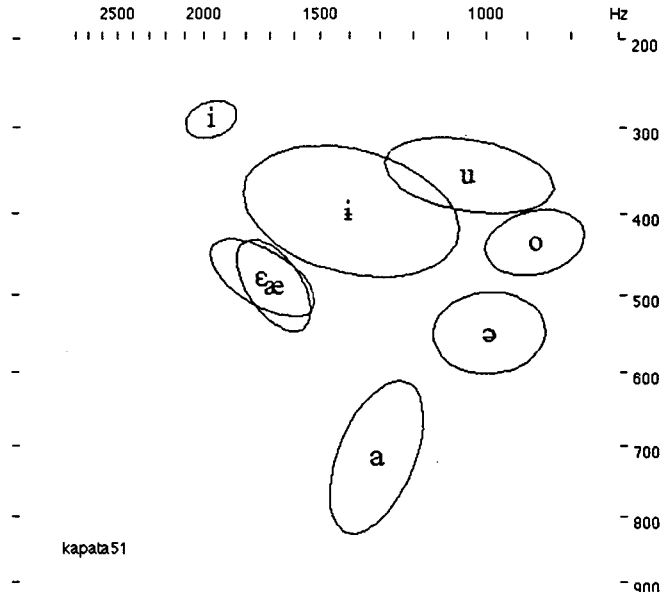


Figure 8. A formant chart of Korean vowels in the kVt, pVt, tVt environments (Thong)

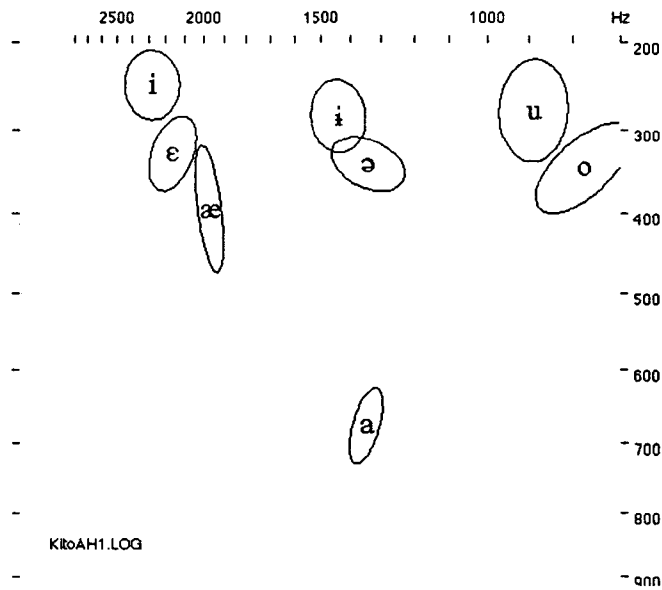


Figure 9. A formant chart of Korean vowels in the kVt environment (Sahn)



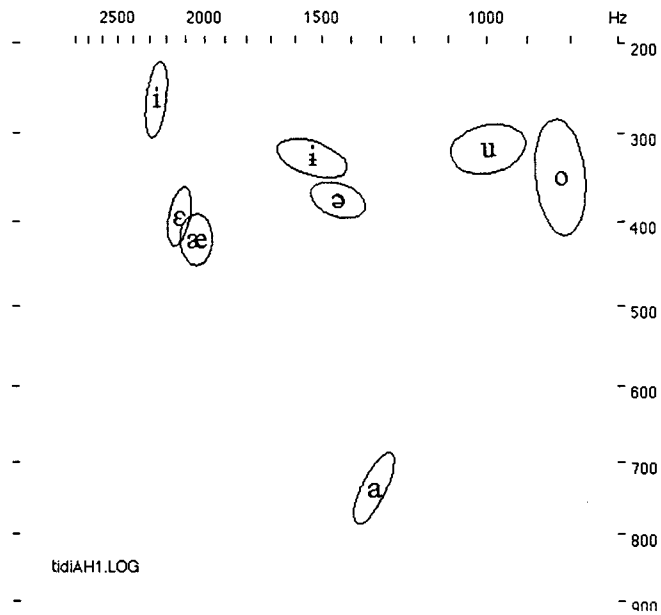


Figure 10. A formant chart of Korean vowels in the pVt environment (Sahn)

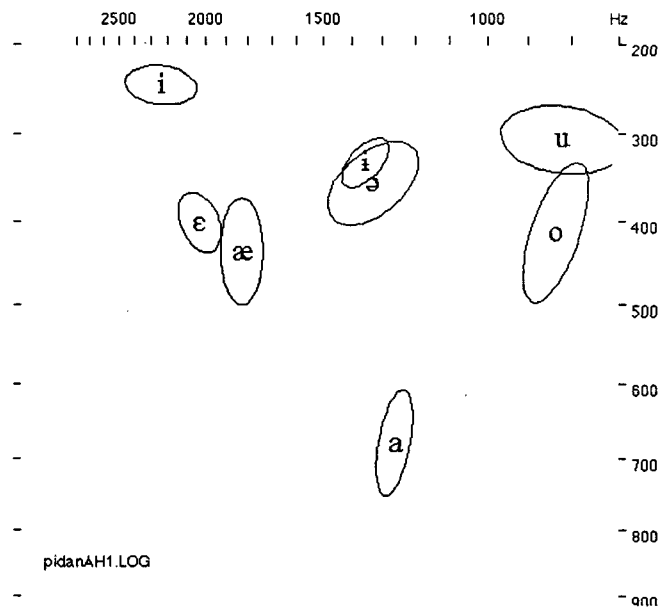


Figure 11. A formant chart of Korean vowels in the tVt environment (Sahn)

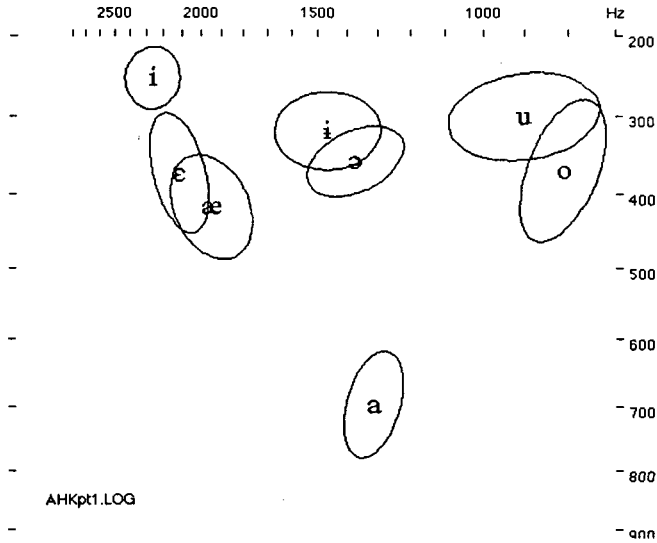


Figure 12. A formant chart of Korean vowels in the kVt, pVt, tVt environment (Sahn)

3.4 Relative positions of English non-phoneme schwa and Korean full vowel /ə/

A comparison of the articulatory positions of the English schwa and two Korean speakers' Korean /ə/ sounds shows that English schwa tends to be centralized, while the Korean /ə/ sound does not (Figure 13). It shows that Korean /ə/ as a full vowel behaves differently from English schwa which is a reduced vowel.

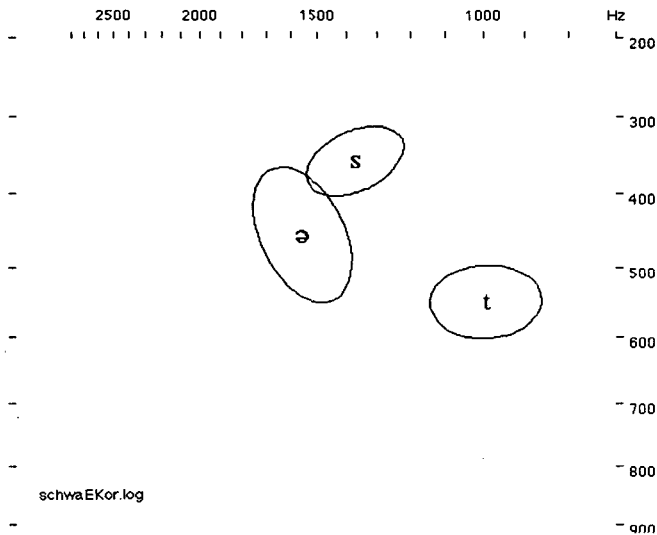


Figure 13. A formant chart of English schwa and Korean /ə/ by two Korean speakers' pronunciation of /ə/ symbolized s for Thong and t for Sahn

Table 3. The mean points of F1 and F2 of English schwa and Korean /ə/ by two

English schwa		Korean /ə/ by Thong		Korean /ə/ by Sahn	
F1	F2	F1	F2	F1	F2
456	1560	548	998	357	1373

Korean speakers

### 3.5 Duration

Figure 14 shows that the duration of each English schwa derived from each full vowel is distinctly shorter than its full vowel. Duration is one of the characteristics of the schwa sound. This can be compared with the Korean vowels which do not show any significant difference in duration between the /ə/ sound and other vowels as shown in Figure 15 and 16. This is natural because the Korean /ə/ is a phoneme, not a reduced form of a vowel as happens in the English schwa.

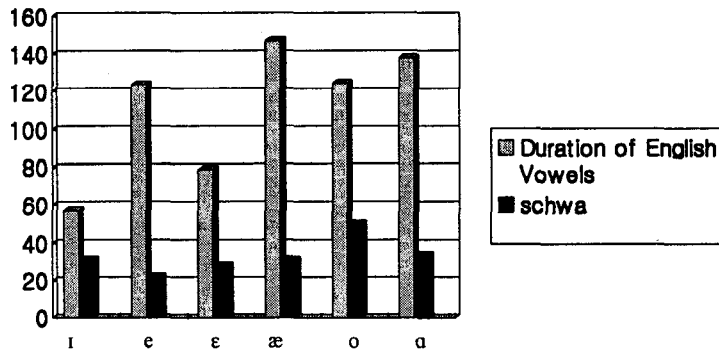


Figure 14. Duration of English vowels compared with the schwa sounds

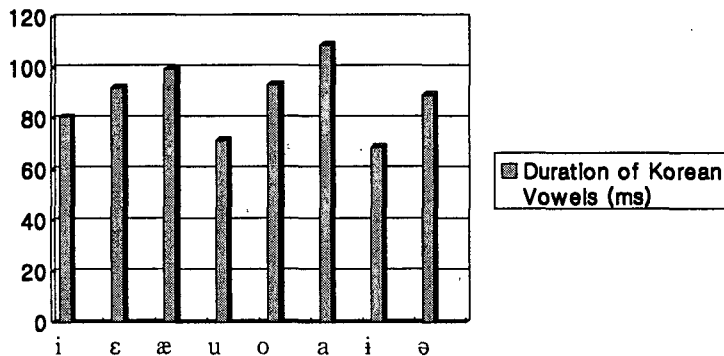


Figure 15. Duration of Korean vowels by subject Thong

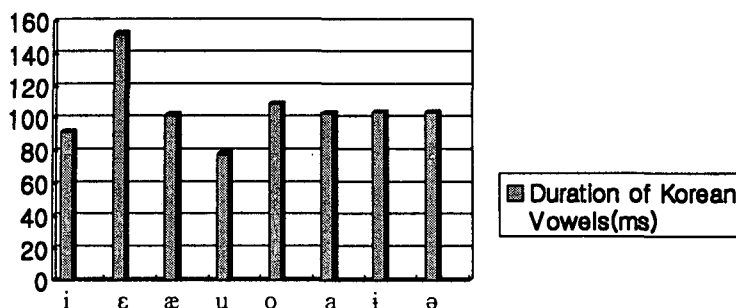


Figure 16. Durations of Korean vowels by subject Sahn

#### 4. Conclusions

No relationship was found between each of the English full vowels and its reduced vowel (schwa) in the articulatory positions. The distribution of the schwa sounds showed that they converge into a possible target which was F1 456 and F2 1560.

The distribution of the English schwa and the Korean vowel /ə/ showed different patterns. The English schwa seems to have a target at the most relaxed and neutral position which was F1 456 and F2 1560, but the Korean /ə/ didn't converge into a neutral position. Its mean value of F1 and F2 showed that it has a distinct position, either a little backward or a little upward from the neutral position depending upon the speaker and the environment where the /ə/ occurs. Thong's /ə/ supported the theory that the Korean /ə/ is a back vowel. But Sahn's /ə/ did not. This study hypothesized that this is either due to Sahn's individual difference or due to the fact that both Thong and the subjects in Kang's study where /ə/ was closer to the back vowel /o/ were Seoul dialect speakers, while Sahn was a Kyongsang dialect speaker. In duration the English schwa was much shorter than the full vowels, but the Korean /ə/ had no significant difference in length from other vowels.

#### REFERENCES

- [1] Ahn, S.W. 1997. The schwa phenomenon in English vowels. *English Teaching*, Vol. 52(3), 257-279.
- [2] Anderson, Stephen R. 1982. The analysis of French schwa: or, how to get something for nothing. *Language*, 58, 534-573.
- [3] Bronstein, Arthur J. 1960. *The pronunciation of American English: An introduction to phonetics*. New York: Appleton-Century-Crofts, Inc.
- [4] Caffee, N. 1951. The phonemic structure of unstressed vowels in English. *American*

- Speech* 26, 103-109.
- [5] Fokes, J. and Bond Z.S. 1989. The vowels of stressed and unstressed syllables in Nonnative English. *Language Learning*, 39(3), 341-373.
- [6] Giegerich, Heinz J. (1992). *English phonology: An introduction*. Cambridge: Cambridge University Press.
- [7] Hamans, Camiel. 1984. The schwa as a dummy vowel. *Linguistics in the Netherlands*, pp. 53-64.
- [8] Harris, John. 1994. *English Sound Structure*. Oxford: Blackwell. Kang, Soon-kyong. 1996. Acoustic analysis of south and north Korean vowels. *Language Research* 32(1), 1-18.
- [9] Kang, Soon-kyong. 1999. The hypercorrection of vowel /u/→/i/ in North Korean dialects. *Speech Sciences*, Vol. 6, 33-44.
- [10] Kreidler, Charles W. 1989. *The pronunciation of English*. Oxford: Basil Blackwell.
- [11] Lindblom, B. 1963. Spectrographic study of vowel reduction. *The Journal of the Acoustical Society of America*, Vol. 35(11), 1773-1781.
- [12] Roach, Peter. 1991. *English phonetics and phonology*. Cambridge: Cambridge University Press.
- [13] Wallace, Karen L. 1994. *An acoustic study of American English schwa in multiple speaking modes*. Doctoral Dissertation. New York University. DAI Vol. 55, no. 4.
- [14] Wells, J. C. 1982. *Accents of English 1: An introduction*. Cambridge: Cambridge University Press.

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