

An Acoustic Study of the English Schwa
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0. Introduction

The aim of this report is to characterize the English schwa through its acoustic analysis. I investigate the differences in quality among schwas, and compare the results with the auditory impression in Jones (1960) and Gimson (1989).

1. Methodology

The twelve acoustic data were taken from Shimaoka and Wells (1992). The data were spoken by John C. Wells. The data were analyzed on CSL (Kay Elemetrics) to compute the frequencies of F1, F2 and F3.

2. Results and discussion

The formant frequencies of the schwas is listed in Table 1. Figure 1 is a formant chart in which F1 is plotted against F2.

		F1	F2	F3 (Hz)
(1)	[ə] [~]	543	1276	2565
(2)	" <u>a</u> bout"	599	1270	2559
(3)	"fa <u>m</u> ous"	474	1356	2795
(4)	"le <u>m</u> on"	435	1267	2762
(5)	"pa <u>y</u> ment"	615	1332	2743
(6)	"su <u>p</u> port"	361	1209	2586
(7)	"po <u>s</u> sible"	461	1153	2513
(8)	"se <u>c</u> ondary"	410	1669	2298
(9)	" <u>A</u> merican"	560	1240	2480
(10)	" <u>A</u> merican"	560	1580	2220
(11)	[ə] in "o"	660	1320	2520
(12)	[ə:] "bi <u>r</u> d"	545	1351	2560

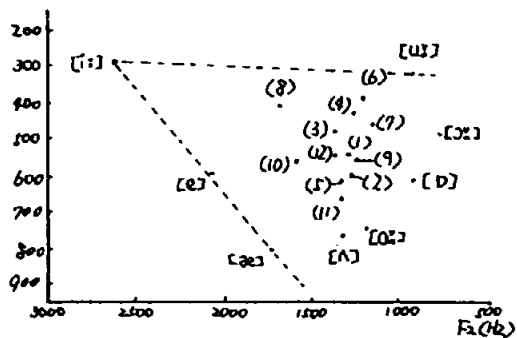


Table 1. Numerical data of the schwas. [ə][~] is the utterance of a schwa alone.

Figure 1. Formant chart of schwas

The schwas above have 1st formants (F1) in the range 361-660 Hz, 2nd formants (F2) in the region 1153-1669 Hz, and 3rd formants (F3) in the range 2220-2795 Hz.

From Figure 1, we can distinguish the example of (8) and (10) from the others. Contrary to previous studies, the data of (8) and (10) show that the tongue is advanced when pronouncing schwas adjacent to the velar consonants. Although Jones (1960) and Gimson (1989) describe schwas in the vicinity of velars as having a tongue-retraction, the data of (8) and (10) show that their values of F2 are greater than those of the others. This means that the tongue position of (8) and (10) is more advanced.

The quality of schwas shown by the values of F1 and F2 has a noticeably wide diversity. Why are schwas regarded as a vowel (or a phoneme) despite the great differences in quality among them? We now look at the value of F3/F2 in Table 2.

		F1	F2	F3 (Hz)	F3/F2
(1)	[ə]"	543	1276	2565	2.01
(2)	" <u>a</u> bout"	599	1270	2559	2.01
(3)	" <u>f</u> amous"	474	1356	2795	2.05
(4)	" <u>l</u> emon"	435	1267	2762	2.17
(5)	" <u>p</u> ayment"	615	1332	2743	2.06
(6)	" <u>s</u> upport"	361	1209	2586	2.14
(7)	" <u>p</u> ossible"	461	1153	2513	2.18
(8)	" <u>s</u> econdary"	410	1669	2298	1.39
(9)	" <u>A</u> merican"	560	1240	2480	2.00
(10)	" <u>A</u> merican"	560	1580	2220	1.40
(11)	[ə] in "o"	660	1320	2520	1.91
(12)	[ə:] " <u>b</u> ird"	545	1351	2560	1.89

Table 2. The F3/F2 values

The value around 2.00 is a standard which decides whether a vowel is a schwa or not. This means that the frequency of F3 is about twice as high as the frequency of F2. The characteristic seems to be important not only to schwa but also to central vowels because the value of F3/F2 is determined irrespective of the value of F1; i.e. the aperture of mouth (therefore other central vowels such as [i] have the same characteristic).

Now another question arises: what makes native speakers of English recognize some vowels which have their F3/F2 values other than 2.00 as a schwa. To find the answer, the following factors should be considered: their extremely short duration, low pitch, or small intensity.