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Acoustic Analysis of Central Vowels of PakE

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Abstract

English, with its many representations around the world, serves as lingua franca among the nations with diverse languages and cultures. The term World Englishes was introduced to represent the diversity of English language. The current study is an acoustic investigation into Pakistani English to observe the phenomenon of central vowels. Researchers (Sailaja, 2009; Garesh, 2006; Kachru, 2005; Gonzalez & Alberca, 1978 as cited in Bautista & Gonzalez, 2006) have observed that in Asian Englishes, there is no distinction in the central vowels, i.e. /ə/, /ɜ:/ and /Λ/. For analysis, 20 subjects (10 male and 10 female) were chosen from BS English programme of University of Sargodha with Punjabi as their L1. Isolated words were recorded using a career phrase. Praat was used for acoustic measurement of the vowel formants. Conclusions were drawn that Pakistani speakers of English did not distinguish between the two vowels /ə/ and /ɜ:/. But the vowel /Λ/ was realized as a different vowel. Hence, it was concluded that Pakistani English has two central vowels.

Key words: World Englishes, Asian Englishes, Praat, Formants, Acoustic measurement

1. Introduction

English is considered the lingua franca that Asians now use to communicate with one another and the rest of the world. Asia is the largest continent with a few major languages of the world regarding their native speakers, Chinese, Urdu, Hindi, etc. yet their status is only regional. The term 'Asian Englishes' refers to the English language as spoken in countries of Asia including Pakistan, India, Malaysia, Japan, etc. 'Asian Englishes' is further development in the broader spectrum of 'World Englishes'. The term World Englishes is used to describe the diversity of English language present in today's world. Bolton (2006, p. 367) has given three interpretations of the term World Englishes. It is an umbrella term for all the varieties of English used across the globe. In the second sense, it refers to the new varieties of English is Africa, Asia and the Caribbean. In the final sense, it refers to plucentric approach to study English.

Kachru (1985) presented a three circle model, i.e. the 'inner circle', the 'outer circle', and the 'expanding circle' that clarifies the complexity of English.

> The Inner Circle refers to the traditional cultural and linguistic bases of English. The Outer Circle represents the institutionalised non-native varieties (ESL) in the regions that have passed through extended periods of colonisation … The Expanding Circle includes the regions where the performance varieties of the language are used essentially in EFL contexts (as cited in Kirkpatrick, 2007, p. 28).

The inner circle comprises the native speakers, including countries like Britain, US, Canada, Australia. The outer circle includes countries with English as their second language. For example, Pakistan has Urdu as its national language along with many other regional languages. English is used as an official language. It is also used as a language of wider communication, at any rate among the higher socio-economic groups. The expanding circle consists of those areas where English is learnt as a foreign language, for trade, travel, etc. An example of an 'expanding circle' country is mainland China. (Barber et al, 2009, Kirkpatrick, 2007, Spichtinger, 2003)

The three circle model has developed a concept that English is not the property of the English; rather it belongs to those who speak it.

> English belongs to its speakers in the Outer Circle, just as much as to its speakers in the Inner Circle, and all of them need to express their own culture through an English adapted to their needs, and expressive of their geographical, national, and cultural identity. (Gupta, A. 2006, para. 3)

The current study attempts that Pakistani English (a member of the outer circle family) should be treated as recognizable, well-analyzed and academically acceptable dialect of English on the basis of various variables especially phonological variables. A variety may be called different from the other variety if it has different semantic, lexical, syntactical, phonological variables. As far as phonological variables are concerned, there are three main ways: "First, their phonological systems can differ ... Secondly, the realizations of the same phoneme can be different... Thirdly, the distribution of phonemes can differ (Barber et al, 2009, p. 247)

According to Bauer (2002), difference in pronunciation occurs due to phonetic realization, phonotactic distribution, phonemic system and lexical distribution.

This study focuses on phonological variables in PE. It examines the central vowels on scientific grounds i.e. measuring their formant values.

2. Literature Review

Asian Englishes have certain common and distinct features, which establish them as different and indigenous varieties of English. There has been considerable regional variation in the realisation of vowel sounds. One common feature is the absence of schwa, or the merger of central vowels. Deterding (2005/2006) has shown that there is a widespread tendency to avoid reduced vowels in the Englishes spoken in South-East Asia, including Singapore, Brunei, the rest of ASEAN, and China. Gargesh (2006) observed that the opposition between /ʌ/ and /ə/ as in [bʌs] and [bəs], /a/ and /O/, and /ɛ/ and /æ/ is not clear-cut in SAE. Gonzalez & Alberca (1978, as cited in Bautista & Gonzalez, 2006, p.134) have reported that the unstressed central vowel 'schwa' is absent in Philippine English. Kachru (2005) described that there is no distinction between a strong and weak vowel in Indian English. According to Sailaja (2009), in Standard Indian English Pronunciation /ʌ/ and /ə/ are sometimes neutralised. Deterding examined the Singapore English and concluded that there are a few examples of reduced vowels. Commenting on Pakistani English, Mesthrie & Bhatt (2008) reported that it has six short vowels. Applying the Well's lexical set, they identified that in nurse /ɜ:/ vowel, [ʌ] is the variation in Pakistani English due to its being rhotic. Mahmood, et al (2011) concluded that Punjabi speakers of Pakistani English substitute /ɜ:/ with /ə/. Front vowels in Pakistani English have been reported in Bilal, et al (2011a, 2011b, 2011c).

3. Materials and Methods

3.1 Participants

The participants were selected from among the students of BS (English) of University of Sargodha. Among 20 participants, 10 were male and 10 were female, all with Punjabi as their first language and comprised the age group of 18 - 25. It was considered that the subjects could speak English in every day communication.

3.2 Material

3.2.1 Selection of Words

The study focussed on the central vowels i.e. /ə/, / ɜ:/ and /ʌ/. The words (bearing the required vowels) were selected from Oxford Advanced Learner Dictionary. Below you can find a list of words used for analysis:

/ʌ/	h**u**nt, st**u**nt, p**u**nt
/ə/	moth**e**r, ov**e**n, fam**ou**s
/ɜ:/	sk**i**rt, sp**u**rt, h**u**rt

3.2.2 Recordings

The words (using a career phrase ‘say _____ please’) were recorded directly on computer Acer Aspire 5735z in a noise free atmosphere. Recordings were made in a soundproof room of FM Radio Station of University of Sargodha.

4. Procedure

There were total 20 participants (10 male and 10 female). Each participant was asked to speak 9 words. The total vowel tokens for analysis were rounded to (20x9) 180 with 60 for each of the three vowels i.e. /ʌ/, /ə/ and /ɜ:/. Praat was used for acoustic analysis.

5. Statistical Analysis

The data were subjected to statistical analysis using computer software MSTAT-C (Russell and Eisensmith, 1983). Completely randomized design was employed for ANOVA and Fisher’s LSD & Tukey’s HSD tests were used to compare significance at < P 0.05.

6. Analysis

6.1 Analysis of Male Sound

There is much difference in the formant values of male and female sounds due to their differences in mouth cavities.

6.1.1 Central vowel /ʌ/

Average F1 was calculated 626Hz and F2, 1473Hz. The values wavered between 442Hz and 854Hz for F1 and 1330Hz and 1452Hz for F2.

6.1.2 Central vowel /ə/

Difference was observed in the average values of /ʌ/ and /ə/. Average F1 – F2 remained 514Hz – 1395Hz respectively. Highest F1 remained 664Hz and F2 1640Hz. Lowest F1 was 315Hz and F2, 1108Hz.

6.1.3 Central vowel /ɜ:/

The formant values were almost similar to values of /ə/. Average F1 – F2 were 537Hz and 1396Hz. Highest F1 and F2 remained 600Hz and 1647Hz while the lowest remained 435Hz and 1171Hz.

6.1.4 Comparison of /ʌ/ vs /ə/

The two vowels were realized as two different phonemes. Statistical analysis (Tables 1 & 1.1) showed significant difference in the formant values of the two vowels. /ʌ/ was realized as a bit front and low as compared to /ə/. Listening to the sounds, it was observed that the speakers tend to reduce the vowel in the words ‘mother, oven and famous’, which was proved in acoustic analysis.

Table 1. ANOVA Summary of /ʌ/ and /ə/ (male sounds)

Source	SS	df	MS	F	P
Treatment b/w groups	22675915	3	7558638.3	469.31	<.0001
Error	1868259.6	116	16105.686		
Total	24544174	119			

Table 1.1: Tukey's HSD Test

HSD[.05]=85.67;			HSD[.01]=104.28	HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.
F1 /ʌ/	vs	F2 /ʌ/	P<.01	
F1 /ʌ/	vs	F1 /ə/	P<.01	
F1 /ʌ/	vs	F2 /ə/	P<.01	
F2 /ʌ/	vs	F1 /ə/	P<.01	
F2 /ʌ/	vs	F2 /ə/	nonsignificant	
F1 /ə/	vs	F2 /ə/	P<.01	

6.1.5 Comparison of /ʌ/ vs /ɜ:/

The two vowels showed statistically significant difference in formant values (Tables 2 & 2.1). The vowel /ɜ:/ was realized as a slightly high and back vowel as compared to /ʌ/, though both remained central.

Table 2. ANOVA Summary of /ʌ/ vs /ɜ:/ (male sounds)

Source	SS	df	MS	F	P
Treatment b/w groups	22048649	3	7349549.6	1083.84	<.0001
Error	786602.17	116	6781.0532		
Total	22835251	119			

Table 2.1. Tukey's HSD Testa

HSD[.05]=55.59;			HSD[.01]=67.67	HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.
F1 /ɜ:/	vs	F2 /ɜ:/	P<.01	
F1 /ɜ:/	vs	F1 /ʌ/	P<.01	
F1 /ɜ:/	vs	F2 /ʌ/	P<.01	
F2 /ɜ:/	vs	F1 /ʌ/	P<.01	
F2 /ɜ:/	vs	F2 /ʌ/	P<.01	
F1 /ʌ/	vs	F2 /ʌ/	P<.01	

6.1.6 Comparison of /ɜ:/ vs /ə/

The two vowels showed no statistically significant difference in their formant values Tables 3 & 3.1). Rather the two vowels overlapped each other. While listening to speakers pronouncing the words bearing the two vowels, it was observed that the pronunciation pattern is the same. The acoustic analysis proved the aural observation.

Table 3: ANOVA Summary of /ɜ:/ and /ə/ (male sound)

Source	SS	df	MS	F	P
Treatment b/w groups	22710279	3	7570092.9	462.95	<.0001
Error	1896810.3	116	16351.813		
Total	24607089	119			

Table 3.1 Tukey's HSD Test

HSD[.05]=86.32; HSD[.01]=105.08	
F1 /ɜ:/ vs F2 /ɜ:/ P<.01	HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.
F1 /ɜ:/ vs F1 /ə/ nonsignificant	
F1 /ɜ:/ vs F2 /ə/ P<.01	
F2 /ɜ:/ vs F1 /ə/ P<.01	
F2 /ɜ:/ vs F2 /ə/ nonsignificant	
F1 /ə/ vs F2 /ə/ P<.01	

6.1.7 Comparison of /Λ/ vs /ɜ:/ vs /ə/

The three vowels were realized as central vowels. The figure below (Fig1) shows the spread of the three vowels which is almost overlapped. Many speakers did not show any difference in the three vowels as it is clear from the figure. F1 and F2 of the two vowels /ɜ:/ and /ə/ are showing no difference at all, while F1 of /Λ/ is slightly higher than the formants of the other two. Looking at the spread of the F2, it is observed that almost half of the speakers have showed no difference in the values of F2 of all the three vowels. So it may be concluded that the male speakers merged /ə/ and /ɜ:/, while /Λ/ was realized with a slightly different tongue position.

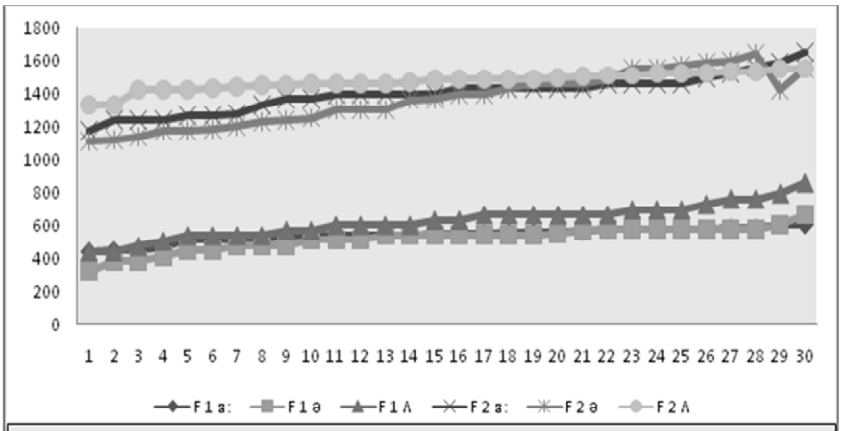

Fig1: Comparison of Formants of the three vowels

The graph below (Fig 2) displayed comparative formant values of the central vowels.

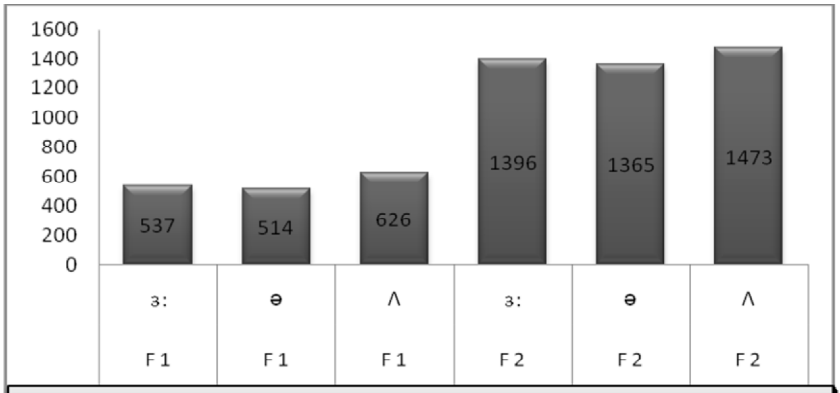

Fig 2: Graph representing the average formant values of the three vowels.

6.2. Analysis of Female Sound

Formants of the female speakers differ from their male counter parts. Separate analysis of female sounds was made.

6.2.1 Central vowel /Λ/

Average F1 was calculated 812Hz and F2, 1708Hz. The values wavered between 590Hz and 917Hz for F1 and 1506Hz and 2100Hz for F2.

6.2.2 Central vowel /ə/

Difference was observed in the average values of /Λ/ and /ə/. Average F1– F2 remained 662Hz – 1618Hz respectively. Highest F1 remained 880Hz and F2 1774Hz. Lowest F1 was 400Hz and F2, 1357Hz.

6.2.3 Central vowel /ɜ:/

The formant values were almost similar to values of /ə/. Average F1 – F2 were 676Hz and 1606Hz. Highest F1 and F2 remained 759Hz and 1869Hz while the lowest remained 560Hz and 1510Hz.

6.2.4 Comparison of /Λ/ vs /ə/

Female speakers showed a similar pattern of realization of the two vowels as was displayed by their male counterparts. The two vowels were realized as two different phonemes. Statistical analysis (Tables 4 & 4.1) showed significant difference in the formant values of the two vowels. /ə/ was realized as a bit high as compared to /Λ/.

Table 4. ANOVA Summary of /Λ/ and /ə/ (female sound)

Source	SS	df	MS	F	P
Treatment b/w groups	26387725	3	8795908.3	579.13	<.0001
Error	1761826.9	116	15188.163		
Total	28149552	119			

Table 4.1 Tukey's HSD Test

HSD[.05]=83.2; HSD[.01]=101.27 **F1 /Λ/** vs **F2 /Λ/** P<.01 **F1 /Λ/** vs **F1 /ə/** P<.01 **F1 /Λ/** vs **F2 /ə/** P<.01 **F2 /Λ/** vs **F1 /ə/** P<.01 **F2 /Λ/** vs **F2 /ə/** nonsignificant **F1 /ə/** vs **F2 /ə/** P<.01	HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.

6.2.5 Comparison of /Λ/ vs /ɜ:/

The difference in the formant values was similar as were observed in the comparison of /Λ/ and /ə/. Statistically significant variation (Table 5, 5.1) was observed in the formant values of the two vowels. /ɜ:/ was realized as a high and back vowel as compared to /Λ/.

Table 5. ANOVA Summary of /Λ/ and /ɜ:/ (female sound)

Source	**SS**	**df**	**MS**	**F**	**P**
Treatment b/w groups	25268449	3	8422816.4	772.62	<.0001
Error	1264593.2	116	10901.665		
Total	26533042	119			

Table 5.1 Tukey's HSD Test

HSD[.05]=70.48; HSD[.01]=85.8 F1 /Λ/ vs F2 /Λ/ P<.01 F1 /Λ/ vs F1 /ɜ:/ P<.01 F1 /Λ/ vs F2 /ɜ:/ P<.01 F2 /Λ/ vs F1 /ɜ:/ P<.01 F2 /Λ/ vs F2 /ɜ:/ P<.01 F1 /ɜ:/ vs F2 /ɜ:/ P<.01	HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.

6.2.6 Comparison of /ɜ:/ vs /ə/

The apparently two different vowels displayed no statistically significant difference in their formant values (Tables 6 & 6.1). Acoustic analysis also showed that the spread of the two vowels overlapped each other.

Table 6. ANOVA Summary of /ə/ and /ɜ:/ (female sound)

Source	**SS**	**df**	**MS**	**F**	**P**
Treatment b/w groups	27116051	3	9038683.5	968.53	<.0001
Error	1082559.4	116	9332.4083		
Total	28198610	119			

Table 6.1 Tukey's HSD Test

HSD[.05]=65.21;		HSD[.01]=79.38		HSD = the absolute [unsigned] difference between any two sample means required for significance at the designated level. HSD[.05] for the .05 level; HSD[.01] for the .01 level.
F1 /ɜ:/	vs	F2 /ɜ:/	P<.01	
F1 /ɜ:/	vs	F1 /ə/	nonsignificant	
F1 /ɜ:/	vs	F2 /ə/	P<.01	
F2 /ɜ:/	vs	F1 /ə/	P<.01	
F2 /ɜ:/	vs	F2 /ə/	nonsignificant	
F1 /ə/	vs	F2 /ə/	P<.01	

6.2.7 Comparison of /Λ/ vs /ɜ:/ vs /ə/

The analysis of female sounds represented the same pattern as was displayed by the male speakers. The figure below (Fig 3) shows that F2 of the three vowels has no significant difference, rather the spread of F2 displayed that they are overlapped. The spread of F1 displays that the values of /ə/ and /ɜ:/ are the same, with slight rise in the values of /Λ/. The two vowels /ə/ and /ɜ:/ are realized as one phoneme by the female speakers.

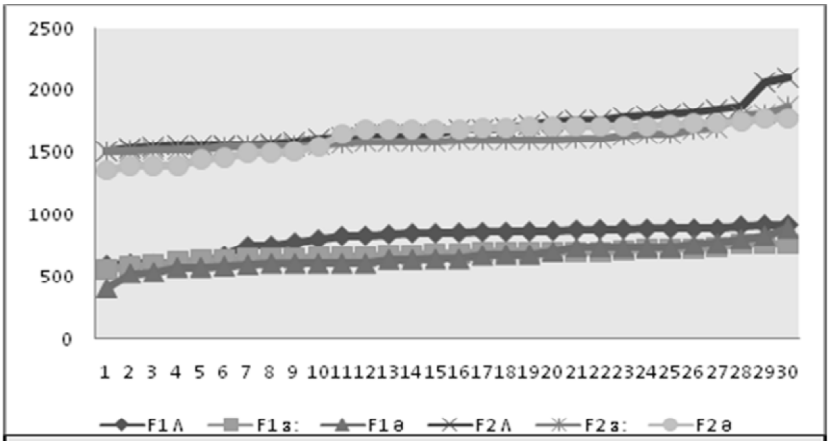

Fig 3: Comparison of Formants of the three vowels

The figure below (Fig 4) shows the average formant values of the central vowels as realised by female speakers.

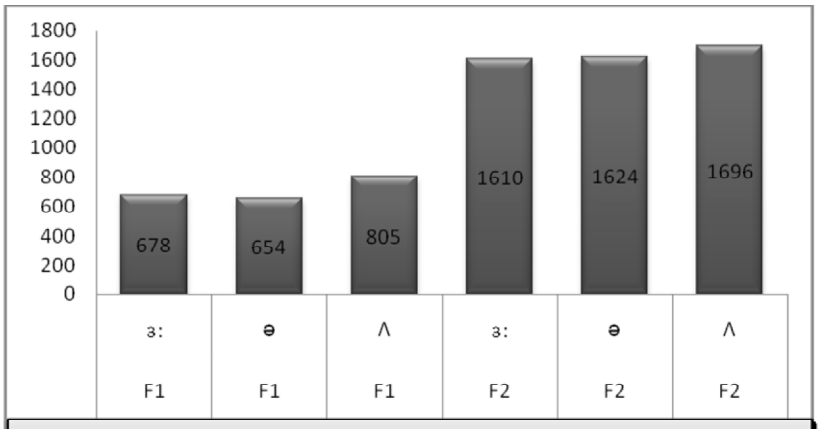

Fig 4: Graph representing the average formant values of the three vowels.

7. Conclusion

We may conclude that there are two central vowels in Pakistani English. There is no /ɜ:/ vowel in Pakistani variety of English. The difference between the two central vowels /ə/ and /Λ/ is very little. Here the influence of L1 (Punjabi) vowel system is quite obvious which has only /ə/ vowel V (Bhattia, 2009, as cited in Mahmood et al, 2011). Statistically there is significant difference between the formant values of the two vowels, which establish them as two different phonemes. /Λ/ is realized with a slightly lowered and fronted tongue as compared to /ə/ (Fig 5 & 6). Though male and female speakers showed a similar pattern yet the major difference was that female speakers pronounced /Λ/ with a much lowered tongue position as compared to their male counterparts. In a nutshell, it is concluded that the study testified the findings of Mesthrie & Bhatt (2008) and Mahmood, et al (2011) that Pakistani English has no /ɜ:/ phoneme.

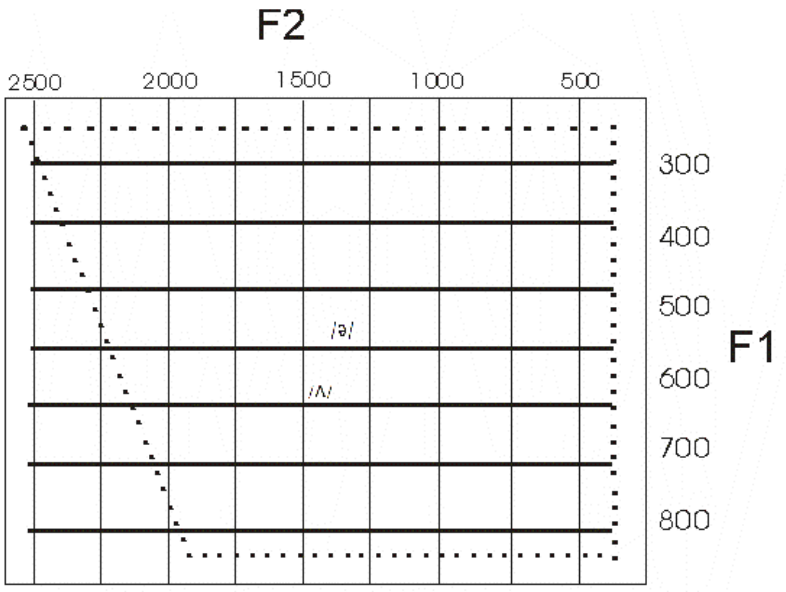

Fig 5: Central vowels as spoken by Pakistani male speakers

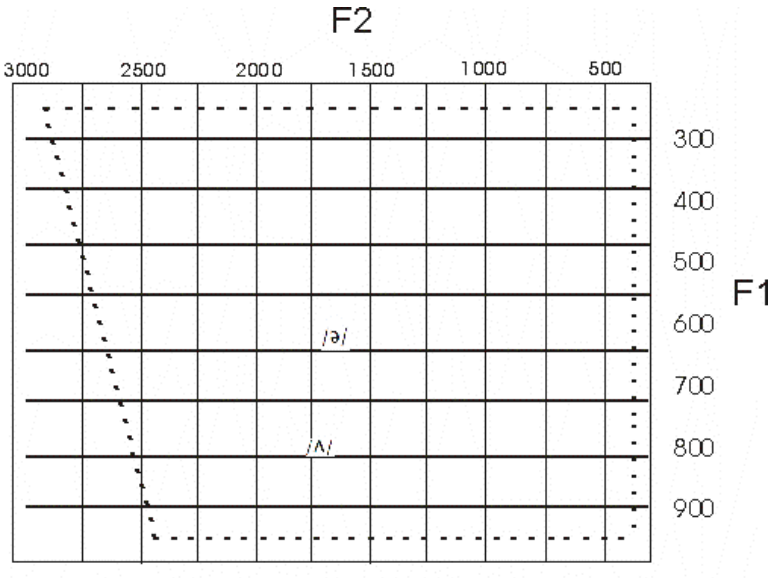

Fig 6: Central vowels as spoken by Pakistani female speakers

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