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Redefining Acoustic Space in Language Contact Situation: Case of Hindi and Punjabi in Delhi

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Introduction

Beginning with the publication of "Languages in contact" by Uriel Weinreich (1953) studies of language contact have contributed to our understanding of language typology, bilingualism, types of language contact and social settings, pidgins and creoles, language change etc. to name a few. The processes which mark a bilingual / language contact situation have been included in studies of 'code switching', 'code mixing', 'interference', 'borrowing', also 'convergence' and 'pidginization' etc. All of these terms reflect a certain perception of the language contact situation. In this paper we use the term 'language contact', a relatively neutral term without implying anything about "subordination" of one language vis a vis the other, or "purity" or "corruption" of language s in contact. Languages in India have been in contact since ages but the contemporary world of globalization has brought in the new paradigm where bilingualism is the norm and monolingualism or a "predominantly monolingual region" is an exception to the rule, globally including India.

Loveday (1996) provides the details of a sociolinguistic history in his study of language contact in Japan. Chambers and Trudgill (1980), Trudgill (1983, 1986), discuss geographical diffusion models to describe how and why diffusion takes place in language contact situations, at a micro level. They refer to the theory of linguistic accommodation

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developed by Howard Giles (1973) and also Giles and Smith (1979). *Dialects in Contact* (Trudgill 1986) focuses on linguistic change through geographical diffusion of linguistic innovations, leading to the development of new dialects through "interdialect forms", "hypercorrections" and "hyperdialectisms" etc.

Significance of studies on languages in contact can not be underestimated. The present study is a micro level investigation of vowel space in Hindi and Punjabi as spoken in Delhi. Hindi and Punjabi are both Indo-Aryan languages with a number of cognates and other similarities of morpho-phonological, and morphosyntactic structures. Mizokami (1987) discusses Language Contact in Punjabi covering the details of phonic, lexical and grammatical "interference" and issues of intelligibility and comprehensibility in detail. There are other studies on Hindi-Punjabi bilingualism but practically none covering the acoustic details of the phonic structure of the two languages. The present study focuses on vowel space as determined by the formant patterns, especially F1 and F2 of the peripheral vowels. The present study attempts to show that the speakers of Hindi and speakers of Punjabi, both claming to be monolingual speakers of their respective languages actually show signs of passive bilingualism where the presence of the other language in the environment brings in significant changes in their own, respective monolingual language norms and behavior. At a micro level we can demonstrate this influence of the bilingual environment through acoustic space which gets "redefined" in the two languages in contact.

Acoustic Vowel Space

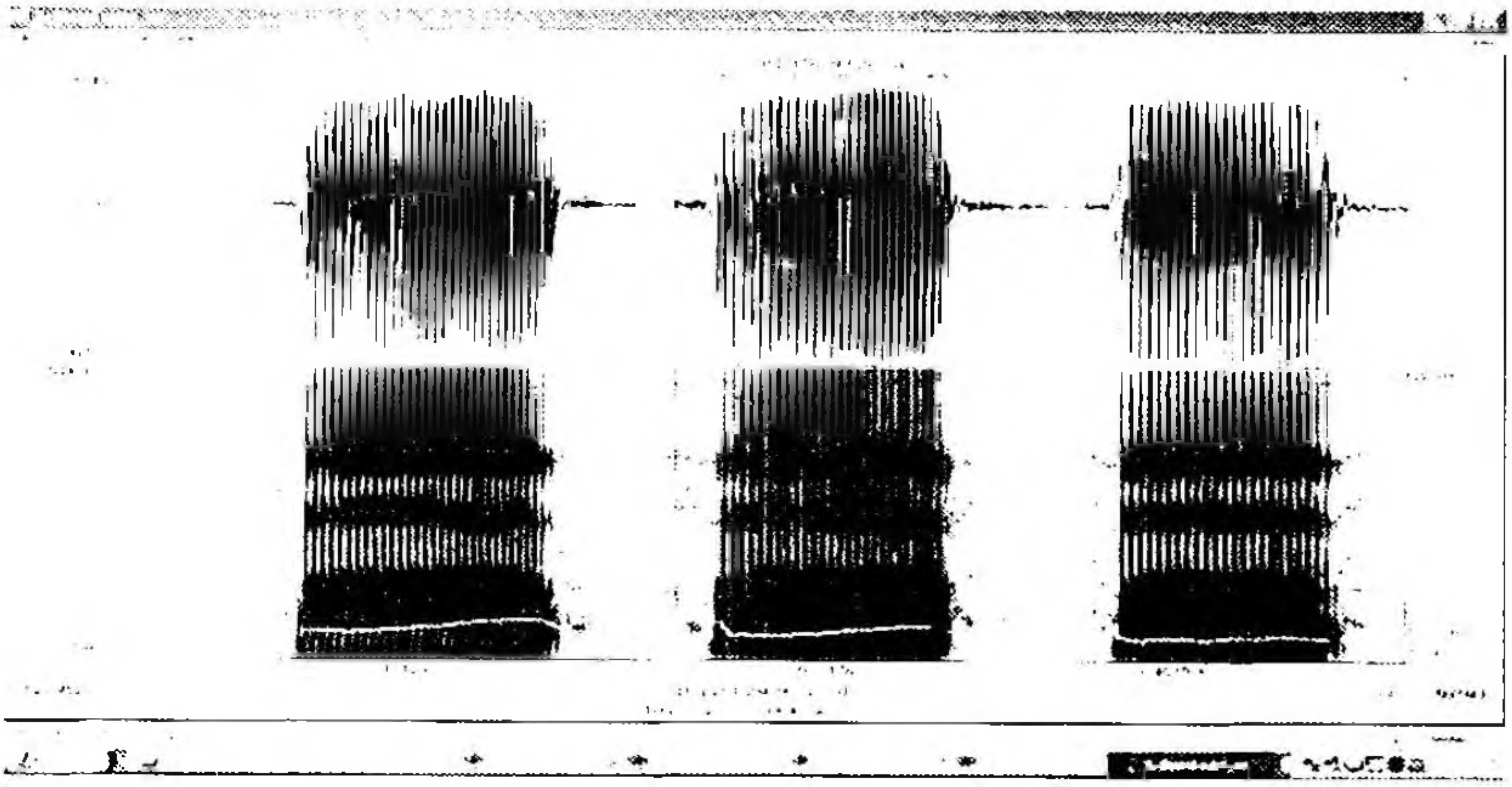
Studies on acoustic vowel space are useful since they find applications in a number of areas such as language pedagogy, speaker identification studies, speech technology and TTS studies and also in the area of speech pathology. The present study of acoustic space in contact situation has implications for sociolinguistic studies of language and bilingualism.

Beginning with Peterson and Barney's article on formant patterns in 1952 followed by Fant (1960), Ladefoged (1975), Disner (1978), Lindau and Wood (1977) and a number of studies thereafter acoustic studies have contributed to our understanding of vowels and vowel spaces in different languages. Lindblom (1989) discusses acoustic vowel space in the context of Dispersion Theory implying that the vowels of a given language are organized in the acoustic vowel space in such a way that they be sufficiently distinct on the perceptual level. According to Ohala (1999), vowels are classified in terms of an abstract 'vowel space' which is represented by a four-sided figure known as 'Vowel Quadrilateral'. This space bears a relation to the position of the tongue in vowel production. Acoustic parameters of Hindi vowels have also been studied in the context of speech recognition by Ganesan et.al. (1985). Other recent studies on acoustic vowel space include Jesudas (2009), Misra (2009), Parihar (2009) and Yadav (2009) unpublished M.Phil dissertations, JNU.

This research aims at finding the differences between acoustic spaces as indicated by seven peripheral vowels of Hindi and Punjabi as spoken in Delhi. These peripheral vowels are/i/, /e/, /ɛ/, /a/, /ɔ/, /o/ and /u/. Five male native speakers of Hindi and five male native speakers of Punjabi, all residents of Delhi, and five subjects from Lucknow, predominantly monolingual region in UP, participated in the study. All the subjects are aged between 15-20 years and are in different stages of High school and Intermediate. The socio-economic status is more or less constant as they belong to lower middle class families. Two separate lists of words were prepared. The first consisting of Hindi words with the vowels /i/, /e/, /ɛ/, /a/, /ɔ/, /o/ and /u/in the three word positions. And the second list consisted of Punjabi words with the vowels /i/, /e/, /ɛ/, /a/, /ɔ/, /o/ and /u/ in the three word positions. Word lists are given at the end of the paper, **(appendix 1).** Punjabi is a tonal language and the three phonemic tones continue to be phonemic despite language contact situation. While the other aspects of pitch variation need a further detailed study with examples of high and low tones as well, the present study has taken all examples of level tone only, because the comparison is with Hindi which does not have high or low tones as phonemic.

The data was recorded in the sound proof recording room of the language laboratory of Jawaharlal Nehru University, with the help of PRAAT and acoustic analysis of the seven vowels /i/, /e/, /ɛ/, /a/, /ɔ/, /o/ and /u/for Hindi and Punjabi was done with the help of Wave Surfer and PRAAT.

The voice files are converted to the WAV format in the wavesurfer interface. We select the vowels under study from the word in which they occur in word -initial, word medial or word-final position. We decided to work on the word medial vowels which were all preceded and followed by stop consonants. Three articulations of the same word medial vowel were included. After selecting the vowel under study, we go to the "Selection to New" option in the File menu and we arrive at the following spectrograms of the three repetitions of the vowel phoneme. A sample is given below.



Spectrogram For H1m16a[1]

Then we 'tab' to select the vowel and save it in the notepad. We arrive at the formant values and then we select the steady state formants to calculate the average. Then the average formant values of each vowel are calculated for each one of the Hindi and Punjabi informants which helped us arrive at values as given in the form of tables and charts, (appendix- 2). The F0 and first three formants are then tabulated, as an example see the following

[1] H1 is first speaker of Hindi

M16 is male, 16 years old

a is the vowel /a/ under study

table for the formant values for the Hindi word medial /a/ for the Hindi subject1 (code H1M16) which is pasted in a Microsoft EXL sheet:

H1M16a

Sample 1			Sample 2			Sample 3		
F0	**F1**	**F2**	**F0**	**F1**	**F2**	**F0**	**F1**	**F2**
135.72	702.35	1202.02	148.35	705.70	1174.71	147.78	616.42	1053.86
134.56	718.80	1208.81	147.60	703.90	1182.99	148.44	607.92	1093.94
134.32	729.38	1214.02	147.59	701.29	1188.89	149.19	606.73	1010.65
134.38	738.73	1217.39	147.33	704.13	1199.09	150.43	618.16	1112.94
138.59	774.89	1228.88	147.73	712.66	1201.21	152.81	629.97	1174.52
139.06	768.47	1238.43	148.66	720.35	1206.78	155.12	644.87	1201.17
140.09	761.56	1245.83	150.32	729.55	1208.44	156.84	657.00	1206.53
139.26	762.62	1263.63	151.71	736.09	1203.96	157.86	665.58	1216.96
139.26	774.00	1302.64	153.11	738.57	1202.18	158.76	676.67	1180.69
Average Values								
136.88	**753.22**	**1228.52**	**149.16**	**716.92**	**1196.47**	**153.03**	**535.92**	**1139.03**

Formant values for H1M16a

The averages of all these values are then put together with similar average values obtained for the other samples. This acoustic analysis helps us arrive at the formant values for every vowel (particularly F1 and F2 and the difference between the two formants). Thus, the F1, (F2-F1) for all the three articulations of each one of the seven vowels for all the ten informants are calculated. F1 is responsible for tongue height and F2 (or

F2-F1) is responsible for front back criteria. These F1 and (F2-F1) are plotted negatively so as to arrive at a graphic representation closer to the cardinal vowel chart. Peter Ladefoged. in the third edition of his text book recommended the use of plots of F1 against F2-F1 to represent vowel quality (Ladefoged, 1993: 198). However, in the fourth edition, he changed to a simple plot of F1 against F2 (Ladefoged, 2001: 177) and this simple plot of F1 against F2 was maintained for the fifth edition of the book (Ladefoged. 2006: 189). Katrina Hayward compares the two types of plots and concludes that plotting of F1 against F2-F1 "is not very satisfactory because of its effect on the placing of the central vowels" (Katrina, 2000: 160). So she also recommended use of a simple plot of F1 against F2. In fact. this kind of a plot of F1 against F2 has been used by analysts to show the quality of the vowels in a wide range of languages.

We have used the plots of (F1) against -(F2-F1) because this gives us a representation of acoustic vowel space which is visually closer to the cardinal vowel chart.

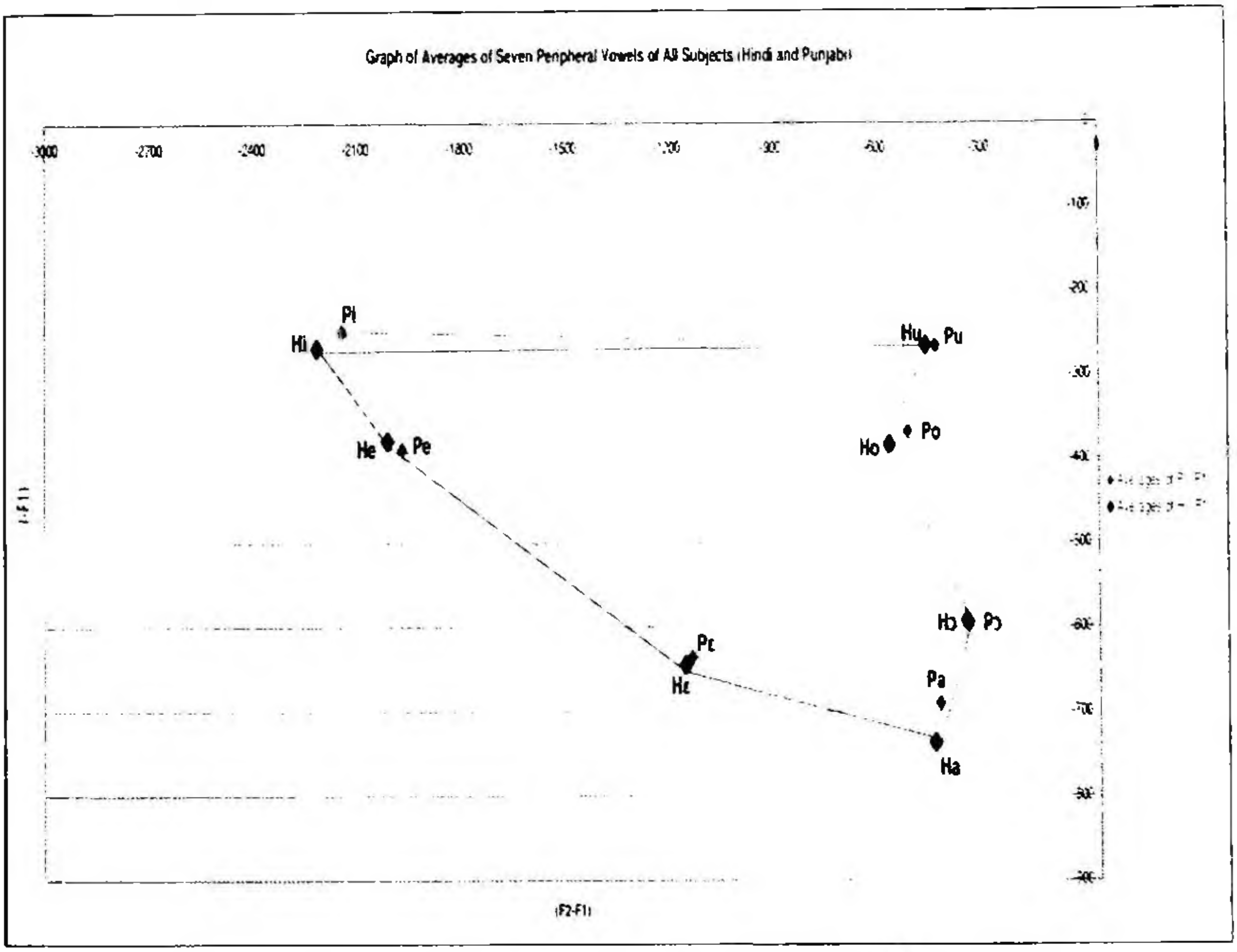
Results

Average formant values of all peripheral vowels of Hindi and Punjabi along with the control sample are given in appendix 2. A comparison of the two languages in Delhi can be seen in the table below giving values of -(F1) and -(F2-F1) for all the seven vowels of Hindi and Punjabi.

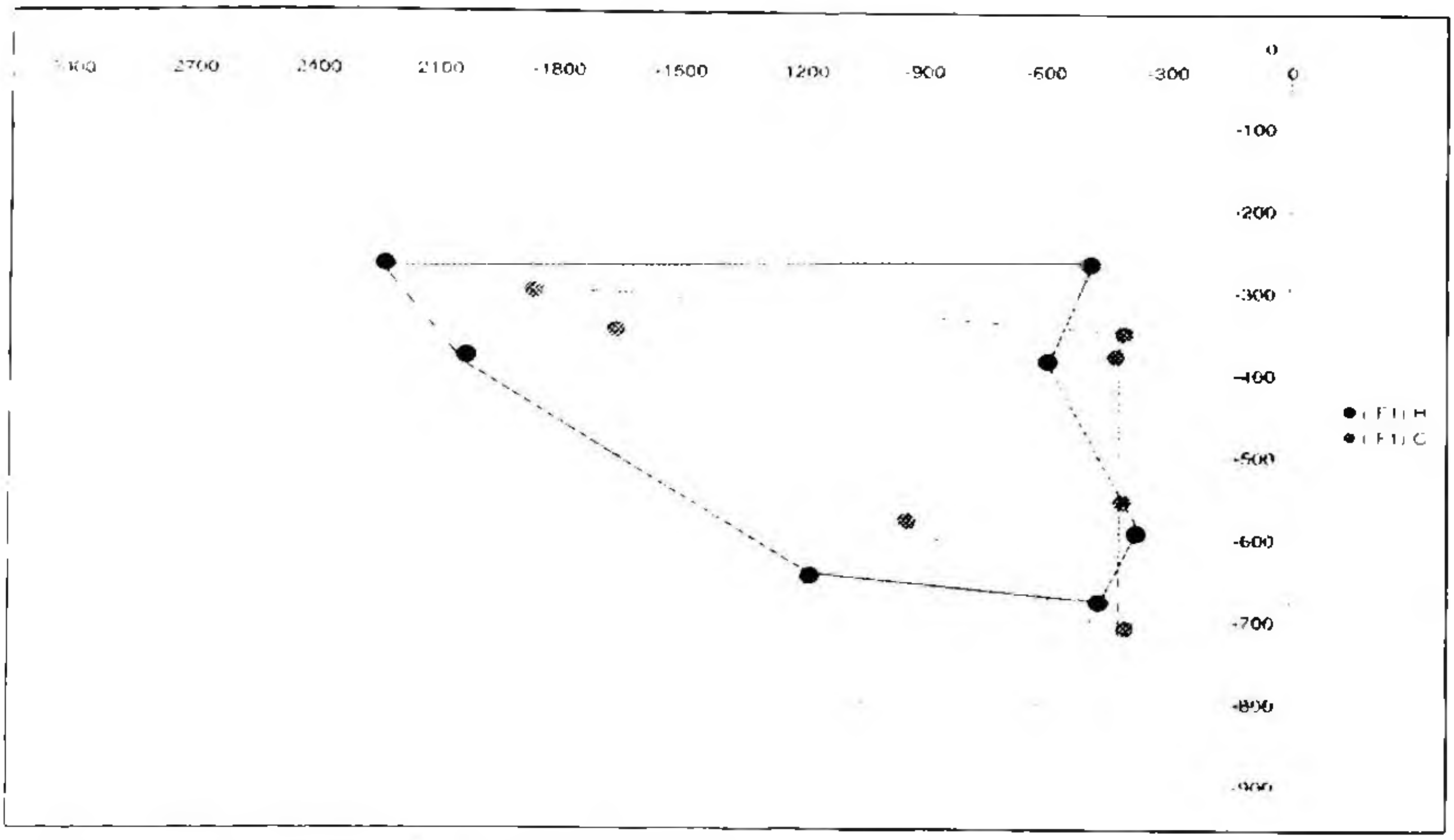
Vowel	(-F1) H	-(F2-F1) H	(-F1) P	-(F2-F1) P	(-F1) C	-(F2-F1) C
/i/	-267.45	-2221.20	-247.39	-2149.12	-299.51	-1856.29
/e/	-378.09	-2021.02	-388.29	-1980.13	-346.56	-1653.94
/ɛ/	-645.67	-1174.91	-635.84	-1155.97	-578.77	-938.77
/a/	-676.86	-468.00	-690.68	-453.58	-708.92	-402.11
/ɔ/	-593.14	-376.87	-594.95	-369.38	-555.05	-411.67
/o/	-	-594.54	-	-543.40	-	-427.13

	383.50		367.61		377.66	
/u/	-265.21	-490.44	-265.00	-463.87	-349.45	-408.37

The values are plotted together to see how the acoustic space of vowels of one language map on to the other language. Black indicates the acoustic space for Hindi and Red indicates the acoustic space for Punjabi, as spoken in Delhi. The second plot shows the values for all the peripheral vowels of Hindi as spoken by monolingual speakers of Hindi from Lucknow who served as the control group, plotted together with values from Hindi speaking subjects from Delhi. Black is for Hindi acoustic vowel space in contact situation and Green is for Hindi acoustic vowel space of the control group from Lucknow.



Acoustic Space of Vowels in Hindi and Punjabi



Acoustic Space of Vowels in Hindi as spoken in Delhi (Black) and as spoken in Lucknow (Green)

Discussion

According to one study, Savithri et.al (2007) which examines *Base of Articulation of 13 Indian Languages*, F1 values for Punjabi are consistently higher than those of Hindi indicating relatively more open articulation of vowels in Punjabi. The same study also shows that F2 values are also relatively higher than those of Hindi indicating that the vowels of Punjabi are more fronted. Another study by the author, Narang (1989) shows the formant values of the seven peripheral vowels of Punjabi for a mix group of male and females, as below. Clearly these values are also higher than those of Hindi and Punjabi as spoken in Delhi.

Vowel	/i/	/e /	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	314.5	487.5	642.5	762.5	570	470	414.5
F2	2680.5	2553.5	2065.5	1416.25	1026.5	927.5	841.5

{* Narang, Vaishna (1989)}

Acoustic Space

The acoustic space as indicated graphically above appears to be practically the same in case of the vowels of Hindi and Punjabi as spoken by monolingual speakers of Hindi and Punjabi residing in Delhi, although there are some differences between F1 and F2 values of Hindi and Punjabi. The two plots show Hindi vowel space of monolingual residents of Delhi has been redefined, perhaps covering a larger space as compared to the control group from Lucknow, because of the language contact situation. Similarly Punjabi vowels as spoken by monolingual residents of Delhi may have also redefined their acoustic space because of the language contact situation. It is important to note that all subjects selected for the present study claimed to be monolinguals, and yet their acoustic vowel space is very different from that of Hindi speakers in Lucknow. A further comparison of Punjabi speakers in Delhi with monolingual speakers of Punjabi proves the point that the acoustic space gets redefined in a language contact situation. The present study shows that on the basis of a comparison of the acoustic space. Based on an average of 15 articulations of every vowel in Hindi and 15 articulations of every vowel in Punjabi, one can only hypothesize that the acoustic space of monolinguals based in a language contact situation gets redefined, probably as a larger acoustic space, due to a lot of exposure to second language spoken in the area. Similar studies on Hindi-Punjabi contact situations elsewhere, as well as on other languages in contact are needed to confirm these findings.

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Appendix: 1: List of words selected for the study

Vowels	**Hindi words**	**Glosses**	**Punjabi words**	**Glosses**
/i/	Pipa	container	Tija	third
/e/	Tel	oil	Ret	sand
/ɛ/	pɛda	birth	pɛr	feet
/a/	Pap	sin	Pap	sin
/ɔ/	pɔdh	seedlings	fɔj	army
/o/	loTa	a container	Dor	thread
/u/	Dudh	milk	Pura	complete

Appendix: 2

Average F1 and F2 values for Hindi, Punjabi and Control group.

Vowel	**F1 H**	**F2 H**	**F1 P**	**F2 P**	**F1 C**	**F2 C**
/i/	267.45	2488.63	247.39	2396.51	-299.51	-1856.29
/e /	378.09	2399.11	388.29	1368.42	-384.56	-1653.94
/ɛ/	645.67	1820.56	635.84	1780.81	-578.77	-983.77
/a/	676.86	1148.86	690.68	1143.26	-708.02	-402.11
/ɔ/	593.14	970.01	594.95	964.33	-555.05	-411.67
/o/	383.50	978.04	367.61	911.01	-377.66	-427.13
/u/	265.21	755.65	265.00	728.87	-349.45	-408.37