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Change in short vowel in the context of /h/

Abstract: *This paper discusses an interesting phenomenon observed in Urdu when a /h/ occurs in syllable-final and is preceded by a short vowel. This phenomenon changes the preceding short vowel. The change occurs either in the quality, duration, or perception of the vowel. It is seen that in most cases the duration of short vowel is not changed but qualitatively it becomes a long vowel. In few cases the features of /h/ are deleted and overridden by that of preceding vowel. However, a case was observed where the quality and duration of vowel is not changed but the listeners perceive it differently.*

Keywords: /h/ sound in Urdu, behavior of short vowels, perception of vowels

1. INTRODUCTION

In all languages there are certain variations, which are not bound to any rule or phono-tactic constraint. These variations are hard to explain and they evolve, probably, due to the tendencies of dissimilation and assimilation of native speakers. This paper seeks to investigate an interesting phenomenon in Urdu. At times, when /h/ occurs at syllable boundary and it is preceded by a short vowel then there is a certain change in the vowel. This change either affects the quality of the vowel or its perception or both. /h/ sound in itself is interesting; as it does not have any feature of itself on the Jakson & Halle feature system. So does this mean that feature of preceding vowel sometime stretches on to the /h/ consonant space to give rise to some amalgamation? Or some other phenomenon is taking place? These are the questions that this paper tries to answer.

2. LITERATURE REVIEW

Vowels are the most important parts in any language. They help determine the complexity of the given language. Vowel systems vary greatly from language to language. Vowel systems distinguish between different vowels. These are namely linear, quadrangular and triangular system (Lass, 1995, p.139). The Urdu language follows the quadrangular system more closely. Daniel Jones devised cardinal vowel system, which has 16 extreme vowels. 8 with normal lips position and 8 with rounded lips position (Clark & Yallop, 1999, p.24). The vowels are sometime further divided in according to the height of

the tongue. There are at most four different level of heights; high 1, high 2, high 3, high 4. In 1989 Kiel IPA Convention, they divided vertical dimension in four levels; close, close-mid, open-mid and open (Laver, 1994, pg. 276). Some of the languages including Urdu make use of all the four levels.

When spectral peaks are separated by less than 3.0 to 3.5 bark, then it gives distinctly different sound than of wider spacing. These vowels are called as high vowels, also these vowels have stable acoustic feature giving well-defined response. Other acoustic and articulatory properties further differentiate in them. Similarly for non-high vowels F1 & F0 is more than 3 bark and they tend to fall in amplitude of the broadband spectrum below the first formant peak (Stevens, 1998, p.268).

Forward movement of tongue increase second formant to maximum possible and backward movement decrease it to minimum possible (Stevens, 1998, p.283).

Then vowels are also classified with short ones and long ones. The short vowel take one time slot and long vowel take two (Goldsmith, 1990, p.48). The long vowel also affects the stress of the word in quantity sensitive languages. So they take up two morae (Lass, 1995, p.253). The stressed vowels are also lengthened in Urdu (Hussain, 1997, p.80).

The duration of the vowels is also greatly affected by the number of factors including stress. Another factor that affects the vowel length is the position of the vowel in the sentence; similarly the speed of the speaker delivery is another important factor. Nasal consonants also tend to increase vowel length. Yet strangely the importance of the word in the sentence increases vowel duration. The adjacent consonants also alter the duration of the vowel, which is still an intriguing effect (Clark & Yallop, 1999, p.33). Stress also changes Urdu vowel quality (Hussain, 1997, p.97).

The speakers of the language usually assimilate and dissimilate frequently for the ease of speaking (Zia, 2002, p.237). In the process of making the speech simpler they some time tend to delete some words too.

The speakers are also capable of substantial amount of compensatory articulation to produce a single desired auditory result in vowel quality (Clark & Yallop, 1999, p.31). As showed by the data collected by Shepard (1972) that remarkable degree of

variability among supposedly identical vowels and overlap between apparently different vowels. This perceptual mystification still bewilders the phonologists (Clark & Yallop, 1999, p.150).

In Jakson & Halle 12 feature /h/ is defined as non-vocalic, non-consonantal, non-voiced, non-nasal, non-discontinuous, non-strident while others are irrelevant for /h/ (Clark & Yallop, 1992, p.313). In Clark & Yallop feature system they have mentioned it as voiceless pharyngeal fricative.

3. METHODOLOGY

We selected 9 words of Urdu and divided them into three groups. Each group contains three words and every word in a group has a one of the short vowel i.e. either of [I, ə, u] according to Feroz al Lughat.

These groups are as under

- G1: [mlhman] “guest”
 [məhtab] “moon”
 [məhlət] “grace period”
- G2: [rəhna] “to live”
 [tjIhra] “face”
 /zuhra/ “venus” (planet)
- G3: /bəhrup/ “mask”
 /flhrIst/ “list”
 /buhtan/ “false allegation”

In all groups each word contains two syllables and stress is same throughout the group. We intentionally placed all words starting with /m/ in a single group in order to observe the effect of nasalization on vowels. Also note that in each word /h/ occurs syllable-finally.

Five male speakers, having Urdu as their native language, were selected. Five readings of each word were taken and speakers were directed to block randomized at the time of speaking. A carrier phrase of “mañ næ ____ kəha” (I said -----) was used. Then quality and duration of vowel, duration of /h/ and total time of vowel + /h/ was calculated. Also, seventeen native speakers did perception testing.

4. RESULTS

The average F1 and F2 of all the words by all speakers is given in Table 1 and Table 2 respectively. The reading of [məhtab] by second speaker is not included in the results because he pronounced it as [mahtab]. Also while analyzing the data, within speaker variations were negligible, shown in Table 5, however across speaker variations are present which are fully represented by Table 1 and 2 also in Figure 2.a

Table 1 Average F1 of all words by all speakers

F1	1124	1132	1119	1095	1135	Avg
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FflhrIst	580	581.4	618.4	674.8	528.4	596.6
Məhtab	603	-	614	659.8	579.8	614.15
Bəhrup	549.6	544.6	569	628.4	518	561.92
TjIhra	431.8	431.8	447.8	449.6	387.4	429.68
Mlhman	603.6	669.4	566	658	557.4	610.88
Rəhna	561.8	610.4	601.2	659.6	520	590.6
zuhra	434.8	514.4	487	518.4	432.2	477.36
məhlət	451.4	593.6	597	603.2	485.4	546.12
buhtan	441	530.2	521	526.8	443.2	492.44

Table 2 Average F2 of all words by all speakers

F2	1124	1132	1119	1095	1135	Avg
FflhrIst	1802.6	1728.8	1845.6	1936	1915	1845.7
məhtab	1855.6	-	2036	1984	1897.8	1943.4
Bəhrup	1769	1781.6	1891.6	1910	1890	1848.4
TjIhra	2029	2012.2	2195.2	2277	2052.6	2113.2
mlhman	1846.8	1741.2	1911	2004	1897	1880.0
Rəhna	1780	1800	1855.2	1947	1776.2	1831.7
zuhra	1026.6	1203.2	1289	1241	1183.8	1188.9
məhlət	795.4	982.6	1732	987	996.8	1098.8
buhtan	836.6	1016.6	1398.4	1038	968	1051.6

The average positions of short vowels with respect to the original vowels are plotted in the graph shown by Figure 1. The readings of original vowels were taken from (Hussain, 1997).

Figure 1 only represents the aggregate behavior of short vowels where words supposedly containing (I,ə,U) are merged together. A better representation of these vowels is given in Figure 2 that represents the behavior of vowels at word level. It also presents the standard deviation present across all speakers.

Figure 1 and 2 provide us some clue about the quality of the vowels but not about their duration. Average duration of vowels and /h/ in each word is shown in Figure 3. From this figure we can see the effect of stress on vowels. It should be kept in mind that the duration of vowels in unstressed syllables is shorter as compared to the stressed ones.

The horizontal & vertical bar across a point in Figure 1 shows the average standard deviation in F1 and F2 of three words supposed to have same vowel respectively, whereas, the horizontal & vertical bar in Figure 2 shows the standard deviation in that word across speakers. The vowels without horizontal and vertical bar in Figure 1 are the ones, which are taken from (Hussain, 1997) for comparison purpose.

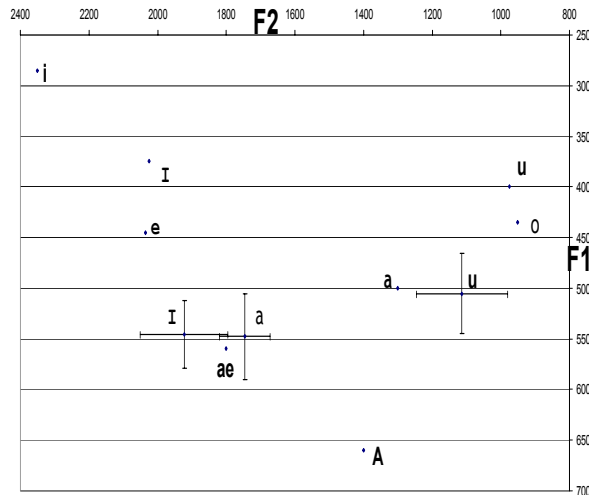


Figure 1 Our Vowels vs. Normal Vowel

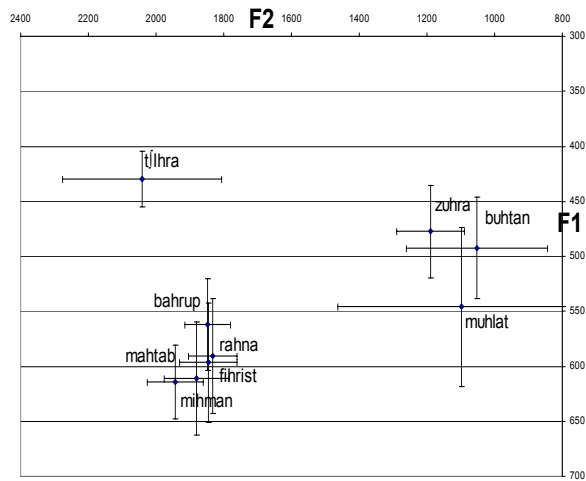


Figure 2 Analysis of vowel on each word level

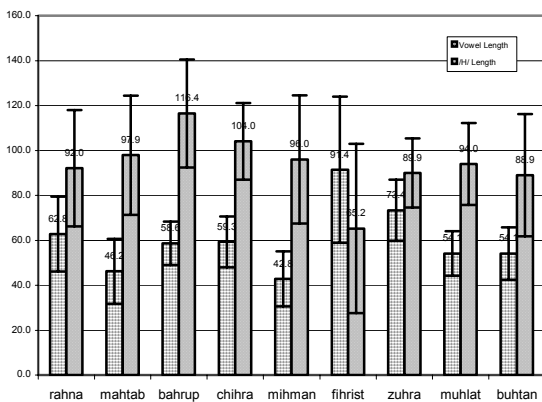


Figure 3 duration of Vowel and/h/

Across speaker variations are also evident from the Table 3 and Table 4, which represent the length of stressed and unstressed vowels respectively.

Table 3 Vowel length of stressed vowels

Words	1124	1132	1119	1095	1135	Avg
rðhna	64	88	62.6	41.6	57.8	62.8
tʃihra	64.4	69.2	68.8	46	48.2	59.3
zuhra	71.8	82.4	81.8	50.2	80.6	73.4
					Avg	65.2

Table 4 Vowel length of unstressed vowels

Words	1124	1132	1119	1095	1135	Avg
mðhtab	56.6	65	44.4	32.6	32.6	46.2
bðhrup	66.8	59.4	62.4	42	62.6	58.6
mihman	52.6	41.4	58	30.4	31.8	42.8
fihrist	107.6	76.4	83.2	52.2	137.8	91.4
muhlöt	62.8	65.8	52.6	43.8	45.6	54.1
buhtan	71.8	53	53.6	39	53.2	54.1
					Avg	57.9

Table 5 within speaker variations

Speakers	STDEV in F1	STDEV in F2
1124		17
1132		36
1119	21	39
1095	40	129
1135	25	35
	20	49
	24.6	75

5. DISCUSSION

From the result section it can be seen that the vowels are mapped differently than anticipated. In most of the words the short vowel maps to a long vowel. At times the perceptual mapping of vowel is also different from its actual mapping. There are cases when the duration of the vowel does not change but its quality does change. However, most interesting cases are the ones in which neither there a change in the duration of the vowel nor in its quality, but in its perception.

In the collected data few cases of deletion were also noticed. The timing slot of /h/ was not deleted but its features were overridden by that of preceding vowel. In this case the vowel length is quite long but there is no significant effect on its behavior.

Stress also changes vowel quality and duration. In stressed syllables like [fihrist] the vowels are longer as compared to unstressed ones like /buhtan/.

Nasalization also has a small impact on the quality of vowel. It is observed that in the words starting with /m/ the F1 and F2 of vowel was relatively high as compared to others. A detailed discussion of all above-mentioned points is as follows:

5.1 Vowel Mappings

Table 6 shows the detailed behavior of vowels in the analyzed data:

Table 6 Different Mappings of Vowels

Vowel	Mapping		
	Expected	Actual	Perceptual
r̄hna	/ɔ̄/	/æ/	/æ/
b̄hrup	/ɔ̄/	/æ/	/æ/
m̄htab	/ɔ̄/	/æ/	/e/
t̄lhra	/I/	/I/	/e/
m̄hman	/I/	/æ/	/e/
f̄hr̄st	/I/	/æ/	/æ/
z̄uhra	/u/	/o/	/o/
b̄htan	/u/	/o/	/o/
m̄hl̄t	/u/	/ɔ̄/	/o/

[Note: In order to determine the perceptual mapping of vowels we analyzed the opinion of about 17 people and the table represents the opinion of majority.]

Following interesting facts are evident from the above table:

- The actual mappings of short vowels in [m̄htab], [t̄lhra], [m̄hman] and [m̄hl̄t] are different from their perceptual mappings.
- In [m̄hman] and [f̄hr̄st] /I/ maps to /æ/ however in [t̄lhra] /I/ is mapped to /I/.

[t̄lhra] is the most interesting case. Its actual mapping agrees with its expected mapping i.e. /I/ maps to /I/. But most people perceived it as /e/ which is strange and in fact quite hard to explain.

5.2 Vowel Duration

From Figure 3 and Table 3 it is evident that the duration of vowels in unstressed syllables is smaller as compared to stressed ones. Particularly in [m̄hman] the average vowel length is quite less as compared to others; interestingly everybody has the least vowel duration in [m̄hman]. This fact can also be verified by examining the following spectrogram of [b̄htan] where also the vowel is occurring in the unstressed syllable:

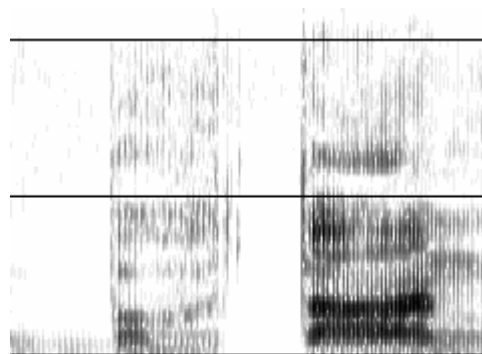


Figure 4 [b̄htan]

Across speaker variations were important in this respect. One of the speakers pronounced /m̄htab/ as /mahtab/ so his reading was neglected.

5.3 Deletion of h

Native speakers of all languages tend to reduce the number of phonemes in the speech. This results in the transformation or deletion of certain sounds. While analyzing the data we found certain cases where /h/ sound was not present in the recording. In these cases the quality of vowel was not affected however its duration was longer. This leads us to the conclusion that the timing slot of /h/ was not deleted but its features were overridden by that of preceding vowel. It may be the case that the featureless of /h/ helps the preceding vowel to overwrite its feature on it (Clark & Yallop, 1992, p.313). Table 7 gives us the statistics about total deletions observed in different words:

Table 7 Total Deletions of /h/

Word	Deletions
r̄hna	1
b̄hrup	1
m̄htab	0
t̄lhra	1
m̄hman	0
f̄hr̄st	4
Z̄uhra	5
B̄htan	0
m̄hl̄t	2

Across speaker variations were also critical at this point. One of the speakers deleted /h/ in z̄uhra 3 out of 5 times. The spectrogram of [z̄uhra] without any deletion is given in Figure 5 below:

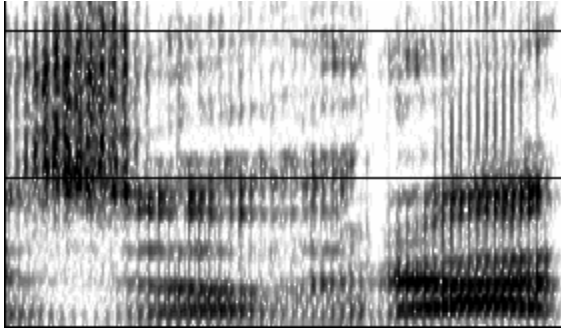


Figure 5 normal [zohra]

And the spectrogram where /h/ is deleted is given in Figure 6.

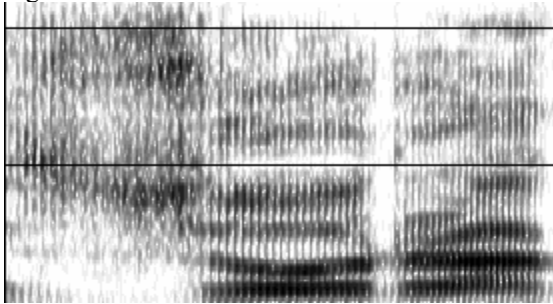


Figure 6 [zohra] without /h/

The spectrogram of [flhrIst] without /h/ sound is given in Figure 7.

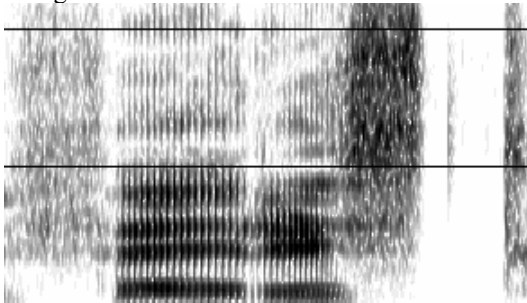


Figure 7 [flhrIst] without /h/

In above spectrograms we can see that the vowel has occupied the time of /h/ but during that time the formants continue which confirms that there was no change in the quality of vowel.

5.4 Special Cases

Couple of words distinctly stood out from the rest. Firstly, unique thing about “[ʃIhra]” is that it is the only “I” word which distinctly & almost accurately mapped on the right place. Also it has pretty low standard deviation across the speakers (specially for F1) and also mapped perfectly to the duration of short stressed vowel.

The other distinct word is “mohlɔt”, in regard that it has a very huge standard deviation in F1 and F2 across speakers, encompassing many other vowels. Then this “fIhrIst” is distinct because it is the only word whose vowel duration is equal to long vowel.

5.5 Retaining of 4 degrees in Urdu vowels

As is common opinion that Urdu follows 4 degree of vowels, before the start of experimentation we expected to find two new levels for especially [rɔhna] and [tʃIhra] like words which are either written with ‘I’ or ‘ɔ’ but sounds a lot different then these vowels. We expected to find a level between ‘æ’ and ‘ɔ’ and ‘æ’ and ‘I’ for these words respectively but if we again look at the Figure 1, we find that these words doesn’t introduce any new level and are at the same level of ‘æ’ and only the front forwardness or backwardness is changed.

6. CONCLUSION

From the results and discussion we can conclude that in Urdu whenever there is a CVh format in a word and /h/ is at the syllable boundary then there is a notable change in the preceding vowel. This change is either present in the quality, duration or perception of the actual vowel. In some cases there is no change in the quality or duration of vowel but in its perception. So, a possible conclusion from these results is that the perception of native speakers is different from the grammar present in their heads, or in other words, there is a non-linear mapping between the grammar present in our lexicon and our perception system.

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