Kiran Khurshid, Salman Ahmad Usman and Nida Javaid Butt

# Possibility of Existence and Identification of Diphthongs and Triphthongs in Urdu Language 


#### Abstract

This paper gives an account of possible diphthongs and triphthongs in Urdu. To identify these diphthongs and triphthongs., first a list of all possible diphthongs and triphthongs is prepared using an Urdu dictionary and then native speakers are asked to syllabify them. Diphthongs identified by them are then verified by analyzing their durations and comparing them with the duration of "pure" vowels. In this way the conclusions given at the end of paper are reached.


Keywords: Diphthong, triphthong, phoneme, syllable, duration

## 1. INTRODUCTION

In phonetics, a diphthong is a vowel combination usually involving a quick but smooth movement from one vowel to another, often interpreted by listeners as a single vowel sound, syllable or phoneme. While "pure" vowels are said to have one target tongue position, diphthongs have a moving tongue.

Pure vowels are represented in phonetic script by one symbol e.g. in English "seem" is represented as [si:m]. On the other hand, diphthongs are represented by two symbols, e.g. in English "house" as [haus], where the two vowel symbols are intended to represent approximately the beginning and ending tongue positions [7].

Duration as a property of sounds or units cannot be separated from the larger context of time and timing in speech production. Vowels are greatly affected in duration by a number of factor, such as the identity of the following consonant, the rate of speaking, the syllable stress, the number of syllables in the word, the position of the vowel in the phrase or sentence, the type of word, and the importance or emphasis assigned to the word by the speaker. Dipthongs follow rules similar to the vowels [6].

## 2. LITERATURE REVIEW

Not much work has been done on diphthongs or triphthongs in Urdu in the past. However, a paper identifying a few diphthongs and their acoustic properties was published by National Language Authority in Akhbar-e-Urdu June 2003 edition [1]. It identified only 13 diphthongs out of a possible list of 22 and declared that there may be more of them as their list was not exhaustive. The aim of this paper is to complete this list.

The majority of the languages of the world do not use diphthongs in their phonological inventory [2]. Generally speaking, if a language distinguishes more than about ten vowels then it may be exploiting diphthongal combinations [3]. As Urdu has 7 long vowels, 4 short vowels and 6
nasalized long vowels (Mannan et. al. 2002), it has chances of exploiting diphthongs.

According to Dr. Mehboob Alam [4] diphthongs in Urdu do not exist phonemically. However, their phonetic existence has not been independently verified, if explored at all.

## 3. METHODOLOGY

### 3.1 Data Collection

A list of words containing possible diphthongs and triphthongs was prepared by scanning the Feroz-ul-lughaat Urdu Dictionary [5]. All words that had 2 or 3 consecutive vowels were considered as possibilities for diphthongs and triphthongs respectively.

### 3.2 Subjects

The subjects of the survey were 20 native speakers of Lahori Urdu. They were given the concept of 'syllable' using examples of a few Urdu words and their syllables. Then they were asked to identify syllables from the list according to these examples using their innate knowledge.

### 3.3 Data Recording and Analysis

The words which contained diphthongs were recorded using 6 native speakers of Urdu, 3 male and 3 female. Also words containing "pure" vowels of Urdu were recorded by the same speakers. This recording and analysis was done in Praat 4.1, a speech processing tool designed for Windows users. Other equipment included high fidelity (Hi-Fi) microphone, a Teac integrated stereo amplifier and two high quality speakers.

### 3.4 Procedure

20 native speakers of Lahori Urdu were interviewed using the identified list of possible words containing diphthongs and triphthongs. They syllabified the words using their innate knowledge and the examples given to them before the interview. Using the results of these interviews we identified the diphthongs. If more than fifty percent of the speakers syllabified a word in such a way that the diphthong was preserved, it was accepted.

The words containing diphthongs or triphthongs, along with the list of words containing pure vowels of Urdu, were then recorded using 6 native speakers of Urdu, 3 males and 3 females. The duration of the diphthongs was used to verify their existence. If the duration of two consecutive vowels came out to be below 350 ms (the maximum duration of a long vowel) it is proved to be a diphthong.

## 4. RESULTS

The result of the survey for diphthongs is shown in Table 1 and that for triphthongs is shown in Table 2. The second column represents the diphthong/triphthong under consideration. The third column gives an example word to show the occurrence of the diphthong/triphthong in Urdu. The fourth column shows the total votes in favor of the diphthong/triphthong existence. Finally, if the votes in favor were $50 \%$ or more of the total votes, the diphthong/triphthong was accepted, as shown in column five.

Out of the list of 37 possible diphthongs, 18 were identified by the native speakers. On the other hand, no triphthongs were identified.

Table 1: Result of Survey of 20 Native Lahori Urdu Speakers for Diphthongs

| Sr \# | Diphthong | Word | Vote count | Result |
| :---: | :---: | :---: | :---: | :---: |
| 1 | iu | kiu~ | 19 | A |
| 2 | ea | gea | 16 | A |
| 3 | $\partial \mathrm{i}$ | k $\partial \mathrm{i}$ | 16 | A |
| 4 | de | gde | 16 | A |
| 5 | aI | daImi | 14 | A |
| 6 | do | do | 14 | A |
| 7 | eo | deo | 14 | A |
| 8 | ui | hui | 14 | A |
| 9 | $\mathrm{au}^{\sim}$ | $\mathrm{au}^{\sim}$ | 13 | A |
| 10 | oe | $\mathrm{k}^{\text {h oe }}$ | 12 | A |
| 11 | au | $t \int^{\text {hauni }}$ | 12 | A |
| 12 | ua | mua $\int$ ra | 12 | A |
| 13 | ue | hue | 12 | A |
| 14 | oi | $k^{\text {h }}$ i | 10 | A |
| 15 | Io | nIota | 10 | A |
| 16 | vว | mvวad3d3 21 | 10 | A |
| 17 | io | d3io | 10 | A |
| 18 | ua | hua | 10 | A |
| 19 | oi ${ }^{\text {r }}$ | roi~ | 8 | R |
| 20 | $\partial \mathrm{I}$ | mutm 2 In | 8 | R |
| 21 | de | $\mathrm{ae}^{\sim}$ | 8 | R |
| 22 | ia | k ia | 8 | R |
| 23 | ed | mumane $\partial \mathrm{t}$ | 8 | R |
| 24 | ui | hui~ | 7 | R |
| 25 | ai | ai | 7 | R |
| 26 | ai | $k^{\text {h }}$ i | 7 | R |
| 27 | oe ${ }^{\sim}$ | roe ${ }^{\sim}$ | 7 | R |
| 28 | $\partial \mathrm{u}$ | Sour | 6 | R |
| 29 | i $\partial$ | zehniot | 5 | R |


| 30 | ia~ | larkia~ | 5 | R |
| :---: | :---: | :---: | :---: | :---: |
| 31 | æi | pæi | 5 | R |
| 32 | ae | $\mathrm{k}^{\mathrm{h}} \mathrm{le}$ | 4 | R |
| 33 | ie | kie | 4 | R |
| 34 | uo ${ }^{\sim}$ | kuo~ | 4 | R |
| 35 | ue ${ }^{\sim}$ | dhue~ | 3 | R |
| 36 | ua~ | dhua~ | 1 | R |
| 37 | vi | muib | 1 | R |
| $\begin{array}{ll} \text { Key: } & \begin{aligned} \text { A } & =\text { Accepted } \\ & R \end{aligned}=\text { Rejected } \end{array}$ |  |  |  |  |

Table 2: Result of Survey of 20 Native Lahori Urdu Speakers for Triphthongs

| Sr \# | Triphthong | Word | Vote count | Result |
| :---: | :---: | :---: | :---: | :---: |
| 1 | Iao | nIao | 2 | R |
| 2 | $\mathrm{aIa}^{\sim}$ | razaia | 0 | R |
| 3 | oie | r oie | 0 | R |
| 4 | aie | aie | 0 | R |
| 5 | uie | $\mathrm{t} \int^{\mathrm{h}}$ uie | 0 | R |
| 6 | uia~ | suia~ | 0 | R |
| 7 | aIa | fIzaia | 0 | R |
| 8 | oia~ | doia~ | 0 | R |
| 9 | oia | poia | 0 | R |
| 10 | vaI | muaIna | 0 | R |
| 11 | Oİ | noIot | 0 | R |
| Key: |  |  |  | Accepted <br> $=$ Rejected |

After identification of these diphthongs, the recordings were made for them. The duration of the diphthong was measured and its average for all speakers was taken (as shown in Appendix 2). These durations came out to be less than 350 ms (the duration of a long vowel) hence verifying these vowels to be diphthongs.

Furthermore, the duration of the pure vowels coming in each diphthong was measured for the same speakers and their average was recorded. The sum of these durations was then compared with the duration of the respective diphthong (see Appendix 3). It was thus verified from this data that the diphthongs identified by the native speakers were in effect lesser than the sum of the duration of separated pure vowels.

## 5. DISCUSSION

From the data collected through the survey, it was noticed that there was a great variation in the total number of diphthongs identified by the speakers (Table 4 in Appendix). For instance, one of the speakers identified as many as 32 diphthongs in a list of 37 , whereas, another identified as low as 7 diphthongs. Hence, this leads to the conclusion that syllabification and perception is more or less speaker dependent.

It is interesting to note that two speakers identified one word as a triphthong whereas none others did (Table 5 in Appendix). Even more interesting is the fact that they identified the same word "nIao" as containing the triphthong "Iao". These speakers failed to identify triphthongs in any other words.

On scanning the dictionary it was discovered that Urdu has very less words containing two consecutive short vowels. Two such words were identified though, out of which only one made it to the final list of diphthongs. Majority of the diphthongs identified contained two long vowels or one long and one short vowel.

It is already a known fact that pure nasalized vowels are rather longer in duration. Out of the 18 diphthongs identified only 2 contained nasalized vowels, which as diphthongs, interestingly, come at the end of words only. Moreover, both of these nasalized vowels are $u^{\sim}$.

Table 3: Comparison between durations of identified diphthongs and the respective pure vowels

| Sr \# | Diph- <br> thong | Average <br> duration <br> of | Average duration <br> of pure vowel (ms) |  | Added <br> duration <br> of pure <br> vowels |
| :---: | :---: | ---: | ---: | ---: | ---: |
| (ms) |  |  |  |  |  |

From the analysis of the duration of the diphthongs it was noticed that the duration is dependent on speaker and on many other factors as already mentioned in section 1. While recording, all these factors were kept in mind.

The duration of diphthongs containing two consecutive long vowels was noticed to be near 350 ms while that of diphthongs containing one short and one long vowel was
observed to be below 300 ms . The duration of diphthongs containing two consecutive short vowels was strikingly as low as 150 ms .

If the duration of two separate long "pure" vowels is added, it exceeds the duration of a long vowel (Table 3). However, if the duration of one long and one short "pure" vowel is added, it is noticed that it sometimes remains within the range of a long vowel, i.e. 200 to 350 ms .

On comparison of the average durations of the diphthongs with that of the sum of average durations of the separate "pure" vowels, it was verified that the diphthongs identified by the native speakers indeed had much lesser durations than the sum of the respective pure vowels (Table $3)$.

## 6. CONCLUSION

From the data collected from our interviews and through the recordings we conclude that Lahori Urdu has 18 diphthongs in total and no triphthongs whatsoever. This list is more or less exhaustive as the whole Urdu dictionary was scanned by the researchers who themselves are native speakers of Lahori Urdu.

It was also concluded that the process of syllabification and hence the identification of diphthongs/triphthongs is speaker dependent. The durations noticed through recordings were also heavily dependent on the speakers.

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## APPENDIX

Table 4: Interview results of 20 native speakers for the identification of diphthongs.

| $\begin{aligned} & \hline \mathrm{Sr} \\ & \# \end{aligned}$ | $\begin{gathered} \text { Dip } \\ \text { h } \end{gathered}$ | Vote s | $\begin{aligned} & \hline \mathrm{S} \\ & 1 \end{aligned}$ | $\begin{aligned} & \hline \mathrm{S} \\ & 2 \end{aligned}$ | $\begin{aligned} & \hline \mathrm{S} \\ & 3 \end{aligned}$ | $\begin{aligned} & \hline \mathrm{S} \\ & 4 \end{aligned}$ | $\begin{aligned} & \hline \mathrm{S} \\ & 5 \end{aligned}$ | $\begin{aligned} & \hline \mathrm{S} \\ & 6 \end{aligned}$ | S 7 | S 8 | $\begin{aligned} & \hline \mathrm{S} \\ & 9 \end{aligned}$ | $\begin{gathered} \hline \mathrm{S} \\ 10 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 11 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 12 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 13 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 14 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 15 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 16 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 17 \end{gathered}$ | $\begin{gathered} \hline \mathrm{S} \\ 18 \end{gathered}$ | S 19 | $\begin{gathered} \hline \mathrm{S} \\ 20 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | iu ${ }^{\sim}$ | 19 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | ea | 16 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 3 | $\partial \mathrm{i}$ | 16 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 4 | $\partial \mathrm{e}$ | 16 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 5 | aI | 14 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 6 | do | 14 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 7 | eo | 14 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 8 | ui | 14 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 9 | $\mathrm{au}^{\sim}$ | 13 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 10 | oe | 12 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 11 | au | 12 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 12 | ua | 12 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 13 | ue | 12 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 14 | oi | 10 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 15 | Io | 10 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 16 | vว | 10 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 17 | io | 10 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 18 | ua | 10 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 19 | oi~ | 8 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 20 | $\partial \mathrm{I}$ | 8 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 21 | $\mathrm{ae}^{\sim}$ | 8 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 22 | ia | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 23 | ed | 8 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 24 | vi~ | 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 25 | ai~ | 7 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 26 | ai | 7 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 27 | oe ${ }^{\sim}$ | 7 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 28 | $\partial \mathrm{u}$ | 6 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 29 | iə | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 30 | ia | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 31 | æi | 5 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 32 | ae | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 33 | ie | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 34 | uo~ | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 35 | $u^{\sim}$ | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 36 | ua~ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 37 | vi | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total |  |  | 24 | 11 | 27 | 14 | 17 | 19 | 15 | 17 | 15 | 19 | 14 | 7 | 10 | 17 | 31 | 9 | 15 | 19 | 8 | 32 |

Table 5: Interview results of 20 native speakers for the identification of diphthongs.

| Sr\# | Diph | Votes | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |  |
| 1 | Iao | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 2 | aIa $^{\sim}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | oie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | aie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | uie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | uia~ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | aIa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | oia~ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | oia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | UaI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | 〇I 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |

$S=$ Native Speakers of Lahori Urdu
$0=$ speaker did not identify it as a diphthong
$1=$ speaker identified it as a diphthong

Table 6: Duration of Diphthongs of 6 Native Speakers (3 male and 3 female)

| Serial \# | Diphthong | Duration of Native Speakers (ms) |  |  |  |  |  | Average duration (ms) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Salman | Nida | Ahmed | Mariam | Asad | Kiran |  |
| 1 | oi | 307.916 | 322.251 | 277.746 | 259.413 | 428.142 | 293.345 | 314.8022 |
| 2 | oe | 313.109 | 309.603 | 243.063 | 308.416 | 447.882 | 328.934 | 325.1678 |
| 3 | Io | 197.303 | 193.341 | 159.431 | 166.272 | 174.925 | 167.886 | 176.5263 |
| 4 | $\partial \mathrm{i}$ | 284.416 | 271.049 | 238.389 | 239.718 | 377.076 | 287.896 | 283.0907 |
| 5 | $\partial \mathrm{e}$ | 345.079 | 266.029 | 268.678 | 255.901 | 367.75 | 286.961 | 298.3997 |
| 6 | va | 224.075 | 184.507 | 157.711 | 174.338 | 168.571 | 162.054 | 178.5427 |
| 7 | $v \partial$ | 175.311 | 162.552 | 160.145 | 141.491 | 123.305 | 139.865 | 150.4448 |
| 8 | aI | 310.61 | 197.556 | 203.242 | 206.585 | 188.308 | 190.157 | 216.0763 |
| 9 | do | 399.621 | 341.183 | 328.715 | 331.642 | 386.212 | 304.304 | 348.6128 |
| 10 | $\mathrm{au}^{\sim}$ | 365.455 | 336.881 | 345.928 | 349.883 | 352.982 | 348.616 | 349.9575 |
| 11 | au | 196.943 | 168.693 | 155.996 | 173.33 | 161.063 | 206.957 | 177.1637 |
| 12 | iu ${ }^{\sim}$ | 305.601 | 300.27 | 287.261 | 281.812 | 426.565 | 277.002 | 313.0852 |
| 13 | io | 352.703 | 325.426 | 239.529 | 309.363 | 391.861 | 314.306 | 322.198 |
| 14 | ea | 291.468 | 265.305 | 285.872 | 307.767 | 347.91 | 295.361 | 298.9472 |
| 15 | eo | 304.085 | 274.801 | 329.817 | 303.059 | 345.092 | 320.641 | 312.9158 |
| 16 | ua | 280.908 | 232.165 | 314.361 | 273.76 | 373.402 | 324.575 | 299.8618 |
| 17 | ui | 314.009 | 294.259 | 316.688 | 308.606 | 405.384 | 336.57 | 329.2527 |
| 18 | ue | 319.268 | 368.196 | 367.159 | 309.893 | 397.698 | 338.428 | 350.107 |

Table 7: Duration of Pure Vowels of 6 Native Speakers (3 male and 3 female)

| Serial \# | Pure vowel | Duration of Native Speakers (ms) |  |  |  |  |  | Average duration (ms) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Salman | Nida | Ahmed | Mariam | Asad | Kiran |  |
| 1 | a | 204.057 | 245.569 | 278.584 | 205.415 | 284.901 | 208.661 | 237.8645 |
| 2 | $\bigcirc$ | 201.703 | 220.56 | 260.975 | 204.75 | 272.008 | 246.266 | 234.377 |
| 3 | $\bigcirc$ | 218.935 | 209.631 | 272.101 | 209.035 | 277.285 | 198.263 | 230.875 |
| 4 | e | 217.099 | 226.212 | 284.975 | 221.37 | 274.663 | 194.917 | 236.5393 |
| 5 | i | 241.535 | 227.739 | 219.774 | 174.614 | 304.492 | 228.14 | 232.7157 |
| 6 | æ | 231.647 | 256.91 | 257.275 | 221.591 | 245.476 | 211.29 | 237.3648 |
| 7 | u | 233.06 | 220.959 | 207.647 | 131.182 | 274.599 | 216.707 | 214.0257 |
| 8 | $\partial$ | 131.079 | 86.53 | 106.025 | 114.009 | 118.182 | 83.894 | 106.6198 |
| 9 | I | 83.449 | 91.783 | 90.7 | 74.455 | 99.854 | 136.358 | 96.09983 |
| 10 | U | 103.582 | 87.56 | 87.212 | 95.986 | 83.802 | 129.427 | 97.92817 |
| 11 | i | 320.069 | 281.564 | 331.197 | 283.563 | 408.771 | 306.737 | 321.9835 |
| 12 | $æ^{\sim}$ | 349.166 | 308.622 | 427.172 | 306.646 | 462.3 | 340.4478 | 365.7256 |
| 13 | $\mathrm{a}^{\sim}$ | 331.934 | 339.731 | 411.806 | 337.373 | 548.883 | 326.177 | 382.6507 |
| 14 | $\mathrm{u}^{\sim}$ | 321.952 | 339.731 | 400.011 | 317.688 | 494.184 | 310.76 | 364.0543 |
| 15 | O | 330.521 | 337.053 | 403.541 | 351.666 | 533.62 | 330.399 | 381.1333 |
| 16 | $\mathrm{e}^{\sim}$ | 269.549 | 326.786 | 287.093 | 258.819 | 324.463 | 264.789 | 288.5832 |

