CHAPTER V
ACOUSTIC BASE OF
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As we have noted in the Introduction, acoustic medium is one of the five orienting principles for phonological analysis in the theoretical framework of the Columbia school of linguistics. Whereas the phonological units of Deccani Urdu, as of any other language or dialect, are established as the elemental units in terms of communication, the substantive characteristics of these units are determined by physiology and acoustics. In fact, the make-up of the phonological paradigm, the network of phonological units, as presented in Diagram I-1, is partly based on the physiologico-acoustic (substantive) characteristics of these units. Further, as we have noted many a time in this thesis, the physiologico-acoustic characteristics of the phonological units also determine the combinatory pattern of these units in the formation of the syllable and the word. It must however be noted that we have mainly dealt with the physiological characteristics of the phonological units in support of our analysis in this work. This limitation is primarily due to the fact that any experimental, acoustic research is beyond the scope of the present research.
At the same time, we feel it imperative that we deal with certain aspects of standard acoustic research that have a direct bearing on the phonology of Deccani Urdu. In this chapter, therefore, we try to gauge the impact of these select acoustic aspects on the make-up and distribution of phonological units in Deccani Urdu.

The impact of acoustic medium is presented in five sections in this chapter. In section A, we deal with the acoustic base of the clearly audible versus the less clearly audible distinction of apertures. In section B, we describe the formation of two resonant cavities within the supraglottal cavity, and examine the role of the two cavities in the production of vowels. In section C, we provide the acoustic rationale for the lip rounding of the back dorsal vowels. In section D, we deal with the acoustic justification for the four-way classification of stops and the impact of this classification on the frequency of usage of these stops in the monosyllabic words in Deccani Urdu. The chapter ends with the summary and conclusions in section E.

Section A: Clearly Audible versus Less Clearly Audible Apertures

It is well-known that the speech sounds are produced through the control of the musculature of the vocal tract. The basic requirement is that the sounds produced be sufficiently
audible, if the communication is to be transmitted from one person to another.

In terms of acoustic medium, the sound waves of speech may be divided into two categories--the clearly audible and the less clearly audible. The clearly audible speech sounds are produced, when three conditions obtain: (1) The supraglottal articulators can only shape the two vocal cavities, the back and the front. The back cavity, lying behind the medium-dorsum mass, is to be shaped by only the medium or dorsum as articulator. The front cavity, in front of the medium-dorsum mass, is to be shaped by both the medium or dorsum and the labia, as articulators. (2) The excitation for the two resonant cavities be provided by the glottis with the vibration of its vocal folds. (3) Irrespective of the variations in the size and opening of the two resonant cavities that are required by the wide range of these sounds, there should be no impediment in the flow of air coming from the lungs through the vocal tract. These three conditions for the production of the clearly audible speech sounds are realized only to apertures 4 and above. The speech sounds produced at the clearly audible apertures are traditionally known as “vowels”.

The less clearly audible speech sounds, on the other hand, are produced by impeding to a greater or lesser degree the air passing through the vocal cavity by means of the supraglottal articulators. This impediment of the air flow
occurs at apertures $\varnothing$, 1, 2, and 3, with the highest degree at aperture $\varnothing$ and the lowest at aperture 3. Therefore, all the speech sounds produced at apertures zero through 3 ("stops", "fricatives", "liquids", etc.) are less clearly audible. The speech sounds produced at the less clearly audible apertures are traditionally known as "consonants".

The classification of the speech sounds in terms of audibility, has a profound impact on the syntagmatic use of these sounds, as the clearly audible and the less clearly audible phonological units of a language, in the formation of lexical morphemes. For the clearly audible units (the "vowels") of a language regularly form what Professor Diver calls the keystone in the arch of the structure of the morpheme. The less clearly audible units (the "consonants") are placed in flanking position, before and after the keystone, in the formation of the morpheme. The clearly audible and the less clearly audible units are thus termed the keystone and the flanking members in the formation of morphemes and words.

On the basis of the clearly audible versus less clearly audible distinction, we may classify the 60 phonological units of Deccani Urdu into 20 vocalic units and 40 consonantal units. Indeed, it is this classification that is reflected in the organization of the phonological units, as seen in the phonological grid in Diagram 1-1.
A profound impact of the classification of the phonological units in terms of audibility can also be seen in how these units are organized in the formation of the syllable. It is noteworthy that only a single keystone, that is, only one vocalic unit, can appear in each syllable. In Deccani Urdu, this vocalic unit may stand alone to form a syllable, or it may be flanked by one or two consonantal units on either side of the vocalic unit. We therefore have a theoretical basis to divide the lexical units into the monosyllabic, the bisyllabic, or the longer words in Deccani Urdu. It may be pointed out that other languages may have differing organization of the syllable in terms of the number of syllables for the lexicon, and the make-up of each syllable with respect to the number of flanking members on each side of the keystone. And as we have demonstrated throughout this thesis, the frequency of occurrence for both the consonantal and the vocalic units in the monosyllabic (and longer) words, can be used to provide indirect, quantitative support to the validation of phonological analysis.

**Section B: Formation of Two Resonant Cavities in the Production of Vowels**

As we have discussed in medium-dorsum mass (Chapter I, section D), the production of clearly audible speech sounds (the "vowels") involves the formation of supraglottal resonant cavity in the oral chamber. This supraglottal resonant cavity
extends from the glottis to the lips. The medium-dorsum mass are used as articulators to determine the shape and size of the cavity. The medium-dorsum divides the cavity into two, the back and the front, each with its own resonant frequency. The position of the medium-dorsum determines both the size of the two cavities and the size of the opening of back cavity; the positioning of the lips determines the size of the opening of the front cavity. The resonant frequency of each cavity is of course determined by its own cavity size and size of the opening. Thus, the resonant frequency of back cavity (F1) is determined by the cavity size and size of the opening of back cavity. Likewise, the resonant frequency of the front cavity (F2) is determined by the cavity size and size of the opening of front cavity. Furthermore, each vowel is characterized by a differing combination of the two resonant frequencies, F1 and F2. The basic inventory of distinct units is developed by varying these two frequencies and combining the variants in different ways. The excitation of the cavities continues to be provided by vibration of the vocal folds. These procedures are of course entirely consistent with the principles of acoustics as well as with the greater precision of control over the musculature.

Finally, it may be noted that the resonant cavity amplifies the acoustic distinction of vocalic units of speech. In the production of medial ("front") vowels, for example, a large
resonance cavity is formed at the back of the oral chamber, extending from the glottis to the medium. And notwithstanding the angle of the jaws, there is a sufficient vertical space for maneuver for the medium as an articulator in this triangular cavity.

This large resonant cavity is sufficient enough for the easy production and clear perception of the medial (the "front") vowels. On the contrary, a much smaller back cavity, from the glottis to the back dorsum, is formed in the production of the back dorsal (the "back") vowels. It is to be noted that the width (the vertical space) of this triangular cavity is greatly reduced because of the angle of the jaws. As a result, the "back" vowels produced by the back dorsum as an articulator, require greater precision of control in their production and an extra effort in their perception. This problem is solved by the formation of another resonance cavity in the front of the oral chamber from the back dorsum to the lips, through the rounding of the labia. For the vocalic distinctions made at the back dorsum are amplified through this front cavity. That is why it is quite natural to have back rounded vowels as opposed to front unrounded vowels in Deccani Urdu as in many other languages or dialects.
Section C: Acoustic Rationale for the Lip Rounding of Back Dorsal Vowels

As discussed above in section B, there is a definite physiologico-acoustic rationale for the use of labium as an additional articulator, through lip rounding in the production of back dorsal vowels. For a much smaller back cavity is formed in the production of back dorsal vowels due to the vertex of the angle of the jaws at the back of the oral cavity. As a result, the production of back dorsal vowels require an extra effort on the part of the speaker to maintain distinction. The impact of the angle of the jaws is neutralized by the utilization of the labia as an additional articulator for producing labio-dorsal ("back rounded") vowels. The vowels thus produced are characterized with acoustic distinctness. That is why it becomes acoustically natural for the "back rounded" vowels to have parity with the "front unrounded" vowels.

It is noteworthy that the equal number of units for medial and back dorsal vowels in the phonological paradigm of Deccani Urdu, and their competitive utilization in the syntagmatic organization of the word, clearly indicate that the asymmetry of the vocal tract affecting the back vowels is more than compensated by the interaction of labium in the production and perception of these labio-dorsal vowels.
Finally, it may be noted that the acoustic rationale for the lip rounding of back dorsal vowels provided above can also be explained with the help of formant frequencies, obtained through spectrographic analysis. The vocalic speech sounds can be acoustically analyzed and properly identified in terms of the formant frequencies (F1, F2, F3, etc.), as observed in the sound spectrograms. It should be noted that the first two formants, F1 and F2, are closely tied to the shape of the vocal tract (the volume and size of the opening of resonant cavity), as the lips and the medium-dorsum move to articulate vocalic units of speech. We, therefore, concentrate only on these two formant frequencies here.

Inasmuch as the vocalic system of Deccani Urdu ideally matches with that of Mewati Urdu⁹ we are reasonably sure that the formant frequencies of the respective vowels for both the dialects is same. We present the formant frequencies (F1 and F2) of long and short vowels separately in Table V-1, and Table V-2 below.

<table>
<thead>
<tr>
<th>Vocalic Units</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>i:</td>
<td>250</td>
<td>1900</td>
</tr>
<tr>
<td>e:</td>
<td>300</td>
<td>1850</td>
</tr>
<tr>
<td>e:</td>
<td>600</td>
<td>1500</td>
</tr>
<tr>
<td>a:</td>
<td>700</td>
<td>1100</td>
</tr>
<tr>
<td>o:</td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td>u:</td>
<td>250</td>
<td>800</td>
</tr>
</tbody>
</table>

⁹We have taken figures for formant frequencies from Dr. A. R. Fatihi’s work on Mewati Urdu phonology (1987).
Table V-1: Formant Frequencies of Long Vowels

Comments on Table V-1

Comment 1: As seen in the first formant (F1) frequencies, in the table above, it is difficult to distinguish "front" vowels from "back" vowels. For example, in case of vowel i: and u:, the first formant (F1) frequency is same (250 Hz.). Thus, the acoustic cues for F1 are not of much help in distinguishing the "front" vowel (i:) from "back" vowel (u:).

It may also be observed that F1 for the back vowels ð: and o: is same (400 Hz.). Here again the cues of F1 do not help in distinguishing these long "back" vowels.

Comment 2: As seen in the second formant (F2) frequencies of the long vowels in the table above, there is a gradual decrease in the F2 frequencies from i: to u:. That is, it is easier to distinguish "front" vowels from the opposing "back" vowels in terms of the acoustic cues of second formant (F2) frequencies. This acoustic distinction is obtained by bringing down F2 frequencies of the back dorsal vowels. This is done by expanding the front cavity through the rounding of the lips in the production of back dorsal vowels. As a result, lip rounding becomes an essential device for making acoustic distinction within the back dorsal vowels, as well as between the medial and the back dorsal vowels.
Table V-2: Formant Frequencies of Short Vowels

Comment on Table V-2

Comment 1: As seen in the first formant (F1) frequencies of the short vowels in the table above, a slight variation in the frequencies of F1 makes it difficult to distinguish medial vowel I (200 Hz.) from back dorsal vowel U (260 Hz.). Thus, the F1 cues are not of much significance in distinguishing “front” vowels from “back” vowels.

Comment 2: As seen in the second formant (F2) frequencies of the short vowels in the table above, there is a sharp difference between the second formant frequencies of the “front” and the “back” vowels. Thus, it is easier to distinguish the “front” vowels from the opposing back vowels in terms of F2 frequencies.

It may also be noted that the acoustic distinction between the vowel u: and U can also be made only in terms of second formant frequencies. This difference in the F2 is again attributed to the lip rounding in the production of back dorsal vowels. That is why rounding of the “back” vowels and the converse unroundedness of the “front” vowels is so naturally widespread in the languages of the world.

<table>
<thead>
<tr>
<th>Vocalic units</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>200</td>
<td>1800</td>
</tr>
<tr>
<td>A</td>
<td>300</td>
<td>950</td>
</tr>
<tr>
<td>U</td>
<td>260</td>
<td>600</td>
</tr>
</tbody>
</table>
Section D: The Four-way Classification of Stops

The 20 stops of Deccani Urdu are traditionally classified into four types:

Voiceless unaspirated: \( p \ t \ T \ c \ k \)
Voiceless aspirated: \( p^h \ t^h \ T^h \ c^h \ k^h \)
Voiced unaspirated: \( b \ d \ D \ j \ g \)
Voiced aspirated: \( b^h \ d^h \ D^h \ j^h \ g^h \)

This traditional four-way classification of stops is justified in view of the distinctiveness of the four classes that are established by communicative contrast. However, we do not follow the simple combinatory relation of voicing, voicelessness, aspiration, and absence of aspiration that is implicit in the traditional terminology. Particularly, the "voiced aspirated stops" are not formed by adding aspiration to the "voiced unaspirated stops".

It may be noted that two Haskins scholars, namely, Leigh Lisker and Arthur S. Abramson, have done pioneering acoustic research on the stop categories in various languages. They have successfully demonstrated that a three-way distinction of stops—the voiced unaspirated, the voiceless unaspirated, and the voiceless aspirated—is possible through the single acoustic variable of voice onset time (VOT) continuum. They have shown through their meticulous measurements that the voicing starts immediately after the release of the voiceless unaspirated stops.
In contradistinction, the voiced unaspirated stops are marked by the voicing lead before their release, whereas the voiceless aspirated stops are characterized by the voicing lag after their release. At the same time, the two researchers have acknowledged that the characteristics of the voiced aspirated stops, which are found in the four-way classification of stops in some Indo-Aryan languages, cannot be accounted for by the voice onset continuum alone.

However, it may not be in conformity with our phonological principles to analyze the four-way distinction of stops, as encountered in Deccani Urdu, in terms of the voice onset time. As noted above, the characteristics of the voiced aspirates cannot be accounted for by the voice onset continuum alone. Further, it is noteworthy that there are quite a few other physiologico-acoustic (substantive) characteristics of the four stop types that must be taken into account for a fuller analysis of these stop types. For, as we have emphasized many a time in the present research, both substance and value are equally important for the phonological analysis in the theoretical framework of the Columbia school of linguistics.

As shown in the phonological grid (Diagram I-1), all four types of stops are alike in having \( \emptyset \) aperture for the supraglottal articulators. The combination of these articulators with \( \emptyset \) degree of aperture, shapes the vocal cavity for the
production of all four types of stops in Deccani Urdu. All these stops also share the excitation of the vocal cavity by explosion that is produced by release of the blockage formed in the oral cavity by the supraglottal articulators. At the same time, the four types are differentiated from each other by the differing uses of the glottal articulator.

The voiceless unaspirated stops (p t k etc.) are the simplest phonological units in that they are produced by the shaping and excitation of the vocal cavity by the supraglottal articulators alone; the glottal articulator is not involved in the production of these stops.

The other three types are characterized by additional excitation of the vocal cavity by the glottal articulator. The voiced unaspirated stops (b d g etc.) include excitation of the vocal cavity by the glottal articulator at aperture 1. The voiceless aspirated stops (pʰ tʰ kʰ etc.) include excitation of the vocal cavity by the glottal articulator at aperture 2. The voiced aspirated stops (bʰ dʰ gʰ etc.) include excitation of the vocal cavity by the glottal articulator at aperture 1¼.

As it should be clear from our discussion above that whereas the voiced unaspirated, the voiceless aspirated, and the voiced aspirated stops are alike in having an extra articulator, the glottis, the three stop types are to be differentiated from one another in terms of the glottal
configurations assumed at aperture 1, 2, and 1½ respectively. (For further details, cf. Chapter I, Diagram I-1, comment 10.)

As noted above, the voiceless unaspirated stops (p t k etc.) are the simplest of the four types, in that they are produced by the supraglottal articulators alone. In view of the common human trait of favoring the simpler task over the more complex, we expect that the voiceless unaspirated stops will be preferred over the other three types of stops.

Whereas the other three types of stops are equally complex in terms of the number of articulators, they are differentiated from one another in the dynamics of their glottal articulation. Of these three, the voiced unaspirated stops (b d g etc.) are naturally produced in combination with the glottal articulator at aperture 1. It is noteworthy that this glottal articulation of \( V(oice) \) is also utilized by human beings for non-linguistic expression. Inasmuch as they are the least complex among the three stop types, the voiced unaspirated stops will be preferred over the other two types of stops in terms of human behavior.

The voiceless aspirated stops (\( p^h \ t^h \ k^h \) etc.) are also naturally produced in combination with the glottal articulator at aperture 2. For this glottal articulation, which generates voiceless A(spiration), is also produced by human beings in hard breathing. But as this hard breathing requires a rush of air from the lungs, this extra effort in the production of the
voiceless aspirated stops makes them less favored than the voiced unaspirated stops.

Of the three complex types of stops, the voiced aspirated stops \( b^h, d^h, g^h \) etc., are extraordinarily complex, for they are produced in combination with a difficult glottal articulation, the voiced \( h \). It is noteworthy that the production of the voiced \( h \) requires an unnatural configuration of the glottis at aperture \( 1\frac{1}{2} \), as this glottal articulation is not used by human beings for any non-linguistic expression. In view of the extraordinary complexity in their articulation, the voiced aspirated stops are the least favored among all four types of stops in Deccani Urdu.

On the basis of our discussion above, we may construct the scale of preference for the placement of the four types of stops in Deccani Urdu. This scale is presented in Diagram V-1.

Diagram V-1: Scale of Preference for the Four Types of Stops

\[
\begin{array}{c}
\text{Preference for Stop Types} \\
\text{Most Favored} \\
\text{voiceless unaspirated} \\
\text{More Favored} \\
\text{voiced unaspirated} \\
\text{Less Favored} \\
\text{voiceless aspirated} \\
\text{Least Favored} \\
\text{voiced aspirated}
\end{array}
\]
With a view to assessing the impact of the scale of preference, as diagrammed above, we now present the actual distribution of the four types of stops in the number of units and the frequency of their usage in the monosyllabic words in Deccani Urdu.

<table>
<thead>
<tr>
<th>Stop Types</th>
<th>Units</th>
<th>Frequency of usage</th>
<th>Stop Types</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Voiceless Unaspirated p t T C k</td>
<td>5</td>
<td>868 46.59</td>
<td>1503 80.68</td>
</tr>
<tr>
<td>Voiced Unaspirated b d D j g</td>
<td>5</td>
<td>635 34.08</td>
<td></td>
</tr>
<tr>
<td>Voiceless Aspirated pʰ tʰ Tʰ cʰ kʰ</td>
<td>5</td>
<td>208 11.17</td>
<td>360 19.32</td>
</tr>
<tr>
<td>Voiced Aspirated bʰ dʰ Dʰ jʰ gʰ</td>
<td>5</td>
<td>152 8.16</td>
<td>1863 100</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>1863 100</td>
<td>1863 100</td>
</tr>
</tbody>
</table>

Table V-3: Favoring and Disfavoring in the Four-way Distribution of Stops in the Monosyllabic Words

Comment on Table V-3

Comment 1: As seen in the table above, the 20 stop units of Deccani Urdu are equally distributed among the four stop types. That is, we have 5 voiceless unaspirated stops, 5 voiced unaspirated stops, 5 voiceless aspirated stops, and 5 voiced aspirated stops. This parity in the number of units for
the four stop types is against our expectations in terms of the scale of preference as presented in Diagram V-1. The symmetrical distribution of the units in a particular phonological paradigm should not surprise us. For in the case of the number of units, the physiologico-acoustic and human traits are often sidelined by the powerful impact of communication. As we have explained in Chapter III, the communicative principle dictates that, as far as possible, all intersections of the phonological paradigm be filled by phonological units. Alternatively, an axis of the paradigm may be totally eliminated, if it is filled by just one phonological unit.

For example, in both classical Urdu and modern standard Urdu, there is only one asymmetry in the number of units. The simplest stop type, namely, the voiceless unaspirated, has 6 units (p t T c k q), whereas the other types have 5 units each. This is clearly a response to the scale of preference, as presented in Diagram V-1. But as q was the only phonological unit at the axis of the post dorsal articulator, in the early stages of Urdu, this unit has been lost and merged with the front dorsal x in Deccani Urdu, bringing about the elimination of the post dorsal axis.

Comment 2: Whereas communication may have a more powerful impact than the other orienting principles on the paradigmatic make-up of phonological units, the impact of
physiology, acoustics, and human behavior can clearly be seen in the selective, asymmetrical utilization of these units in the formation of the syllable and the word. Thus, when we look at the frequency of occurrence of the four stop types among the monosyllabic words of Deccani Urdu, as shown in Table V-3, we find the skewings in the figures to be fully in conformity with our expectation. From the top down, in order of increasing complexity, the numbers are 868, 635, 208, 152. In fact, the most favored type alone (868) compares well in its frequency with the other three types combined (995).

Comment 3: Moving now to the right hand side of the table and reading to the left, it is noteworthy that there is a very strong favoring of the unaspirated over the aspirated stops. For the unaspirated stops (1503) outnumber by over 4 to 1 the aspirated stops (360) in their syntagmatic occurrences.

Comment 4: Among the aspirated stops alone, it may also be noted that the naturally produced voiceless aspirated stops occur more frequently (208) than the unnaturally produced voiced aspirated stops (152), despite the fact that the former are a relatively recent creation in the history of the Indo-Aryan languages.

Section E: Summary and Conclusions

In this chapter an attempt has been made to gauge the impact of some select acoustic aspects that have a bearing on
the make-up and distribution of phonological units in Deccani Urdu.

In section A, we have dealt with the acoustic base of the clearly audible versus the less clearly audible distinction of apertures. It is noted that the clearly audible sounds are produced, when three conditions obtain: (1) The supraglottal articulators can only shape the cavity. The medium-dorsum mass and the labia determine the volume of the cavity and size of the opening of the cavity. (2) The excitation for the two resonant cavities be provided by the glottis with the vibration of its vocal folds. (3) There should be no impediment in the flow of air coming from the lungs. These three conditions can be realized only at aperture 4 and above. The sounds produced at these apertures are traditionally known as "vowels".

The less clearly speech sounds, on the other hand are produced by impeding the air flow at apertures 0, 1, 2, and 3, through the supraglottal articulators. The speech sounds produced at these apertures ("stops", "fricatives", "liquids", etc.) are traditionally known as consonants.

On the basis of the clearly audible versus less clearly audible distinction, we have classified the 60 phonological units of Deccani Urdu into 20 vocalic and 40 consonantal units. This classification is reflected in the organization of the
phonological units, as seen in the phonological grid of Deccani Urdu.

The profound impact of the classification of the phonological units in terms of audibility has also been dealt here. On the basis of audibility, we have examined the combinatorial pattern of phonological units in the formation of the syllable. Thus, a theoretical basis has been provided to divide the lexical units into the monosyllabic, the bisyllabic, or the longer words, in Deccani Urdu, on the basis of the combination of keystone and flanking units.

In section B, we have described the formation of two resonant cavities within the supraglottal cavity, and examined the role that these two cavities play in the production of vocalic units of speech. The volume and the size of the opening of the front and back cavity directly affects the acoustic distinction in the production as well as perception of these units. We have also discussed here that in the production of medial vowels, a large resonance cavity is formed at the back, extending from glottis to the medium. This large cavity is more than adequate for the easy production and clear perception of the medial vowels. On the contrary, a much smaller back cavity, from the glottis to the back dorsum, is formed in the production of back dorsal vowels. This rather small back cavity does not have sufficient vertical space to amplify the acoustic distinction between back vowels. As a
result, another resonant cavity is formed in the front, extending from back dorsum to the lips, through the rounding of the labia, to solve this problem.

In section C, we have provided the acoustic rationale for the rounding of the lips in the production of back dorsal vowels. It has been discussed that the formant frequencies, obtained through spectrographic analysis, also help in distinguishing different vocalic units. For the first two formants, F1 and F2, are closely tied to the shape of the vocal tract. We have amply demonstrated that the lip rounding is essentially required to bring down the second formant F2 of the back dorsal vowels to fulfill the acoustic need for an amplified audible distinction between the “front” and the “back”, as well as within the “back” vowels.

In section D, we have dealt with the acoustic justification for the four-way classification of stops and the impact of this classification on the frequency of usage of these stops in the monosyllabic words in Deccani Urdu. As a yardstick, we have set up the scale of preference for the four-stop types, and we predicted that the voiceless unaspirated stops should be most favored, the voiced unaspirated stops more favored, the voiceless aspirated stops less favored, and the voiced aspirated stops least favored. The fuller utilization of the opposing stops by forming 5 units each in the phonological paradigm is motivated by the communicative need for a
greater number of distinctive units. However, the marked skewings in the frequency of usage for the four stop types in the syntagmatic organization of the word, conforms to our expectations in terms of the degrees of preference based on the physiologico-acoustic and human behavior constraints in the production of these stops.

To conclude:

(1) The 60 phonological units of Deccani Urdu are classified into 20 vocalic and 40 consonantal units on the basis of clearly audible versus less clearly audible distinction.

(2) The combinatory pattern of phonological units is examined in terms of audibility (keystones and flanking units) to provide a theoretical basis to divide the lexical units, into the monosyllabic, the bisyllabic, or the longer words in Deccani Urdu.

(3) The supraglottal resonant cavity, which extends from the glottis to the lips, is divided by medium-dorsum mass into two cavities, the front and the back, each with its own resonant frequency. Each vowels is characterized by a differing combination of the two resonant frequencies, F1 and F2.

(4) In the production of medial vowels, a large resonance cavity is formed at the back, extending from the glottis to the medium, which is sufficient enough to provide acoustic distinction to the medial vowels. On the contrary, a
much smaller back cavity, from the glottis to the back dorsum, is formed which has less vertical space to provide acoustic distinction to the back dorsal vowels. This problem is solved by forming another extended front cavity, from the back dorsum to the lips, through lip rounding.

(5) The impact of the angle of the jaws is more than compensated by the rounding of the lips in the production of back dorsal vowels.

(6) The four-way classification of stops in Deccani Urdu is mainly based on the communicative principle of contrast. However, the four-way distinction of these stops is primarily established in terms of acoustic principle. For only with the full understanding of the glottal dynamics, can we distinguish the four stop types from one another.

(7) In terms of the scale of preference for the four stop types, we predict that the voiceless unaspirated stops should be most favored, the voiced unaspirated stops more favored, the voiceless aspirated stops less favored, and the voiced aspirated stops least favored.

(8) The fuller utilization of the four-way opposition of stops by forming 5 units each, in the phonological paradigm of Deccani Urdu caters to the communicative need for a greater number of distinctive units.

(9) The marked skewings in the frequency of usage for the four stop types in the syntagmatic organization of the
word, responds to the degrees of preference based on the physiologico-acoustic and human behavior constraints in the production of these stops.