CHAPTER I

PHYSIOLOGICAL BASE OF THE DECCANI URDU PHONOLOGY
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In this chapter, we provide an explanation in terms of physiological mechanism as an orienting principle, for the paradigmatic make-up and the syntagmatic distribution of the phonological units (the "phonemes") in Deccani Urdu, as spoken in the old city of Hyderabad. As outlined in the theoretical background in the Introduction, the articulators and the apertures are the basic physiological parameters for the classification of phonological units of a language or a dialect. All phonological units, both consonantal and vocalic, are projected on the relevant intersections of the articulators and the apertures to form the network of these units, which is formally termed the phonological grid ("phonemic inventory"). It is noteworthy that the organization of the phonological units in the grid is not uniform; we find that there are clear skewings in the formation of the phonological paradigm in Deccani Urdu. We also find that the phonological units do not combine arbitrarily to form morphones and words; there are clear skewings of phonological units in the syntagmatic make-up of the word in Deccani Urdu. All these paradigmatic and combinatorial asymmetries of the phonological units of Deccani
Urdu are here explained in terms of physiological mechanism as an orienting principle.

An important theoretical difference between Columbia school phonology and American descriptive phonemics should be made clear here. In traditional phonemics, the physiological classification of speech sounds is treated as a non-linguistic level under articulatory phonetics. But in the present analysis, physiological mechanism is a problem solving device (an orienting principle) that provides a motivated rationale for the particular substantive make-up of the phonological units and the interrelationships of these units in the organization of the phonological grid and in the formation of morphemes and words, in Deccani Urdu, as in any other language.

The present chapter has four sections. In section A, we present and justify the paradigmatic make-up of the phonological units--the phonological grid--of Deccani Urdu. In section B, we evaluate the impact of the hierarchy of adroitness of articulators on the paradigmatic make-up and the syntagmatic distribution of consonantal units. In section C, we discuss the physiological motivation of the medium-dorsum mass as the articulator for vowels. In section D, we present the summary with concluding remarks on the physiological base of Deccani Urdu.
Section A: The Phonological Grid of Deccani Urdu

It may be noted that the phonological grid (paradigmatic make-up of the phonological units) of Deccani Urdu, as that of any other language, is motivated by four orienting principles, namely, physiological mechanism, communication, human behavior and acoustic medium. But of these four principles, only two, namely, physiology and communication, play a major role in the formation of the phonological grid. Whereas it is through communication that we establish the phonological units ("phonemes") of a language or a dialect by contrast through minimal and subminimal pairs, these units are appropriately placed on the intersections of the relevant axes of the articulators and apertures on the basis of their substantive characteristics in terms of physiological mechanism. Thus, by way of our principle of communication, we establish the "phonemic inventory" of Deccani Urdu, comprising 56 "phonemes". It may be noted that the number of phonological units established for Deccani Urdu is actually 60, comprising 56 "phonemes" and 4 "positional variants". (For details, cf. Diagram I-1, comments below and Chapter III, section A.) However, it is the projection of all the 60 phonological units on the phonological paradigm of Deccani Urdu as motivated by the physiology of the vocal tract, that is dealt with here.
Diagram I-1: The Phonological Grid of the Deccani Urdu of Hyderabad
Of the 60 phonological units established for Deccani Urdu, 40 are consonantal and 20 vocalic. The 40 consonantal units may traditionally be classified into 20 stops, 5 nasals, 8 fricatives, and 7 liquids. The 20 vocalic units are traditionally classified into 14 long vowels (7 oral and 7 nasal), and 6 short vowels (3 oral and 3 nasal). The phonological grid of Deccani Urdu, with the projection of all the 60 units on the appropriate intersections, is presented in Diagram 1-1.

Comments on the Phonological Grid of Deccani Urdu

1. Mechanics of Diagraming

As shown in the phonological grid above, the paradigmatic relationships of the phonological units are indicated by the network of black solid lines drawn in terms of articulators and apertures.

It may be noted that three highly abstract units of V(ooicing), A(spiration), and N(asality), are produced at glottal apertures 1 and 2, and the nasal aperture 3, respectively. These three units are superimposed on many phonological units in the grid. As indicated by the solid lines, the V is superimposed over voiceless unaspirated stops (p t k etc.) and the voiceless fricatives (f s x etc.), to produce their voiced counterparts (b d g etc. and v z y etc.). The V is also superimposed as a necessary concomitant over all the phonological units produced at aperture 3 (the "liquids") and above (the "vowels"). As shown by the dashes, the A, i.e., the
voiceless aspiration is superimposed on the voiceless unaspirated stops (p t k etc.) to produce voiceless aspirates (pʰ tʰ kʰ etc.). Finally, the superimposition of N over the voiced unaspirated stops (b d g etc.) to produce their nasal counterparts (m n ɳ etc.), is indicated by the dotted lines. As the dotted lines indicate, the N is also superimposed on the oral vowels (iː aː uː etc.), to produce their nasal counterparts (iːⁿ aːⁿ uːⁿ etc.).

As indicated by the dashes and dots, the glottal unit h (the voiced aspiration) is superimposed on the simple stops (p t k etc.) and the liquid R, to produce the highly complex voiced aspirates (bʰ dʰ gʰ etc.) and the aspirated liquid Rʰ.

The interaction of two articulators, namely, the labium and the back dorsum, is indicated by solid black lines with arrows. For both these articulators jointly produce the semivowel w and the "back rounded" vowels (uː U oː etc.) in Deccani Urdu.

The apertures may be classified into two broad divisions, namely, Constriction versus Opening, and Clearly Audible versus Less Clearly Audible. The constriction apertures (Ø through 2) are set apart from the opening apertures (3 through 9) by the bold double solid lines. The bold solid line indicates the division of apertures in terms of audibility. Apertures Ø through 3 are recognized as less
clearly audible, whereas apertures 4 and above are regarded as clearly audible.

2. Articulators and Apertures

Articulators and apertures are the two basic physiological parameters for the classification of phonological units of a language or a dialect. Articulators are the adroit members of the vocal organs that are placed horizontally along the vocal tract, whereas apertures are the various degrees of vertical openings of the oral cavity that are brought about by the movement of the lower jaw.

As seen in the phonological grid of Deccani Urdu (Diagram 1-1), the phonological units in the paradigm are produced by combining articulators, singly or in combination, with degrees of aperture. The articulators for Deccani Urdu are the lower lip, the apex of the tongue, the medium of the tongue, the dorsum of the tongue, the velum (that opens the nasal cavity), and the larynx. The degrees of aperture are: $\emptyset$--complete stoppage; $1$--partial stoppage, so that air is forced between the articulator and the place of articulation, they are in contact; $2$--no stoppage, but the air forming a sufficiently small aperture that it can control the stream of air coming from the lungs (noise is produced by turbulence as the air stream comes in contact with some target); $3$, $4$, $5$, $6$, $7$, $8$, and $9$--the articulator used to produce resonant cavities with
successively larger degrees of aperture. (For further details, cf. Introduction: theoretical background.)

3. Constriction versus Opening

As shown in the phonological grid of Deccani Urdu (Diagram I-1), a broad division of apertures is based on the distinction of constriction (apertures 0 through 2) versus opening (apertures 3 through 9). The distinction of constriction versus opening apertures is based on both physiology of the vocal tract and the acoustic medium.

The phonological units produced at constriction apertures include 20 stops, 5 nasals, and 8 fricatives. The phonological units articulated at the opening apertures comprise the 7 "liquids" and all the 20 vowels of Deccani Urdu.

As pointed out in the theoretical background in the Introduction, the phonological units at the constriction apertures--Ø, 1, 1½ and 2--are produced through a narrow passage between articulators and the associated places of articulation. As a result, the supraglottal articulators both shape and excite the oral cavity in the production of consonantal units at these apertures. It may however be noted that the simultaneous addition of the glottal articulation, through voicing or aspiration, makes the voiced and the aspirated consonantal units more complex at these apertures.
For example, b d g or v z γ are more complex than p t k or f s x.

Finally, it may be noted that due to the close contact between the articulators and the places of articulation through the very narrow passage in the production of the "stops" and the "fricatives", the constriction apertures can be measured in absolute terms.

In contradistinction to constriction apertures (Ø through 2), the larger apertures (3 and above) are termed opening apertures. As the distance between the articulators and the associated places of articulation increases, in the production of phonological units at these apertures, the articulators can only shape the cavity and the excitation has to be provided by the larynx, through voicing, by setting the edges of the vocal folds in vibration. Thus, voicing becomes a necessary concomitant for the production of phonological units at these apertures.

Furthermore, unlike the absolutely defined constriction apertures (Ø through 2), the opening apertures (3 through 9) can only be defined in relative terms. For the distances between the degrees of aperture are relative and they vary from language to language to conform to the differing vocalic systems. (For further details, see section C below.)
4. Clearly Audible versus Less Clearly Audible

As seen in the phonological grid of Deccani Urdu (Diagram I-1), there is another broad division of apertures, namely, the clearly audible (apertures 4 through 9) versus the less clearly audible (apertures $\emptyset$ through 3), based on the acoustic medium. For only at apertures 4 and above, with the appropriate shaping of the vocal tract and with no impediment of the air flow coming from the lungs, can we produce the clearly audible phonological units of our language. On the contrary, the less clearly audible units are produced at aperture $\emptyset$ through 3, by impeding to a greater or lesser degree the air flow by the supraglottal articulators. This distinction in terms of audibility provides a basic classification of phonological units into the vocalic units ("vowels") and the consonantal units ("consonants") for Deccani Urdu, as for any other language. (For further details, cf. Chapter V, section A.)

5. Phonemes versus Phonological Units

As it will be seen in Chapter III, the phonemes of a language are motivated by communication and can therefore be established by contrast through minimal and subminimal pairs. All the phonemes thus established are then appropriately placed, in terms of their physiologico-acoustic make-up, in the paradigmatic network of the phonological grid (Diagram I-1). When the communicatively based phonemes of a language are interrelated to one another in terms of their
physiologico-acoustic base in the grid, they may be called phonological units. It may however be noted that the number of phonological units for a language is slightly higher than the number of phonemes for that language. For a few positional variants of some of the phonemes, may, in terms of their phonetic substance, fall on the relevant intersections of the articulators and the apertures. These positional variants are also elevated to the status of phonological units.

Thus, of the 60 phonological units postulated for Deccani Urdu, as seen in Diagram I-1, 56 units are communicatively based "phonemes", and only 4 units, namely, L, R, N, ñ, are positional variants.

6. The Status of V A and N as Phonological Units

Like all other phonological units, V(oicing), A(spiration), and N(asality) are also produced by the combination of articulators and apertures. Thus, V(oicing) is produced by the glottal articulator at aperture 1. Further, A(spiration) is generated by the glottal articulator at aperture 2, and N(asality) is produced by the velum as an articulator at aperture 3.

The phonological units of V, A, and N, as shown in Diagram I-1, are set apart from other phonological units in that they do not appear as individual, independent units in the speech chain or written text. But these three special units are required, for they are superimposed on certain other, simpler
classes of phonological units (consonantal or vocalic), to produce relatively more complex units in terms of physiology and acoustics. In this way, V, A, and N represent a higher degree of abstraction as compared to other phonological units.

7. The Production of N(asality)

As pointed out in the comment above, N(asality) is produced by the velum as an articulator at nasal aperture 3 (Diagram I-1).

As noted earlier in comment 3, V(oicing) is essentially required to bring about excitation of the vocal cavity in the production of supraglottal phonological units at the oral apertures 3 and above. It is noteworthy that V(oicing) is also equally essential in the production of all nasal units, both consonantal and vocalic, formed at oral apertures 0 and 4 through 9, in combination with N(asality) at nasal aperture 3. For V(oicing) is a necessary concomitant for the production of N(asality), as the nasal cavity is opened to aperture 3 by the velum as an articulator.

As shown in Diagram I-1, N(asality) is superimposed on the voiced stops (b d g, etc.) to produce nasal consonants (m n ɳ etc.). As such, the nasal consonants seem to be more complex in terms of physiology and acoustics than the corresponding (oral) voiced stops. But as V(oicing) is a necessary concomitant for the production of the nasal
consonants, these consonants may be considered on a par with the voiced stops in terms of complexity.

It is noteworthy that V(oice) is also required in the production of both the oral vowels and the nasal vowels. However, as the oral vowels have already made an investment in V(oice), the superimposition of N(asality) brings about an added physiologico-acoustic complication in the production of the opposing nasal vowels. We therefore expect that the nasal vowels should be disfavored vis-a-vis the oral vowels.

As seen in the Diagram, there is a parity in terms of the number of units between the oral vowels and the nasal vowels in Deccani Urdu. However, as will be seen in Chapter II, section A, the disfavoring for the nasal vocalic units, vis-a-vis, the corresponding oral vocalic units, is clearly manifest in the frequency of their usage in the word.

8. Units Formed at Two Places of Articulation with the Same Articulator: Apico-Dentals versus Apico-Palataals

As seen in the phonological grid of Deccani Urdu (Diagram I-1), the apex as an articulator combines with two distinctly different places of articulation, namely, the teeth and the palate, to produce two sets of phonological units—the apico-dental and the apico-palatal. The apico-dental (the traditional "dental") consonantal units—\( t^h, d^h, l, n, s, r \)—are produced, when the apex comes in contact with the teeth. Likewise, the apico-palatal (the traditional "retroflex")
consonantal units –T Tʰ D Dʰ L N R Rʰ--are formed when the apex comes in contact with the palate.

To be sure, the production of two sets of consonantal units by the apex as an articulator is not a mere coincidence. For the apex is the most adroit among all the supraglottal articulators. (For details, cf. section B below.)

9. Units Formed with Two Articulators: The Labio-Dorsals

Some of the phonological units in Urdu, as in many other languages, are produced jointly by two articulators, viz., the back dorsum and the labium. Thus, both labium and back dorsum simultaneously act as articulators, to produce the “semivowel” w at aperture 3, and the “back rounded” vowels—uːː U Uʰ oːː oːː Uːː— at apertures 4 and above, in the Deccani dialect of Urdu.

Finally, it may be noted that it is not coincidental that the labium is used as an additional articulator to produce the lip rounding in the formation of the back rounded vowels. The role of the labium in the production of these vowels, is taken up in Chapter V: Acoustic Base of Deccani Urdu Phonology.

10. The Production of V, A, and the voiced h²

As seen in Diagram I-1, these three glottal units,

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² For the glottal dynamics in the production of the voiceless h and the voiceless aspirates versus the voiced h and the voiced aspirates, we have benefited through personal communication from Professor R. Prakash Dixit, the noted scholar of experimental phonetics at the Louisiana State University, Baton Rouge, Louisiana.
namely, V(оicing), A(spiration) and the voiced h, are produced by the glottal articulator in combination with apertures 1, 2 and 1½ respectively. The glottal configurations for the production of these three phonological units are shown in Diagram 1-2.

Diagram 1-2: Configurations of the Vocal Folds in the Production of V, A, and the voiced h.

Whereas the phonological grid, as shown in Diagram 1-1, is an overview of the entire phonological paradigm, it may be noted that Diagram 1-2 presents an excerpt of the phonological grid, highlighting the characteristic glottal
configurations in the production of V, A, and the voiced h in Deccani Urdu. Therefore, it is mainly with reference to this diagram that we characterize the make-up of these three special units, and their role in the production of other, supraglottal units.

Comments on Diagram 1-2:

(a) V(oiicing): In the production of V, the vocal folds form a narrow slit at glottal aperture 1, as seen in the Diagram above. As the air stream coming from the lungs is forced through this narrow slit, it sets the edges of the vocal folds in vibration, producing the musical tone technically known as "voice".

Although it is not used as an individual unit by itself, the V(oiicing) is a necessary concomitant for the production of the vocalic units and some consonantal units (the "liquids" and the "nasals") in Deccani Urdu, as in almost all the languages of the world. Further, V is superimposed on simple stops (p t k, etc.) and fricatives (f s x, etc.) to produce the more complex voiced stops (b d g, etc.) and voiced fricatives (v z ɣ, etc.).

(b) A(spiration): As seen in Diagram 1-2, the vocal folds assume a wide triangular configuration in the production of A (or the voiceless h) at glottal aperture 2. The lungs provide sufficient air to push through this relatively large glottal opening. Whereas A (or the voiceless h) appears as an individual, independent unit in many languages of the world, it
is noteworthy that this unit does not occur independently in Urdu, including Deccani Urdu. As a highly abstract unit, A(spiration) is superimposed on simpler phonological units (such as p t k, etc.) to produce relatively more complex units (such as pʰ tʰ kʰ, etc.).

(c) The voiced h: In the formation of the voiced h at glottal aperture 1½, as seen in Diagram 1-2, the vocal folds form a narrow trigangular configuration. This narrow triangle is exactly half the size of the wider triangle that is formed in the production of the voiceless h at aperture 2.

In view of the extraordinary glottal configurations, the production of the voiced h becomes highly complex. But it is noteworthy that this physiologico-acoustically most complex glottal unit occur as an independent unit in the speech chain (or the written text) in Urdu, including Deccani Urdu, as in some other Indo-Aryan languages.

Further, this voiced h is superimposed on the simple phonological units, such as p t k etc., to produce the physiologico-acoustically most complex supraglottal units, such as bʰ dʰ gʰ etc., in Urdu and its dialects, as well as in some other Indo-Aryan languages.
Section B: The Hierarchy of Adroitness of Articulators:
The Make-up and Distribution of Consonantal Units

As discussed in the Introduction: the theoretical background (Section C2(b)(v)), the relative adroitness of the various lingual articulators (the apex, the dorsum, the medium, the post-dorsum) is directly related to their physiological musculature. On that basis, the scale of adroitness of lingual articulators was set up in Diagram 0-1. As seen in that diagram, the apex of the tongue holds the top position in the hierarchy of adroitness among the lingual articulators, followed by the dorsum, the medium, and the post-dorsum (or the root), in that order. It may be recalled that we also made a de facto placement of the labium, somewhere near the dorsum of the tongue, on the scale of adroitness for the supraglottal articulators. For interms of adroitness, the labium, with its flexible muscles, falls certainly below the apex and above the medium.

It is noteworthy that the impact of the hierarchy of adroitness of articulators is limited only to the consonantal units ("stops", "fricatives", "liquids", and "nasals"), which are produced at the less clearly audible apertures (Ø through 3). Parenthetically, it may be pointed out that a different dissection of the tongue, based on the size, shape, and mass, is required to provide the physiologico-acoustic rationale for
the production of the vocalic units, which are produced at the clearly audible apertures (4 through 9). For details, see section C on the medium-dorsum mass below.

The relative adroitness of articulators has an impact on the paradigmatic make-up and the syntagmatic distribution of the phonological units in Deccani Urdu, as in any other language or dialect. It is noteworthy that the apex is the most adroit articulator among all the supraglottal (including lingual) articulators. That is why, the apex can freely move across the length and breadth of the entire oral cavity. What is important from our viewpoint is the fact that this highly adroit articulator can come in contact with more than one places of articulation in the formation of consonantal units in many Indian languages. Thus, we have two orders of consonantal units, the apico-dental ("dental") and the apico-palatal ("retroflex") in Deccani Urdu. In contradistinction to the apex, the other lingual articulators are less flexible. Therefore, they generally come in contact with their nearest places of articulation. That is why, we have only one order of consonantal units each for the dorsal, and the medial articulators in Deccani Urdu. And it is not coincidental that whereas the post dorsal axis is marginally employed for only the production of q in modern standard Urdu, the least adroit post dorsum (or the root) is not used at all as an articulator in the Deccani dialect of Urdu studied here.
In view of the apex being the most adroit among the lingual and all other supraglottal articulators, we expect that there will be a vast skewing in the number of units and their frequency of usage, in favor of the apical consonants, vis-a-vis the number of units and the frequency of their occurrence produced by the other supraglottal articulators.

Further, within the consonantal units produced by other lingual articulators, we expect that the dorsal consonants formed by the more adroit dorsum, will be preferred over the medial consonants formed by the less adroit medium. And, as we have noted above, there is a total skewing against the post-dorsal units formed by the least adroit post-dorsum in Deccani Urdu, whereas only one post-dorsal unit, namely q, occurs in modern standard Urdu.

It will be generally agreed that the labium as an articulator may be close to the dorsum in terms of the adroitness. We therefore expect that the labial consonants may compete well with the dorsal consonants in terms of the number of units, and their frequencies of usage in the word in Deccani Urdu.

In the light of our discussion above, we gauge, in section B1, the impact of the hierarchy of adroitness of articulators on the number of consonantal units in the phonological grid of Deccani Urdu. In section B2, we examine the impact of the hierarchy of adroitness on the frequency of
occurrence of these units in the formation of words in the Deccani dialect of Urdu.

Section B1: Impact of the Hierarchy of Adroitness of Articulators on the Number of Consonantal Units in the Paradigm

In terms of the scale of adroitness of articulators (Diagram 0-1), we expect the apical consonants to be most favored, followed by the dorsal or labial, the medial, and the post-dorsal consonants, in that order.

With a view to establishing the validity of our postulation, we present the paradigmatic make-up of the consonant units of Deccani Urdu, in Table I-1.

<table>
<thead>
<tr>
<th>Articulators</th>
<th>Apex</th>
<th>Labium</th>
<th>Dorsum</th>
<th>Medium</th>
<th>Post-Dorsum</th>
<th>Total</th>
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<tbody>
<tr>
<td>Oral Nasal</td>
<td>t T</td>
<td>P</td>
<td>k</td>
<td>c</td>
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<td>13</td>
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<td></td>
<td>d D</td>
<td>b</td>
<td>g</td>
<td>j</td>
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<td>t&quot; T&quot;</td>
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<td>k'</td>
<td>c'</td>
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<td>8</td>
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<tr>
<td></td>
<td>d&quot; D&quot;</td>
<td>b'</td>
<td>g'</td>
<td>j'</td>
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<td>1</td>
<td>l r</td>
<td>w</td>
<td>w</td>
<td>y</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>17</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>40</td>
</tr>
</tbody>
</table>

Table I-1: Hierarchy of the Adroitness of Articulators and the Make-up of the Consonantal Units
Comments on Table 1-1:

Comment 1: As seen in this table, of the 40 consonantal units in Deccani Urdu, the apex produces 17 units (apcio-dental 9 and apico-palatal 8), the dorsum 8, the labium 8 and the medium 7. Inasmuch as the labio-dorsal units w is simultaneously produced by two articulators—the labium and the dorsum—is unit is counted both as labial and as dorsal in the table. Further, it may be noted that there is no consonantal unit at the post-dorsal axis in Deccani Urdu.

As argued below, the above distribution of the consonantal units in the phonological paradigm of Deccani Urdu unit is perfectly in conformity with our expectations in terms of the scale of adroitness of articulators.

Comment 2: It is noteworthy that the apical consonants (17) appear in a ratio of over 2 to 1 the dorsal consonants (8) and the labial consonants (8). This rather drastic tilt in favor of the apical consonants and against the dorsal and the labial consonants, is fully justified in view of the extraordinary adroitness of the apex. In fact, as pointed out earlier, the apex, as the most adroit supraglottal articulator, comes in contact with two places of articulation—the teeth and the palate—to produce two orders of consonants, namely, the apico-dental ("dental") and the apico-palatal ("retroflex"), in Deccani Urdu, as in some other Indian languages.
Comment 3: As noted earlier, the labium is closer to the dorsum in terms of the adroitness of articulators. As seen in Table I-1, there is a parity in the number of units, 8 each, produced by the dorsum and the labium. This parity in the number of units for the two articulators is perfectly in conformity with our expectation.

Comment 4: As shown in the table, the medium of the tongue as a less adroit articulator produces 7 consonantal units in Deccani Urdu, and this lower figure for the medial ("palatal") consonants is compatible with our hierarchy of adroitness postulation.

Comment 5: As noted earlier, the post-dorsum of the tongue is the least adroit among the lingual articulators. It is therefore not coincidental that this articulator does not form any unit in Deccani Urdu. To be sure, the consonant g produced by the post-dorsum did exist in old Urdu and has been preserved in classical Urdu, as well as in modern standard Urdu. However, the post-dorsal g of old Urdu was lost in Deccani Urdu, and was merged with the dorsal x.

Section B2: Impact of the Hierarchy of Adroitness of Articulators on the Frequency of Occurrence of the Consonantal Units.

We now evaluate the impact of the hierarchy of adroitness of articulators on the syntagmatic usage of consonantal units in Deccani Urdu. As stated earlier, we
expect the apical units to be most favored in their frequency of usage, followed by the dorsals or labials, and the medial consonants, in that order. With a view to providing quantitative support in favor of our predictions, we present the frequency counts for the four types of consonants in Deccani Urdu in four subsections below.

In section B2(a), we examine the impact of the hierarchy of the adroitness of articulators in the syntagmatic distribution of the consonantal units in their entirety. In section B2(b), B2(c), and B2(d), we gauge the impact of this hierarchy on the frequency of occurrence for the "stops", the "nasals", and the "liquids", respectively.


In this section, we evaluate the impact of the hierarchy of the adroitness of articulators on the distribution of the apical, the labial, the dorsal, and the medial consonants in the formation of the word in Deccani Urdu. The actual occurrences of the opposing consonantal types, as they appear in the monosyllabic words, are presented in Table I-2.
Consonantal Units
Apertures 0, 1, 2, 3
Articulators
Apex-Teeth
Apex-Palate
Apex
Labium
Dorsum
Medium
Total

CVC words
No %
1080 38.08
226 43.29
7 31.82
1313 38.84

CVCC words
No %
335 11.81
31 5.94
- -
366 10.83

CCVC words
No %
1415 49.69
257 49.23
7 31.82
1679 49.67

Total
2836 100
522 100
22 100
3380 100

Table 1-2: Frequency of the Consonantal Units in the Monosyllabic Words in Terms of Articulators

Comments on Table 1-2
Comment 1: As seen in the last column for the monosyllabic words in Table 1-2, the apex alone produces nearly half (1679) of the total number of occurrences (3380) for all the four consonantal types combined. This vast skewing in favor of the apical consonants is brought about by the extraordinary mobility of the apex as an articulator.

Of these 1679 apical occurrences, 1313 occurrences are apico-dental ("dental"), and only 366 occurrences are apico-palatal ("retroflex"). That is, the apico-palatal occurrences appear in a ratio of almost 1 to 4 the apico-dental occurrences. This skewing against the apico-palatal and in favor of the apico-dental, is taken up in Chapter II, section B.
Although they are left far behind in the frequency of usage as compared to the apical consonants, both the labial and the dorsal consonants, with 675 and 605 occurrences respectively, compete well with each other in their usage in the word. This close competition between the dorsals and the labials is perfectly justified in view of the parallel placement of labium and dorsum on the scale of adroitness of articulators.

Further, as seen in the last column, the medial consonants are the least frequent of all the four types of consonants. It is noteworthy that the medial consonants (421) appear in a ratio of almost 1 to 1¼ the dorsal consonants (605) and the labial consonants (675). Thus, whereas in terms of the number of units, the medial consonants (7) are only slightly disfavored as compared to the dorsal consonants (8), and the labial consonants (8), the skewing against the medials becomes much more sharp vis-a-vis the dorsals and the labials, in their frequency of usage in the word. This low frequency of usage for the medial consonants is fully justified in view of the scale relationship.

Comment 2: As seen in the CVC column in Table I-2, of the 2836 consonantal occurrences appearing in the syntagmatically simple CVC words, 1415 occurrences are apical, 583 labial, 476 dorsal, and 362 medial. As these figures show, the number of occurrences decline as we move
down from the most adroit apex to the less adroit medium. As a matter of fact, with minor variations, these figures appear in the same ratios, as those seen for all the monosyllabic words combined in comment 1 above. That is, the frequency of occurrence for the apical, dorsal, labial, and medial consonants in the CVC words fully conforms to our predictions in terms of the hierarchy of adroitness of supraglottal articulators.

Comment 3: As shown in the CVCC-column in the table, the figures for the apical consonants (257), dorsal consonants (125), labial consonants (86), and the medial consonants (54) also conform to our expectations in terms of the scale of adroitness. To be sure, there is a substantial increase in the frequency of occurrence for the dorsals (125) vis-a-vis the labials (86). (Parenthetically, it may be noted that this skewing in the frequency of usage may be due to the syntagmatic complexity of the CVCC words, with a final consonant cluster.) However, it is important to note that even here the labials are competing well with the dorsals, and the figures for both the dorsal and the labial consonants do fall between the highly favored apicals (257) and the disfavored medials (54).

Comment 4: As seen in the column for the CCVC words in Table 1-2, of the 22 consonantal occurrences in these words, 7 are apical, 6 labial, 4 dorsal, and 5 medial. Here, the figures
for the dorsals and the medials are against our expectation in terms of the scale relationship. An explanation of this discrepancy is provided below.

Firstly, there are only \( 7 \) words in Deccani Urdu with an initial consonant cluster. Further, the second consonant of this cluster is limited to only \( v \) or \( w \). Thus, of the \( 7 \) CCVC words, \( 5 \) words, such as \( kva \): 'what', contain \( v \) as the second member of the cluster, and these are the only \( 5 \) occurrences of the medial consonants that appear in these words. Not a single occurrence of the disfavored medial consonants appears in the first position of this consonant cluster.

Secondly, it may be noted that both the number of CCVC words (7), and the total number of occurrences (22), are statistically insignificant for validating the phonological analysis.

Section B2(b): Syntagmatic Distribution of the Stops in Terms of the Hierarchy of Adroitness of Articulators

In this section, we make a comparison of the frequencies for the apical, the labial, the dorsal, and the medial stops with a view to gauging the impact of the hierarchy of adroitness of articulators. We present in Table 1-3, the actual occurrences of the opposing stops in the monosyllabic words in Deccani Urdu.
Table I-3: Frequency of the Stops in the Monosyllabic Words in Terms of Articulators

Comments on Table I-3

Comment 1: As seen in the last column in Table I-3, there are 1863 occurrences of stops in all the monosyllabic words of Deccani Urdu. Of all these stop occurrences, the apicals have 639 occurrences, followed by the labials with 452, the dorsals with 442, and the medials with 330. These figures are in complete conformity with our predictions in terms of the hierarchy of adroitness of articulators.

It is noteworthy that the apical stops alone, with 639 occurrences, appear in a ratio of almost 1 to 3 with 1863 occurrences for all four types of stops combined. As discussed earlier, this vast skewing in favor of the occurrences produced by the most adroit apex, is fully justified. (For the drastic
skewing in favor of the apico-dentals and against the apico-palatals, cf. Chapter II, section B.)

Comment 2: As seen in the CVC column in the table above, of a total of 1647 occurrences for all the stops in the CVC words, the apical stops remain on top, with 549 occurrences, followed by the labials with 411 occurrences, the dorsals with 380 occurrences, and the medials with 307 occurrences, in that order. Again, it is worth noting that the apical stops alone appear in a ratio of 1 to 3 with the occurrences for all four types of stops combined.

Parenthetically, it may be noted that of the 549 occurrences of the apical stops, 301 are apico-dental and 248 are apico-palatal. As these figures show, there is a fair competition between the apico-dental and the apico-palatal stops in the frequency of their usage in the CVC words in Deccani Urdu. This competitive usage of the two types of stops in the syntagmatically simple CVC words, is taken up in Chapter II, section B.

The actual occurrences of the four stop types in the CVC words, as presented above, are fully justified by the scale relationship in terms of adroitness of articulators.

Comment 3: As shown in Table 1-3, of a total of 209 occurrences in the column for the CVCC words, the figures for the apical stops are 88, the dorsal stops 61, the labial stops 37, and the medial stops 23.
As seen in these figures, there is a drastic skewing in favor of the most adroit apex in these syntagmatically complex CVCC words. For the apicals appear in a ratio of over 2 to 5 with the occurrences of all four types of stops combined in these words. The lowest figure (23 occurrences) for the medial stops, produced by the less adroit medium, are also justified by the scale relationship.

As seen in the table, the frequency of occurrences for the labial stops (37) and the dorsal stops (61), are all right in that both the labial and the dorsal stops are less frequent than the apical stops, and are more frequent than the medial stops. However, it is apparent that rather than a fair competition between the dorsals and the labials, there is a clear skewing in favor of the former and against the latter. This skewed distribution for the dorsal and the labial stops can again be attributed to the complexity of the CVCC words, with a final consonant cluster. It may not be coincidental that of the 61 occurrences for the dorsal stops in the CVCC words, over 40 occurrences of these stops appear as the second member of the consonant cluster after a dorsal nasal (ŋ).

Parenthetically, it may be noted that of the 88 occurrences of the apical stops, 67 are apico-dental and 21 are apico-palatal. Unlike their distribution in the CVC words dealt with in comment 2 above, it is clear that the favoring for the preferred apico-dental stops is sharply increased in the
syntagmatically complex CVCC words, whereas the disfavored
apico-palatal stops are additionally disfavored in these words.
For an explanation of this vast skewing, cf Chapter II, section
B.

Comment 4: As shown in the column for the CCVC words in
Table I-3, of the 7 occurrences for the four types of stops in
these words, the apical stops have 2 occurrences, labial 4,
dorsal 1 and medial 0. It may be noted that the figures for the
apical and the labial stops are against our predictions.
However, the total number of words (7) and the total number
of occurrences (7) for the stops in the CCVC words are not
sufficient for a quantitative validation of our analysis in terms
of the hierarchy of adroitness of articulators.

Section B2(c):  Syntagmatic Distribution of the Nasal
Consonants in Terms of the Hierarchy of
Adroitness of Articulators

In this section, we measure the impact of the hierarchy
of adroitness of articulators on the distribution of nasal
consonants in the formation of the word in Deccani Urdu. The
actual occurrences of the nasal consonants, as they appear in
the monosyllabic words, are presented in Table I-4.
Table 1-4: Frequency of the Nasals in the Monosyllabic Words in Terms of Articulators

Comments on Table 1-4

Comment 1: As seen in the last column in the table above, of 427 occurrences of nasal consonants in all the monosyllabic words in Deccani Urdu, the apex produces 204, the labium 152, the dorsum 65, and the medium 6, in that order. The above figures for the nasal consonants, with the exception of those for the dorsal nasals, are in conformity with our expectation in terms of the hierarchy of adroitness of articulators.

The apical nasals (204), produced by the most adroit apex, comprise almost half of the total number of occurrences (427) in the monosyllabic words. This skewing in favor of the apicals is not a coincidence. For in view of the extraordinary adroitness of the apex, we expect the apical nasals to be
highly favored as compared to the labial, dorsal, and the medial nasals.

Further, within the apicals, we again encounter a vast skewing in favor of the apico-dentals (194) vis-a-vis the apico-palatals (10), and this vast preference for the apico-dental nasals is perfectly all right in terms of human behavior as an orienting principle. (For details, cf. Chapter II, section B.)

In terms of the scale relationships, we expect a fair competition between the labial nasal m and the dorsal nasal n. But as seen in the figures in the table, the labials have 152 occurrences and the dorsal only 65. That is, there is a clear preference for the labials vis-a-vis the dorsals in the frequency of their occurrence in the monosyllabic words. The rationale for this skewed distribution in the frequency of usage can be seen in the make-up of the labial m and the dorsal n as phonological units. Whereas m as a fulfledged phoneme, may occur in any position of the word, n as a positional variant, can appear only before a dorsal consonant or in word final position. (Cf. Chapter III, section B3.)

Comment 2: The figures in the CVC column in Table 1-4, again show that of a total of 322 occurrences for the nasal consonants in the CVC words, the apical nasals with 167 occurrences occupy the top position, followed by the labials with 124, the dorsals with 31, and the medials with 0.
Here again, the apical nasals (167) are vastly favored, for they account for more than half the total number of occurrences for all four nasal types combined (322). And this tilt in favor of the apicals is fully justified in terms of the physiological principle of the adroitness of articulators.

Parenthetically, it may be noted that among the apical nasals, there is a total skewing in favor of the apcio-dentals (167) and against the apcio-palatals (0). This extreme skewing against the apico-palatal ("retroflex") nasals is brought about by two factors. First, as noted above, the "dentals" are preferred over the "retroflex" in terms of human behavior. (Cf. Chapter II, section B.) Second, unlike the apico-dental .getParam, which is fulfledged phoneme, the apico-palatal ("retroflex") getParam appears only as a positional variant before a "retroflex" stop in Deccani Urdu (Cf. Chapter III, Section B3.)

As seen in the CVC column in the table above, there is a total skewing against the medial nasal .getParam (with 0 occurrence) among the CVC words. Again there are two reasons for this extreme skewing against the medial nasal (getParam). First this nasal is produced by the less adroit medium as an articulator. Second, being a positional variant, getParam can only occur before a stop in Deccani Urdu, and therefore there is no scope for its occurrence in the syntagmatically simple CVC words.

Finally, a note on the skewed distribution for the labial nasal .getParam (124) and the dorsal nasal getParam (31) in the CVC words.
As noted earlier in comment 1, the dorsal nasal ɳ is a positional variant that can appear before another nasal or in word final position. Therefore, in the CVC words dealt with here, this nasal consonant can occur in only word final position. In contradistinction to the dorsal nasal, the labial nasal m appears as a fulfledged phoneme in Deccani Urdu. (Cf. Chapter III, section B3.) Hence, we have the skewed distribution of the labial nasal and the dorsal nasal, as observed here.

Comment 3: As shown in the CVCC column in the table above, of 104 occurrences for all the nasal consonants, the apical nasal retains its top position with 36 occurrences, followed by the dorsal 34, the labial 28, and the medial 6. These figures, for each nasal type, are in complete conformity with our expectations in terms of the hierarchy of adroitness of articulators.

Comment 4: As seen in the CCVC column in the table above, only 1 occurrence is observed for the nasal consonants in the CCVC words. And it is noteworthy that this single occurrence is apical, produced by the most adroit lingual articulator, the apex. The appearance this lone apical nasal in of the CCVC words is fully justified in terms of our physiological criterion of the adrotiness of articulators.
Section B2(d): Syntagmatic Distribution of the Liquids in Terms of the Hierarchy of Adroitness of Articulators

In this section, we assess the impact of the hierarchy of the adroitness of articulators on the frequency of occurrence of the "liquids" (the semivowels—w, y, and all other phonological units—l, r, etc.—at aperture 3) in the monosyllabic words in Deccani Urdu. The actual frequencies of the opposing phonological units in terms of articulators, are presented in Table 1-5.

<table>
<thead>
<tr>
<th>LIQUIDS</th>
<th>CVC words</th>
<th>CVCC words</th>
<th>CCVC words</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture 3</td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Articulators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apex-Teeth</td>
<td>393</td>
<td>78.92</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td>Apex-Palate</td>
<td>87</td>
<td>17.74</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Apex</td>
<td>480</td>
<td>96.39</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td>Labium</td>
<td>4</td>
<td>.80</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dorsum</td>
<td>4</td>
<td>.80</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medium</td>
<td>10</td>
<td>2.01</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>498</td>
<td>100</td>
<td>73</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1-5: Frequency of the Liquids in the Monosyllabic Words in Terms of Articulators

Comments on Table 1-5

Comment 1: As seen in the last column in this table, of the 582 occurrences of the "liquids" in the monosyllabic words, 555 are apical, 6 dorsal, 6 labial, and 15 medial. As these
figures show, the apical "liquids" (555) appear in a ratio of over 10 to 1 with the labial, dorsal and medial "liquids", combined (27). That is, there is a drastic skewing, approaching an almost total skewing, in favor of the occurrences produced by the most adroit apex. Of course, it is the extraordinary adroitness of the apex that brings about this drastic skewing in favor of the apical liquids.

Another manifestation of the extraordinary adroitness of the apex can be seen in the formation of two orders of consonantal units at aperture 3, the apico-dental liquids $l\ r$ and the apico-palatal liquids $l\ R\ R^h$. Parenthetically, it may be noted that within these two apical liquids, as seen in the figures in Table 1-5, the apico-dental (468) are vastly favored over the apico-palatal (87). (For details, cf. Chapter II, section B.)

As seen in the last column in the table for the liquids, there are only 6 occurrences each for the labial and the dorsal $w$ produced by the more adroit labium and dorsum, but there are 15 occurrences for the medial $v$ produced by the less adroit medium. This skewing in the frequency of occurrence against the labium-dorsum and in favor of the medium requires an explanation.

It may be pointed out that the semivowel $w$ is produced simultaneously by two articulators, the labium and the dorsum. (That is why, the occurrences of $w$ are listed twice in the table
under discussion.) The low frequency of $w$ may be attributed to the human trait to sparingly utilize the more complex units in terms of the number of articulators. (Cf. Chapter II, section A.)

Now a word about the 15 occurrences of the medial semivowel $y$. Unlike the labio-dorsal $w$, the medial $y$ is produced by only one articulator, namely, the medium. In terms of number of articulators, therefore, $y$ may be preferred over $w$ (For further details, also see comment 4 below.)

Comment 2: As seen in the CVC column in the table above, of a total of 498 occurrences of "liquids" in the CVC words, the apicals occupy the top position with 480 occurrences. As noted above, this drastic skewing in favor of the apical liquids may well be attributed to the extraordinary adroitness of the apex as an articulator. Further, among the apical liquids, the highly favored apico-dentals (393) appear in a ratio of $4\frac{3}{4}$ to 1 with the disfavored apico-palatals (87). (Cf. Chapter II, section B.)

As compared to the high frequency of the apical liquids, the labial, the dorsal, and the medial liquids are characterized by the low frequency of occurrences. As seen in the CVC column in the table, the labial and the dorsal (labio-dorsal $w$) have 4 occurrences each, whereas the medial ($y$) has 10 occurrences. This skewing in favor of the medial liquid is against our expectation in terms of the hierarchy of
adroitness of articulators. But as noted in comment 1 above, the rationale for this skewing may be provided by taking into account the human preference of using more frequently the phonological units produced by fewer articulators over those produced by more articulators. (Cf. Chapter II, section A.)

Comment 3: As seen in the CVCC column of the table above, there are 73 occurrences in all for the liquids in the CVCC words. It is noteworthy that all these 73 occurrences belong to the apical liquids (l, r, etc.); there is no occurrence of the labio-dorsal w or the medial y in these words with final consonant cluster. That is, we encounter a total skewing in favor of the apical liquids and against the labial, dorsal and medial liquids in these words. As noted earlier, this total skewing in favor of the apical liquids is fully justified in view of the extraordinary adroitness of the apex.

Parenthetically, it may be noted, that of the 73 occurrences of the apical liquids in the CVCC words, all appear as apico-dental, with a 0 frequency for the apico-palatal. This total skewing in favor of the apico-dental liquids is explained in Chapter II, section B.

Comment 4: As shown in the CCVC column in Table I-5, there are only 11 occurrences of the liquids for all the 7 CCVC words in Deccani Urdu. Of these 11 occurrences of the liquids, the apical, the labial and the dorsal have 2 occurrences each, whereas the medial liquid y alone has 5
occurrences. This unexpected skewing in favor of medial liquid may be explained in terms of the syntagmatic make-up of the CCVC words. In Urdu, the second member of the initial consonant cluster is restricted to only the semivowels y and w. And it so happens that 5 of the 7 CCVC words in Deccani Urdu contain semivowel y as the second member of the initial cluster.

Section C: The Medium-Dorsum Mass as the Articulator for Vowels

Unlike the apex of the tongue, the musculature of the medium-dorsum is ideally suited for the production of the clearly audible, vocalic units of a language. For, with its massy structure and wide rectangular shape, in combination with the labia, the medium-dorsum is perfectly suitable to form supraglottal resonant cavities, which are a necessary requirement for the production of the clearly audible sounds (the "vowels").

The supraglottal cavity extends from the glottis to the lips, and the principal technique for producing clearly audible, vocalic sounds is to use the medium-dorsum, and the lips, as articulators to determine the shape and size of the cavity. The medium-dorsum divides the oral cavity into two cavities, the back and the front, each with its own resonant frequency. Both the size and the opening of the back cavity is determined by the relevant articulator (the medium, the front dorsum, or the
back dorsum) of the medium-dorsum mass. But only the size of the front cavity is determined by the relevant medium-dorsum articulator, whereas the opening of this cavity is determined by the labia as an articulator. And of course, the resonant frequency of each cavity is determined by its own size and opening, with the excitation coming from the V(oice) through the vibration of the vocal folds.

In Diagram I-3, we present the vocalic system of Deccani Urdu in terms of the three articulators of the medium-dorsum mass. It may be pointed out that the vocalic system, as presented in this diagram, is an excerpt of the phonological grid presented earlier in Diagram I-1.
Diagram 1-3: The Vocalic System of Deccani Urdu

As seen in the above diagram of the vocalic system of Deccani Urdu, the musculature of the medium-dorsum mass is divided into three distinct articulators, namely, the medium, the front dorsum, and the back dorsum, traditionally known as the “front”, the “central”, and the “back”, respectively. These three articulators combine independently with different degrees of clearly audible aperture—ranging from 4 to 9—to produce 20 vocalic units in this dialect of Urdu. Of these 20
vocalic units, the medium and the back dorsum produce 8 units each (4 oral, 4 nasal), whereas the front dorsum forms only 4 units (2 oral, 2 nasal).

As noted above, there is a parity in the number of units produced by the medium and the back dorsum as articulators. For all the 8 medial ("front") vowels—\(i:\) \(e:\) and \(i^{n}:\) \(l^{n}:\) \(e^{n}:\) \(e^{n}::\) —- have 8 matching back dorsal ("back") vowels—\(u:\) \(o:\) \(\varpi::\) and \(u^{n}:\) \(u^{n}:\) \(o^{n}:\) \(\varpi^{n}::\). The crowding of 4 vocalic units, whether oral or nasal, at the axis of the back dorsum is against our expectation in terms of Andre Martinet's concept of the asymmetry of the vocal tract. For, inasmuch as the back dorsum is closer to the vertex of the angle of the jaw than the medium, there is less vertical space available to the back dorsum in comparison with the medium.

However, the impact of the angle of the jaw can be more than compensated by the use of the labia as an additional articulator for producing the labio-dorsal ("back rounded") vowels in some languages and dialects. That is why it becomes acoustically natural for the "back rounded" vowels to have parity with the "front unrounded" vowels, as seen in Deccani Urdu. (For further details, cf. Chapter V, section C.)

Further, it is not coincidental that whereas both medium and back dorsum utilize apertures 4, 5, 6 and 8, the front dorsum interacts at its own, distinctly different, apertures, namely, 7 and 9. Inasmuch as no front dorsal ("central")
vocalic units are formed at apertures 4, 5, 6 and 8, there is only a two-way opposition between the medial ("front") vowels and the back dorsal ("back") vowels. With the maximum horizontal space available for the opposing "front" and "back" units, the acoustic distinction between the opposing units can easily be maintained by the speaker and can clearly be perceived by the hearer. That is why, a horizontal opposition between 8 "front" vowels (4 oral, 4 nasal) and 8 "back" vowels (4 oral, 4 nasal) is fully maintained in Deccani Urdu. However, the four-way opposition by the medium "front" and by the back dorsum "back", does create vertical crowding of the vocalic units, and it requires precision of control on the part of the speaker to maintain the acoustic distinction between the opposing units. It is therefore reasonable to assume that there may be a relatively less frequent utilization of the "front" and the "back" vowels in the syntagmatic organization of the word in Deccani Urdu.

Unlike the medial ("front") and the back dorsal ("back") vowels, the front dorsal ("central") vowels—A Aⁿ and a: aⁿ—have no horizontal opposition at all, as they stand alone on their apertures, 7 and 9, respectively. To be sure, there is a two-way vertical opposition (apertures 7 versus 9) for the "central" vowels. However, there is sufficient space in between the opposing "central" vowels that should provide the necessary margin for the easy production and the clear
perception of these vowels. We therefore expect that the "central" vocalic units, though fewer in number, will be more frequently used in the formation of words than the medial ("front") and the back dorsal ("back") vocalic units, notwithstanding the predominance of the latter in terms of the number of units.

With a view to ascertaining the validity of our predictions, we need to examine the frequency of occurrence of the vocalic units in the syntagmatic organization of the word in Deccani Urdu, in association with the medial ("front"), the back dorsal ("back") and the front dorsal ("central") as articulators. This is taken up in Table 1-6 and Table 1-7 below.

<table>
<thead>
<tr>
<th>Vocalic Units</th>
<th>ORAL</th>
<th></th>
<th>NASAL</th>
<th></th>
<th>TOTAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Frequency No.</td>
<td>%</td>
<td>No.</td>
<td>Frequency No.</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Units</td>
<td></td>
<td></td>
<td></td>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>Medial &quot;Front&quot;</td>
<td>4</td>
<td>339</td>
<td>25.74</td>
<td>4</td>
<td>81</td>
<td>19.38</td>
</tr>
<tr>
<td>Back Dorsal &quot;Back&quot;</td>
<td>4</td>
<td>375</td>
<td>28.46</td>
<td>4</td>
<td>106</td>
<td>25.36</td>
</tr>
<tr>
<td>Front Dorsal &quot;Central&quot;</td>
<td>2</td>
<td>603</td>
<td>45.80</td>
<td>2</td>
<td>231</td>
<td>55.26</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>1317</td>
<td>100</td>
<td>10</td>
<td>418</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1-6: Frequency of Oral and Nasal Vocalic Units in the Monosyllabic Words in Terms of Articulators

Comments on Table 1-6

Comment 1: As seen in the column for the total number of units in the table above, there are 20 vocalic units, 8 "front", 8 "back", and only 4 "central" in Deccani Urdu. That is, whereas
there is a parity in the number of units for the "front" and the "back" vowels, the number of "central" vowels is just half in relation to the "front" and the "back" vowels, separately. The rationale for this particular distribution of the vocalic units in the paradigm, has already been presented in the introductory remarks above.

As seen in the last column of the table, of the total of 1735 occurrences of all the vocalic units, in the monosyllabic words, 420 occurrences are medial ("front"), 481 back dorsal ("back"), and 834 front dorsal ("central"). That is, the "central" vowels appear in a ratio of about 2 to 1 in comparison with the "front" vowels and the "back" vowels, separately.

As we have discussed above, the "central" vocalic units (A Aⁿ and a: a:ⁿ), thought fewer in number, appear alone on their apertures (7 and 9 relatively), and are less complex in their physiologico-acoustic make-up. As expected, therefore, there is a vast skewing in favor of these vowels and against the numerically strong "front" vowels (i: I e: e: and i:ⁿ Iⁿ e:ⁿ e:ⁿ) and "back" vowels (u: U o: o: and u:ⁿ Uⁿ o:ⁿ o:ⁿ). For the "front" vowels and the "back" vowels of Deccani Urdu require precision of control in their production by the speaker and an extra effort in their perception by the hearer, and these vowels are therefore disfavored in terms of human behavior. (Cf. Chapter II.)
Finally, it may be noted that there is a fair competition in the frequency of usage between the “front” vowels (420 occurrences) and the “back” vowels (481 occurrences) in Deccani Urdu. As we have discussed in the introductory remarks above, this competitive usage of the two vocalic types is all right, for the symmetry of the vocal tract affecting the “back” vowels is more than compensated by the interaction of the labium in the production and perception of these labiodorsal vowels.

Comment 2: As seen in the column for the oral vowels in Table 1-6, there are 10 vocalic units, 4 “front”, 4 “back”, and 2 “central”. (For this distribution of the vocalic units, cf. comment 1.)

As shown in this column, of the 1317 words using oral vocalic units, 339 words employ the “front” vowels, 375 the “back” vowels, and 603 the “central” vowels. In comparison with the overall distribution of the three types of vowels presented in comment 1 above, there is a slight decrease in the usage for the “central” vowels and a comparative increase in the usage for the “front” and the “back” vowels among the oral vowels in Deccani Urdu. This slightly competitive use of the three vocalic types in the monosyllabic words, is directly related to the simple, less complex character of the oral vowels. The slight skewing in favor of the “front” and the “back” vowels and against the “central” vowels, as observed
here, is fully justified in view of the human preference for simpler phonological units over more complex units.

Comment 3: As seen in the column for nasal vowels in Table I-6, there are 10 vocalic units, 4 "front", 4 "back" and only 2 "central". (For this distribution of the vocalic units, cf. comment 1 above.)

Again, as seen in the same column, there are 418 nasal occurrences in the monosyllabic words. Of these 418 occurrences, there are 81 "front" vowels, 106 "back" and 231 "central". In comparison with the over all distribution of the three types of vowels presented in comment 1 above, there is a slight increase in the usage for the "central" vowels and a comparative decrease in the usage for the "front" and "back" vowels among the nasal vowels in Deccani Urdu. Inasmuch as the nasal vowels are produced by an additional articulator, the velum, they are more complex than their oral counterparts. In view of the nasal complexity, the favored "central" vowels become additionally favored and the disfavored "front" and "back" vowels become additionally disfavored in the syntagmatic make-up of the word in Deccani Urdu.
Table I-7: Frequency of Long and Short Vocalic Units in 
the Monosyllabic Words in Terms 
of Articulators 

Comments on table I-7 

Comment 1: 

As seen in the last column of the table above, there are 20 vocalic units in Deccani Urdu, 8 “front”, 8 “back”, and 4 “central”. (for this distribution of the vocalic units, cf. Table I-6, comment 1.) 

As shown in the last column of the table, of the 1735 vocalic occurrences in all the monosyllabic words, there are 420 medial (“front”), 481 back dorsal (“back”), and 834 front dorsal (“central”). (For the rationale of this syntagmatic distribution of the vocalic units, cf. Table I-6, comment 1.) 

Comment 2: As seen in the column for long vocalic units in this table, of the 14 long vowels, 6 are medial (“front”), 6 back dorsal (“back”), and 2 front dorsal (“central”). That is, the
"central" vocalic units appear in a ratio of 1 to 3 the "front" and the "back" vocalic units, separately. It is noteworthy that the larger number of long vocalic units in the "front" and the "back", is sustained by the very duration of these vowels. For the length becomes an aid in a smooth production and an easy perception of the long vowels in Deccani Urdu.

As seen in the column for the long vowels, of the 1121 occurrences of these vowels in the monosyllabic words, 330 are "front", 362 are "back" and 429 are "central". In comparison with the overall distribution of the three types of vowels presented in comment 1 above, there is a substantial decrease in the usage for the "central" vowels vis-a-vis the "front" and the "back" vowels, among the long vowels. That is, the syntagmatic usage of the "front", "back" and "central" vowels becomes more competitive among the long vowels. This particular syntagmatic distribution is brought about by (1) the increase in the number of units for the "front" and the "back" vowels, and (2) the length of these vowels that facilitates their smooth production by the speaker and the easy perception by the hearer.

Comment 3: As seen in the column for short vowels in Table 1-7, there are 6 vocalic units, 2 medial ("front"), 2 back dorsal ("back"), and 2 front dorsal ("central"). That is, there is a parity in the number of units for all three types of vocalic units.
As we have noted in comment 2 above, the duration of the long vowels has facilitated the formation of threefold more units in the "back" and the "front" than in the "central", in Deccani Urdu. But no such facility in the production and perception is available in the case of short vowels. If there were more than one short vocalic units in the "back" and the "front", it would require an extra effort in their discrimination by the native speakers. It is therefore perfectly understandable that a complete parity in the number of units is realised in the form of the ideal phonological triangles, I A U and I° A° U°, in Deccani Urdu.

Now a word about the syntagmatic distribution of the short vowels in Deccani Urdu. As seen in Table 1-7, of the 614 occurrences of short vowels in the monosyllabic words, there are 90 "front", 119 "back" and 405 "central". Thus, the short "central" vowels appear in a ratio of $\frac{4}{5}$ to 1 in comparison with the "front" vowels, and almost $\frac{3}{4}$ to 1 in comparison with the back vowels. As we have noted earlier in the introductory remarks, of all the vowels, the "central" vowels, A (schwa) and a:, are the simplest in terms of physiology and acoustics, and are therefore vastly favored over the "front" and the "back" vowels. Given the parity in the number of units for the "front", "central", and "back" among the short vowels in Deccani Urdu, it is perfectly in conformity with our expectations that the frequency of occurrence for the short vowels be vastly tilted in
favor of the “central” vowels and against the “front” and the “back” vowels.

Section D: Summary and Conclusions

In this chapter, we have made an attempt to briefly present the physiological base of Deccani Urdu phonology in terms of physiological mechanism, an orienting (phonological) principle of Columbia school of linguistics. Here we have taken up only those physiological characteristics of the vocal tract that provide justification for the phonological skewings observed in the paradigmatic make-up and the syntagmatic organization of the word in Deccani Urdu.

In section A, we have presented the phonological grid of Deccani Urdu (Diagram I-1), followed by explanatory comments dealing with the different aspects of the grid. It is noted that the phonological units in the grid are primarily established by contrast through minimal and subminimal pairs in terms of communication, another orienting principle of Columbia school of linguistics. However, these phonological units have been appropriately placed on the intersections of the relevant axes of articulators and apertures on the basis of their substantive characteristics in terms of the physiology of the vocal tract.

We have established 9 degrees of aperture, and 8 articulators for the placement of phonological units in the phonological grid of Deccani Urdu. The degrees of aperture
are subjected to two broad divisions, namely, the constriction versus opening, and the clearly audible versus less clearly audible.

The constriction apertures, extending from $\emptyset$ through 2 are used to produce the "stops", and the "fricatives", whereas the opening apertures, extending from 3 through 9, are utilized in the production of "liquids", and the "vowels" in Deccani Urdu.

The division of apertures into the clearly audible and the less clearly audible is primarily carried out in terms of acoustic medium, another orienting principle that motivates the phonological analysis in the present research. In Deccani Urdu, the clearly audible apertures (4 through 9) are used in the production of the vocalic units, whereas the less clearly audible apertures ($\emptyset$ through 3) are used in the production of the consonantal units.

Articulators are the adroit vocal organs that are placed horizontally along the vocal tract. In view of their characteristic functioning, they have been divided into the glottal articulators (the vocal folds), and the supraglottal articulators. The supraglottal articulators combine with the degrees of aperture to shape, and in some instances to excite, the vocal cavity in the production of speech sounds. Besides producing some other sounds at its own apertures, the glottal articulators, in combination with glottal aperture 1, articulates
V(oice) that excites the vocal cavity in the production of the voiced speech sounds.

The articulators that are particularly relevant to the production of phonological units in Deccani Urdu, are the labia, the apex, the medium, the front dorsum, the back dorsum, the velum and the glottis.

On the intersections of the relevant articulators and apertures, we have established 60 phonological units for Deccani Urdu. Of these 60 phonological units, 56 are full fledged "phonemes", the elemental units of communication. The other 4 units are non-distinctive positional variants that appropriately fill some empty intersections on the phonological grid, and have therefore been raised to the status of phonological units. Further, three highly abstract units of V(oiceing), A(spiration), and N(asality), have also been placed on the phonological grid. For these three units are superimposed on other, simpler phonological units to produce more complex units, i.e., the voiced stops, the voiceless aspirated stops, and the nasal vowels, respectively, in Deccani Urdu.

In section B, we have evaluated the impact of the hierarchy of adroitness of articulators on the paradigmatic make-up of consonantal units and their frequency of occurrence in the monosyllabic words of Deccani Urdu. As a yardstick, we have set up the scale of adroitness of
articulators, with the apex as the most adroit, the dorsum (and
the labium) as more adroit, the medium as less adroit, and the
post dorsum as the least adroit. In accordance with this scale
relationship, we predicted that the apical consonants should
be most preferred both in the number of units and in their
frequency of usage in the word in Deccani Urdu, as in any
other language or dialect. On the same basis, we predicted
that the dorsal or labial consonants, the medial consonants,
and the post dorsal consonants should be progressively
disfavored in terms of the number of units and their frequency
of usage in the word. And we have amply demonstrated
through actual counts that the paradigmatic and the
syntagmatic distribution of phonological units fully conforms to
our expectations.

Of all four types of consonants, the apical ("dental" and
"retroflex") consonants are found to be vastly favored both in
the number of units and their frequency of occurrence in the
word. It has also been noted that the post dorsal axis, though
still maintained in modern standard Urdu with only one
phonological unit (q), is totally eliminated from Deccani Urdu.

Further, as we have shown, the dorsal ("velar")
consonants and the labial consonants compete well with each
other in the make-up of the consonantal paradigm and in their
syntagmatic usage in the word. Finally, it has been
demonstrated that in comparison with the dorsal and the labial
consonants, the medial ("palatal") consonants fall a notch below in terms of the number of units, and they are far behind in their frequency of usage in the monosyllabic words in Deccani Urdu.

In section C, we have dealt with the medium-dorsum mass as the articulator for vowels. It is argued that the massy structure and the rectangular shape of the medium-dorsum mass is ideally suited for the formation of two resonant cavities, which are a necessary requirement for the production of vowels in a language. The musculature of the medium-dorsum mass is divided into three distinct articulators, namely, the medium, the front dorsum, and the back dorsum, traditionally known as "front", "central", and "back", respectively. It has been shown through a diagram that these three articulators, in association with the clearly audible apertures 4 through 9, produce 20 vocalic units in Deccani Urdu.

Of the 20 vocalic units in Deccani Urdu, 8 are produced by medium ("front"), 8 by back dorsum ("back"), and 4 by front dorsum ("central"). It has been noted that despite the asymmetry of the vocal tract, we encounter a parity in the number of units produced by the medium and the back dorsum as articulators. For all the 8 medial ("front") vowels--i: I e: ε: and i:: I o: ε:--have 8 corresponding back dorsal ("back") vowels--u: U o: o: and u:: U o: o: o: In defense of this parity,
it has been argued that as all the back dorsal vowels are labio-dorsal ("back rounded"), the impact of the angle of the jaw with its vertex at the back, is more than compensated by the use of the labia as an additional articulator in the production of these vowels in Deccani Urdu.

Further, it has been noted that there is only a two-way horizontal opposition between the medial ("front") vowels and the back dorsal ("back") vowels in Deccani Urdu. For no front dorsal ("central") vowel is formed in between them on their own apertures. As the opposing "front" and "back" vowels are formed at the fringes of the horizontal axes, there is maximum horizontal space available to the opposing units for a relatively easy production and a clear perception of these vowels. It is argued that this factor also contributes to the parity of the "front" and the "back" vowels in Deccani Urdu.

However, it has also been noted that the four-way opposition at the axis of both the medium ("front") and the back dorsum ("back") does create vertical crowding of the vocalic units, and it requires precision of control on the part of the speaker to maintain the acoustic distinction between the opposing units. In conformity with the human trait to disfavor relatively more complex phonological units, it has been established through frequency counts that in comparison with the "central" vowels, the "front" and the "back" vowels are less
frequently utilized in the syntagmatic organization of the word in Deccani Urdu.

Unlike the medial ("front") and the back dorsal ("back") vowels, the front dorsal ("central") vowels--A A^n and a: a:^n--have no horizontal opposition at all, as they stand alone on their apertures, 7 and 9, respectively. To be sure, there is a two-way vertical opposition--A versus a: and A^n versus a:^n --at apertures 7 versus 9 for the "central" vowels. However, there is sufficient space in between the opposing "central" vowels for an easy production and a clear perception of these vowels. That is why the "central" vocalic units, though fewer in number vis-a-vis the "front" and the "back" vocalic units, are more frequently utilized in the formation of words in Deccani Urdu.

Finally, it has been noted that there is an asymmetry in the number of units for the long vowels (14) in comparison with the short vowels (6) in the vocalic paradigm of Deccani Urdu. It has been argued that this discrepancy in the number of vocalic units is brought about by the quantitative distinction of the duration itself. The greater duration of the long vowels greatly facilitates their proper production and clear perception by the native speakers. On the contrary, the momentary phase of the short vowels in the speech chain, becomes a hindrance in the exact articulation and clear perception of these vowels. In consequence, Deccani Urdu has a rich, 7-vowel system for the long vowels, for both the
oral vowels and the nasal vowels. At the same time, the problems of articulation and perception associated with the short vowels, are satisfactorily resolved in Deccani Urdu by forming a 3-vowel system for these vowels in the form of an ideal phonological triangle in I A U and I\textsuperscript{n} A\textsuperscript{n} U\textsuperscript{n} in Deccani Urdu.

To conclude:

1. The phonological grid of Deccani Urdu is a systematic presentation of all its phonological units. The grid is primarily based on the physiological criteria of articulators and apertures. The "substance" of the phonological units is determined by the articulatory characteristics of these units.

2. The network of phonological units presented in the phonological grid also highlights the interrelationships of these units. That is, the grid also indicates the "value" relationship of the phonological units. Thus equal weight is given to both, the phonetic substance and the phonological value in the present analysis.

3. A total of 60 phonological units have been established for Deccani Urdu. Of the 60 phonological units, 56 are fulfdledged "phonemes", the elemental units of communication. The other 4 units are non-distinctive positional variants that appropriately fill some empty intersections of articulators and apertures in the phonological grid, and have therefore been elevated to the status of phonological units.
(4) Of the 60 phonological units established for Deccani Urdu, 40 are consonantal and 20 vocalic. The scale of the adroitness of articulators is an important yardstick for evaluating the particular distribution of consonantal units and their frequency of usage in the word in Deccani Urdu, as in any other language or dialect. In terms of this scale, it is demonstrated through statistical support that the apical consonants are most favored, the dorsal/labial more favored, the medial less favored, and the post dorsal least favored.

(5) The musculature of the medium-dorsum mass is divided into three distinct articulators, namely, the medium ("front"), the front dorsum ("cental"), and the back dorsum ("back"). Of the 20 vocalic units in Deccani Urdu, 8 are produced by the "front", 8 by the "back" and only 4 by the "central". The "central" vocalic units, though fewer in number, are more frequently utilized in the formation of words than the "front" and the "back" units, separately. As demonstrated through statistical support, this vocalic skewing is brought about by the vertical overcrowding of the "front" and the "back" vowels vis-a-vis the lesser physioloico-acoustic complexity of the "central" vowels.

(6) Of the 20 vocalic units of Deccani Urdu, 14 are long and only 6 are short. It is argued that this asymmetry in the number of units for the long and the short vowels, is brought about by the polar distinction in duration of the opposing
vowels. The prolonged duration of the long vowels becomes an aid to an easier articulation and a clearer perception of these vowels. However, as this aid through sustained duration is not available to the short vowels, the problems of articulation and perception of these vowels are resolved in Deccani Urdu by the formation of a 3-vowels system for both short oral and short nasal vowels.

(7) In validation of our phonological analysis in terms of physiological mechanism in this chapter, it is found that more often than not there are other articulating principles which are at work in creating the phonological skewings that are encountered in Deccani Urdu. Thus, in many cases the distribution of phonological units in Deccani Urdu reflects an interaction of physiology and acoustics or physiology and human behavior. In the chapter that follows, we particularly evaluate the role the human behavior plays in the phonology of Deccani Urdu.