CHAPTER V

SUMMARY AND CONCLUSIONS
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In this chapter, we make an attempt to briefly outline all what has been done in the present thesis. We, then, end the chapter with the conclusions.

In the Introduction, we have dealt with the historical setting of Modern Standard Arabic, the procedures utilized in the collection and analysis of the data, the theoretical principles of form-content linguistics that motivate the phonological analysis, and the scope of the study in Sections A, B, C, and D, respectively.

In Chapter I, an attempt has been made to evaluate the role of physiological mechanism as an orienting principle, in order to provide justification for the phonological skewings that are encountered in the paradigmatic makeup and the syntagmatic distribution of phonological units of Arabic, in terms of the physiological parameters of articulators and apertures.

In Section A, we have presented the phonological grid of Modern Standard Arabic (Diagram I-1), and highlighted the different aspects of the grid through comments. In the grid, the phonological units of Arabic have been appropriately placed on the relevant axes of the established 9 articulators and 7 apertures, on the basis of their substantive characteristics in terms of the physiology of the vocal tract.

The articulators postulated for the formation of the phonological units in Arabic are: the labium, the apex, the medium, the front dorsum, the back dorsum, the post dorsum, the velum, the pharynx and the larynx. These articulators play a significant role in the shaping and excitation of the vocal cavity.

The degrees of apertures are subjected to two broad divisions. The first one, which is based on physiological mechanism, divides the apertures into absolutely defined, smaller constriction apertures (0 through 2), and relative, larger opening apertures (3 through 6). The second division, which is mainly
based on acoustics, draws a line between clearly audible (0 through 3) and less clearly audible (4 through 6) apertures, and, hence, divides the phonological units into the two categories traditionally termed as “vowels” and “consonants”, respectively.

On the intersections of the relevant axes of articulators and apertures, 40 phonological units have been established for Modern Standard Arabic. Of these 40 phonological units, 34 are full-fledged “phonemes” and 6 are positional variants that have been raised to the status of phonological units because they fill empty intersections on the phonological grid. In addition, two highly abstract units of V(oicing) and N(asality), have also been placed on the phonological grid. For these two units are superimposed on other simpler phonological units to produce more complex units, such as, voiced stops and spirants on the one hand, and nasal consonants on the other, in Modern Standard Arabic.

In Section B, we have set up a scale of adroitness for the supraglottal articulators with the apex as the most adroit, the dorsum and the labium as more adroit, the medium as less adroit, the pharynx as the lesser adroit, and the post dorsum as the least adroit. This scale was formed with a de facto placement of the labium and the pharynx in relation to the scale of adroitness of the lingual articulators. On the basis of their structure and musculature, the labium was placed on the level of the dorsum, and the pharynx was gauged to be below the medium and above the post dorsum on the scale of adroitness of supraglottal articulators.

Further, we evaluated the impact of the hierarchy of adroitness of articulators on the paradigmatic makeup of the consonantal units and their frequency of occurrence in the monosyllabic words in Arabic. In view of the hierarchy of adroitness of articulators, we predicted that the apical consonants should be most favored both in the number of units and in their frequency of usage in the word, followed by the dorsal or labial consonants, the medial consonants, the pharyngeal consonants and the post dorsal consonants in that order. We evaluated these predictions and found out that the actual figures
were almost in perfect conformity with our expectations in terms of the physiological criterion of adroitness of articulators.

In Section C, we have taken up the phonological phenomenon of the emphatic consonants in Arabic. After a short review of the various viewpoints to tackle this highly complex phenomenon of emphasis, we arrived at the conclusion that the emphatic consonants are produced by the apex with simultaneous coarticulation by the back dorsum.

In accordance with the complex formation of the emphatic consonants, we predicated that these consonants should be disfavored vis-à-vis the simple apical consonants, both in the number of units and in their frequency of occurrence in the word in Arabic. This prediction proved to be true. Of the 15 apical consonants, 10 are simple and only 5 are emphatic. Further, even when we compared the frequency counts for these 5 emphatic consonants with that of only their 5 non-emphatic counterparts, we found an extreme skewing in favor of the non-emphatic and against the emphatic consonants.

In addition, we argued that in view of its extraordinary complexity, the voiced emphatic apico-interdental consonant ḍ should be the most disfavored emphatic consonant, and should be prone to elimination by its change to the emphatic apico-dental *z to fill an ideal slot on the grid for the emphatic consonants in Modern Standard Arabic. As the figures show, the emphatic apico-interdental ḍ does have the lowest frequency of usage among all the emphatic consonants. However this highly disfavored emphatic consonant has maintained its original, Qur’anic pronunciation in conformity with the tradition.

The physiological justification for the preference of the medium-dorsum mass as the articulator for vowels has been tackled in Section D. We have argued that the medium-dorsum mass, with its massy structure, wide rectangular shape and central position in the oral cavity, along with the labia is ideally suited for the formation of vowels.

In Section E, we presented the vocalic system of Modern Standard Arabic, highlighting its ideal triangular configuration (a i u). In addition, we argued that, the front dorsal “central” vowel a is physiologically more favored
vis-à-vis the medial "front" vowel \( i \) and the back dorsal "back" vowel \( u \). In consequence, it was predicted that the central vowel \( a \): of the long vocalic system, and the central vowel \( a \) (schwa) of the short vocalic system should be more productively utilized than their front and back counterparts, in the formation of morphemes and words in Arabic. As it turns out, there is a vast skewing in favor of the central vowel and against their front and back counterparts in the two vocalic systems of Modern Standard Arabic.

In Section F, we evaluated the impact of the asymmetry of the vocal tract on the back and front vowels of Modern Standard Arabic. Taking into consideration the shorter vertical space in the back of the oral cavity than in the front of that cavity in consequence of the angle of the jaws, and despite the parity in the number of units, we expected the back vowels in the two vocalic systems to be disfavored vis-à-vis their front counterparts. As hypothesized, there is a substantial skewing in favor of the front vowels and against the back vowels in the two vocalic systems of the Arabic language.

In Chapter II, we have dealt with the justification for the paradigmatic makeup and the syntagmatic distribution of phonological units in Modern Standard Arabic, in terms of human behavior, as an orienting principle.

In Section A, we have taken up three main dichotomies among the phonological units of Modern Standard Arabic that are motivated by the human trait of preferring fewer articulators over more articulators. These dichotomies are voiced versus voiceless consonants, simple versus emphatic apicals, and rounded versus unrounded vowels. And in accordance with our expectations in terms of preference for fewer articulators, the actual frequency counts of these opposing groups of units showed that there is a clear skewing in favor of the units produced by fewer articulators over those produced by more articulators.

In Section B, we have studied the combinatory aspect of Modern Standard Arabic phonology through the assimilative trait of neighboring phonological units. In view of the human avoidance of fine, precisely coordinated movement of articulator, we predicted a favoring for the combination of similar phonological units over that of dissimilar units. These
expectations were proved true through the actual frequency counts of stops and spirants in the Arabic CVC and CVCC words. In addition, we highlighted the impact of the confluence of the human preference for fewer articulators, and the assimilative trait of neighboring units on the frequency of usage of voiceless and voiced stops in CVCC words in Arabic.

Finally, in Section C, we have examined how human behavior orientation provides reinforcement to the validity of the phonological units in the grid. The phonological skewings in the grid, such as, the absence of the voiced counterparts of some voiced stops and spirants, and the use of articulators in the formation of phonological units.

The role of communication, as an orienting principle, in the phonology of Modern Standard Arabic has been dealt with in Chapter III.

In Section A, we have established the phonemic inventory of Modern Standard Arabic. By way of contrast through minimal and subminimal pairs of words, we established 34 elemental units of communication ("phonemes") for Modern Standard Arabic, of which 28 are "consonants" and 6 are "vowels".

In Section B, we have examined the combinatory pattern of the phonological units with a view to highlighting the role of communication in Arabic phonology. Here it is discussed, and illustrated with a list of examples, that the consonantal interchange in the initial and final positions in the CVC words brings about the formation of two well-defined words with entirely different meanings in Arabic.

Further, it has been argued that the beginning of the word carries greater communicative load than the end of the word. Thus, in view of the differing communicative load associated with the initial and final positions of the word, we encounter a skewing in the distribution of phonological units in the two positions. It has been shown through the frequency counts that all the six types of consonants (apical, labial, dorsal, medial, pharyngeal and post dorsal) compete well in the communicatively important word initial position. However, the apical consonants, produced by the most adroit apex, are drastically favored as opposed to the non-apical consonants in the
communicatively less important word final position. This disparity in the usage of consonants in the initial and final positions is brought about by the communicative factor.

In Section C, we have taken up homonymy as a communicative problem. It was argued that because of the communicative problem, a large scale homonymy is to be avoided in the languages. This claim was supported with an exhaustive list of all the 45 pairs of homonymous words found in the 3134 monosyllabic words constituting the database for the present study.

In Chapter IV, an attempt has been made to evaluate the impact of some select acoustic aspects that have a direct bearing on the makeup and distribution of phonological units in Modern Standard Arabic.

In Section A, we have discussed the acoustic base of the clearly audible versus less the less clearly audible distinction of apertures. We explained that, it is on the basis of this classification of apertures in terms of audibility that the 40 phonological units of Arabic are divided into 6 vocalic and 28 consonantal units. This classification is reflected in the organization of the phonological units, as seen in the phonological grid of Arabic.

It has been noted that the audibility provides the theoretical basis to divide the lexical units into the monosyllabic, the bisyllabic, and the longer words on the basis of the combination of keystone and flanking units.

In Section B, we have taken up the acoustic justification for the preference of the medium-dorsum mass as the articulator for vowels. We have shown how two resonant cavities are formed within the supraglottal cavity and how significant the role these two cavities play in the production of vowels in a language. Then, we argued that, since these two resonant cavities can best be controlled by the medium-dorsum mass, it is preferred as the articulator of vowels, even over the most adroit articulator apex.

In Section C, we have provided the acoustic rationale for the rounding of the lips in the production of back dorsal vowels. We argued that, due to the lack of vertical space in the back resonant cavity, which greatly effect the acoustic clarity of back vowels, the size of front cavity is increased through the
use of the lips (lip rounding), as an additional articulator. This justification is supported by the spectrographic analysis of the formant frequencies (F1 and F2) of the vocalic units of Arabic.

In Section D, we have dealt with the acoustic explanation of the scarcity of units at aperture 1. It was argued that, since only the teeth tips, with their perforated nature, are ideally suited for the production of the frictionless turbulence characterizing the phonological units formed at aperture 1, all these units are produced with the teeth tips as their point of articulation. And, hence, aperture 1 is characterized by a scarcity of units, as compared to apertures 0, 2 and 3. In Arabic, only 4 units are formed on aperture 1 as opposed to 10 units on aperture 0, 9 units on aperture 2 and 5 units on aperture 3.

In Section E, we provided an acoustic rationale for the absence of the phonemes $p$ and $g$ in Arabic, in terms of the build-up of pressure needed for the production of stop consonants.

We have argued that, the production of stops requires a build-up of air pressure for the explosion needed for the excitation of the cavity. Whereas voiceless stops are produced by this supraglottal excitation only, the glottis is also used for the excitation of the vocal cavity in the production of voiced stops. Consequently, in terms of the pressure factor, for voiceless stops, the smaller the size of the cavity, the faster the build-up of pressure, and hence the better. On the contrary, larger cavity is preferred for voiced stops to reduce the interference of air pressure with voicing. Therefore, the pressure factor entails the preference of voiceless stops formed at the back of the vocal cavity, such as, k and q, and the preference of voiced stops like b, formed at the front of the vocal cavity.

The frequency of usage of voiceless and voiced stops in the formation of words in Arabic not only was in conformity with our expectations in terms of the pressure factor of acoustics, but also reflected the powerful impact of that factor on the syntagmatic usage of all stop types in Arabic words.
Conclusions

We conclude with the following observations:

1) As presented in the phonological grid (Diagram I-1), a total of 40 phonological units (34 consonantal and 6 vocalic) have been established for Modern Standard Arabic.

2) In addition to highlighting the value relations of the phonological units, the phonological grid shows the phonetic substance of these units through the physiological parameters of articulators and apertures. Thus, unlike the phonemic inventory, it is not just a mere listing of the phonological units.

3) In the present phonological analysis both phonetic substance and phonological value are weighed on equal scales.

4) In the present study, physiological mechanism is a problem solving device (an orienting principle) that provides motivated rationale for the particular substantive makeup 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 Arabic, as in any other language.

5) The phonological analysis of Modern Standard Arabic undertaken here is based on the assumption that phonological units of a language are tied to one another in a non-random relationship, both paradigmatically and syntagmatically. This non-random distribution of phonological units is determined by physiological, human behavior, communicative, or acoustic traits. In other words, the phonological characteristics of a language are fully motivated by the orientations. The evidence that we have presented in validating the phonological analysis of Modern Standard Arabic, seems to prove this point beyond doubt. Therefore, this thesis may not only explain the inner mechanism of the Modern Standard Arabic phonology, but may also contribute to our understanding of the phonological theory that presents new procedures for the validity of phonological units, and their particular distributional patterns.
6) The thesis contains both theoretical and methodological innovations in the study of the phonology of Modern Standard Arabic. It abandons description in favor of explanation in terms of independently verifiable orientations, and presents quantitative procedures for the validating the phonological analysis.