Syllable Structure of Bangla
Syllable Structure of Bangla:
An Optimality-Theoretic Approach

By

Somdev Kar
TO MY PARENTS.....
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PART I:

PHONOLOGY
CHAPTER ONE

INTRODUCTION

The syllable structure in Bangla has a unique space of its own in the overall research activities seen in this language. Hence, even in Bangla, it is a well cultivated area in the phonological and morphological research activities. But, most of these works are typically based on segmental and metrical approach. With respect to the relevant developments in phonological works, segments and their features are the micro units of phonology. This could be compared to the molecules and atoms of mass in the physical sciences. Among these two concepts, macro unit scheme of phonology begins at the syllable level and goes up to the higher level of foot and ultimately to the lexical category of word. In Bangla, however, a small amount of the research is done in the macro level. The primary goal of this work is an attempt to offer a constraint-based account of the syllable structure (of Bangla) which is considered as the first and foremost macro unit of phonology and then a morphological analysis of certain syllable structures available in verbal paradigms in Bangla. It will be a twofold study consisting a phonological structuring and then a general application on a morphological paradigm. First, we examine different aspects of the syllable structure of Bangla in a stratified model of its lexicon. Various constraints would be deployed to figure out the overall structure of the syllable. This part would be done in the framework of optimality theory ((McCarthy & Prince, 1993a, , 1993b; Prince & Smolensky, 1993)). Afterwards, there will be an attempt to construct a verbal inflectional paradigm in Bangla within the framework of the distributed morphology ((Halle & Marantz, 1993)). One could point out that both the theoretical frameworks (phonological and morphological) used in this study are very much contemporary and developed in the early 90’s. Among them, optimality theory (OT) is probably more cultivated compared to distributed morphology.

This study is organized as follows: in the remainder of this introduction, I will sketch quickly the basic theoretical assumptions of optimality theory focusing on those most relevant to my analysis. Then I will tell about a corpus used in this work, the transcription convention and the language (Bangla) we are going to deal with. Then some basic concepts of Bangla
phonology, such as vowels, semivowels, consonants etc followed by an account of the syllable structure in Bangla will be discussed. In chapter 2, I will illustrate the basic stratification of Bangla vocabulary and the constraint rankings as per stratum. Chapter 3 deals with the OT analysis of word-medial clusters. Then, gemination cases are discussed in the following chapter. Lastly, chapter 4 discusses the word peripheral consonant clusters. In the next level, chapter 5 shows a set of possible verbal inflections of two roots in Bangla in the DM framework (given in tabular form). A section of this chapter shows possible applications of some of the inflected forms in a syntactic tree structure of Bangla. In the following section, first I will illustrate syntactic analysis of some English inflections; then gradually all the inflections of Bangla.

The analysis of syllable structure has received considerable attention in the phonological literature by opening numerous avenues in the sphere of linguistic research. Among different approaches applied in this endeavor, optimality theory is one of the most recent, important and powerful ((McCarthy & Prince, 1993a, , 1993b; Prince & Smolensky, 1993)). The constraint based approach of this theory has a very strong impact on the linguistic studies in general.

In recent years, there has been a shift in focus in many of the studies on phonological theory, from rule-based system to sets of constraints on well-formedness principles making way to the formation of optimality theory ((Bird & Klein, 1994; Burzio, 1994; Frank & Satta, 1997; McCarthy, 2001; McCarthy & Prince, 1993a, , 1993b; Paradis, 1988; Prince & Smolensky, 1997; Scobbie, 1991), inter alia). This theory was developed as a response to a “conceptual crisis at the center of phonological thought” ((Prince & Smolensky, 1993)) concerning the role of output constraints. It was also (partly) inspired by the concepts of neural networks, as we can see the ideas of optimization, parallel evaluation, competition, and soft, conflicting constraints are familiar in this framework. Optimality theory (henceforth, OT) is widely adopted by scholars not only in the area of phonology, where OT was initially developed and applied, but also in other areas of linguistic studies, such as in syntax and semantics (see (Legendre, Grimshaw, & Vikner, 2001)).

In a compact introduction, phonological (rather, grammatical) constraints are ranked and violable by the phonetic forms of their underlying representations in the OT structure. These constraints are minimally violated by a set of candidates (potential surface forms) and the one which incurs the least serious violations wins. The seriousness of a violation is defined in terms of hierarchies of constraints; the violations of higher-ranked constraints are most serious.
More elaborately, OT works in a constraint-based competition system among a possibly infinite set of candidates (at least two). In classical representation, the generation of utterances in the optimality theory involves two very important functions, viz., GEN and EVAL. From an input, GEN returns a set of unique output candidates. Among these candidates at least one could be identical to the input and the rest are somewhat modified in their structure. Then, EVAL functions to choose the optimal candidate that best satisfies a set of specially ranked constraints depending on the violation. That means, in OT constraints are violable. The ranking process of constraints is very crucial here, because it is the most important criterion that chooses the optimal candidate as output. EVAL chooses the output from a set of candidates starting from two to an infinite number (n). The figure in (1) below illustrates the process to reach an output from the input through the function of GEN and EVAL ((Davenport & Hannahs, 2005)).

(1) Graphic representation of OT structure

There are two types of constraints which act as EVAL: markedness and well-formedness constraints. Markedness constraints enforce well-formedness of the output candidate, prohibiting structures that are difficult to produce or comprehend, such as consonant clusters or phrases without overt heads ((Arbib, 2002; Kager, 1999)). These constraints usually prohibit some phenomena or impose restrictions on the occurrence of certain segments. Examples of such markedness constraint are:

(2) Examples of markedness constraints
   a. Syllables must not have codas (NoCODA)
   b. Syllables must have onsets (ONSET)
   c. Obstruents at coda position must not be voiced (*VDOBS(CODA))
   d. Obstruents must be voiced (*VDOBS)

On the other hand, faithfulness constraints enforce similarity between input and output. For instance, all morphosyntactic features in the input to
be overtly realized in the output. (Kager, 1999) lists some typical instances of faithfulness constraints that are available in most languages.

(3) Examples of faithfulness constraint
   a. The output must preserve all segments present in the input (DEP-IO)
   b. Elements adjacent in the input must be adjacent in the output (CONTIGUITY)
   c. Input segments must have counterparts in the output (MAX-IO)
   d. The specification for place of articulation of an input segment must be preserved in its output correspondent (IDENT-IO(PLACE))

These constraints, both markedness and faithfulness, are ranked in a language-specific order. In an analysis, different markedness and faithfulness constraints usually do conflict, so the ranking of these constraints are decisive in choosing the right candidate as the output depending on the violation (of constraints) pattern. This ranking of constraints is not a strict universal ranking; rather it differs from language to language. I have already mentioned that constraints are not universals In other words; different languages have their own constraint ranking which applies to that particular language only. But, for every language, the constraint ranking is very strict. That means a candidate violating a high-ranking constraint can never be a winner by satisfying lower-ranked constraints. Here, the other important issue is the violability of constraints. Violability ensures that the optimal candidate is not required to satisfy all constraints. It may violate a constraint and still win as the optimal candidate, if it satisfies the top-ranked candidate(s). Another way of describing EVAL is that a candidate x is optimal if and only if, for any constraint that prefers another candidate y to x, there is a higher-ranked constraint that prefers x to y (see (Zuraw, 2003)). So, the main point in this section is that OT allows the specification of a ranking among the constraints and allows lower ranked constraints to be violated in order for higher ranked constraints to be satisfied.

The constraint ranking and their interaction among the input candidates are typically shown in tableaux in the OT analysis. In such a tableau, the candidates are listed vertically while the constraints are ranked along the horizontal line. For a hypothetical language X, let us assume that constraint 1 (con₁) is satisfied by candidate 1 and on the other hand, candidate 2 satisfies constraint 2 (con₂). In the following tableau, it is shown how the optimal candidate is being chosen by EVAL through the constraint interaction.
(4) Constraint ranking for language X

<table>
<thead>
<tr>
<th>input</th>
<th>con₁</th>
<th>con₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. cand 1</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>2. cand 2</td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

In (4), con₁ is ranked above con₂. Con₁ is violated by the candidate 2. This is a fatal violation for this candidate, because of the high ranking of con₁. The fatal violation is marked by an exclamation (!) symbol. As a result, candidate 1 becomes the optimal candidate, in spite of violating the low ranked con₂. A hand symbol is used in OT to indicate the optimal candidate in a tableau (see the above tableau).

Optimality theory examines several restrictions available in phonological processes in a language and relevant constraints are formed to account for those restrictions. Syllable structure is one of the prominent topics in the research activities in the OT framework. In recent time, (Féry & van de Vijver, 2003) presented a collection of studies in this topic that opens up new ways for further research on several issues of syllable structure. But, so far OT is comparatively a less preferred methodology among researchers who work in Bangla phonology. There are only a few works ((Das, 2002), (Vijayakrishnan, 2003), (Kothari, 2004) inter alia) in different phonological studies of Bangla using this theoretical framework. So, there is always a deficit of literature for anyone who would study this issue in Bangla. But, on the other hand, OT itself is a very innovative methodology and is always challenging to deal with. In this study, an account of how consonant clusters work in different positions in a syllable and a word is given in an analytical fashion. This account is furnished with examples from a set of results of a corpus study (Bangla) and then, applied to the morphological analysis of the verbal paradigms in a later section of this study.
CHAPTER TWO

BANGLA:
THE FOCUS LANGUAGE

Bangla (also known as Bengali) is typologically an agglutinative language mainly spoken in the Indian sub-continent. It is the national language of Bangladesh (144 million speakers – 98% of total population – ranked first)\(^1\) and an official (and regional official) language of the states of West Bengal, Tripura and Assam of the Republic of India (80 million speakers – 8.3% of the total population – ranked second)\(^2\). Bangla is spoken in many other states of India and a significant number of populations are in the USA, UK, Singapore, Nepal and several other countries (Gordon, 2005). With more than 224 million speakers, Bangla secures the 6\(^{th}\) position among the world’s languages in terms of together first and second language speakers ((Comrie, 2005), (Katzner, 2002), (Weber, 1997)).

There are marked dialectal differences between the spoken varieties of Bengalis living on the western side and the eastern side of the Padma River. During standardization of Bangla in the late 19th and early 20th century, the cultural elite were mostly from West Bengal, especially Kolkata (formerly Calcutta). Hence, the dialect of that area was considered the standard. However, at present, the accepted standard language in West Bengal and (all parts of) Bangladesh are identical, i.e., the West Bengal variety. However, there is another important division. In Bangla, there exists what is known as Shadhu bhasha (the elegant language; literally "language of sages"; also called Shuddho bhasha) and Cholti bhasha (the current, or colloquial, language; literally "the current or running language"; also called Cholito bhasha or Cholit bhasha in common speech). Shadhu bhasha owes its origin to the literature largely produced by the intellectuals of Gour, the then capital of West Bengal. On account of this, it was primarily known as ‘Shadhu Gouriyo bhasha’ (Sen 1939). The Cholit variety seems more speaker friendly pitted against the

---

\(^1\) Bangladesh Census 2001.
\(^2\) India Census 2001 and 1991.
adherence to traditional grammar (i.e. the archaic forms of Medieval Bangla) and to a heavily Sanskritized vocabulary in Shadhu bhasha. However, Shadhu bhasha is not spoken in commonplace settings but confined to some literary and formal contexts. Here we discuss mainly the standard colloquial Bangla (SCB), i.e., cholit bhasa and hereafter the term “Bangla” will denote only the SCB. On the other hand, old literary form, i.e., sadhu bhasa will be mentioned as OLB (Old Literary Bangla).

2.1 Transcription Convention

Several different transcriptions are used in the linguistic study of Bangla. The standard IPA convention for transcriptions is closely followed in this work. Some of the symbols may differ slightly, but largely it is based on the IPA 2005 convention. However, many recent works in the linguistic study of Bangla follow another transcription convention developed by (Ray, Hai, & Ray, 1966), which is based on the standard Roman alphabet and without any special symbols. Since, many works referred in this study use the Ray et al. system; a few examples where the symbols differ from the standard IPA system are listed in (5).

(5) Transcription comparison (IPA and (Ray, Hai, & Ray, 1966))

<table>
<thead>
<tr>
<th>Characters</th>
<th>IPA</th>
<th>Ray et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front mid-high vowel</td>
<td>e</td>
<td>e</td>
</tr>
<tr>
<td>Front mid-low vowel</td>
<td>æ</td>
<td>E</td>
</tr>
<tr>
<td>Back mid-high vowel</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Back mid-low vowel</td>
<td>ɔ</td>
<td>O</td>
</tr>
<tr>
<td>Front high semivowel</td>
<td>ɛ</td>
<td>y</td>
</tr>
<tr>
<td>Front mid-high semivowel</td>
<td>i̯</td>
<td>Y</td>
</tr>
<tr>
<td>Back high semivowel</td>
<td>u̯</td>
<td>w</td>
</tr>
<tr>
<td>Back mid-high semivowel</td>
<td>o̯</td>
<td>W</td>
</tr>
<tr>
<td>Voiceless unaspirated retroflex</td>
<td>t̯</td>
<td>T</td>
</tr>
<tr>
<td>voiced unaspirated retroflex</td>
<td>d̯</td>
<td>D</td>
</tr>
</tbody>
</table>
The remaining symbols agree with the IPA 2005 convention; hence they are not listed here again.

### 2.2 The Corpus

A Bangla corpus is used in this work in order to obtain certain data, mostly the frequency of occurrences of specific sounds or sound combinations. This corpus was developed under the TDIL program of the erstwhile DoE (Dept of Electronics, Govt. of India, now Ministry of Communication and Information Technology). It was developed under the supervision of Prof. D.P. Pattanayak. Subsequently, the corpora were passed on to the Central Institute of Indian Languages (CIIL), Mysore and have been in their custody since then. The original corpus contains approximately a total of 1.6 million words (with repetition of same entries) and is compiled in Bangla script. This is available in Indian Standard Code for Information Interchange or Indian Script Code for Information Interchange (ISCII) format. However, a Romanized version of the same is used here, with certain modifications. This is a thoroughly cleaned Romanized version of the above said corpus. It was produced under the supervision of Prof. Gautam Sengupta (University of Hyderabad) with assistance from Dr. Soma Paul of the International Institute of Information Technology (IIIT, Hyderabad).

For the present study, only the distinct entries are extracted from the whole corpus using a small PERL program and approx. 57,000 entries were taken in a single file. From now onwards, we will refer this file as corpus. Since the original corpus was created using sampling methods and an orthography-based collection, I had to apply certain modifications to that compilation in order to make it useful for phonological studies, too. Still there are some cases where the orthography and phonemic mapping could not be done. For instance, Bangla ḍ [ɔ] is frequently pronounced as ḍ [o] (in many places). But it is not completely done in this modified version that I am going to use in this work. So the frequency of
occurrences of these two is shown together. A similar method applies to [e] and [æ] (as in ək/ [æk] ‘one’) which often interchange their places.

### 2.3 Vowels

The segmental phones of Bangla are slightly different from those of other Indo-European languages. According to (Ray, Hai, & Ray, 1966), in Bangla there are seven oral vowels, four semi-vowels and thirty consonants. The consonants are subdivided into twenty plosives (ten unaspirated and ten aspirated), three nasals, three liquids and four fricatives.

Bangla vowel systems basically follow the structure of cardinal vowels. All seven vowels are opposed to each other according to the height of the tongue (openness) and the articulatory area. The roundness of the lips is another point to be considered.

The vowels in Bangla are generally articulated a little lower in the oral cavity than those of cardinal vowels. The main difference between the two systems is the nasalized counterparts of the vowels in Bangla. Cardinal vowel system does not represent nasalized vowels, but Bangla does. A comparison between Bangla vowels and the IPA transcription convention shows that the later system has rounded front vowels ([y], [ʏ], [ø] and [œ]) and two middle vowels (the schwa [ə] and the vocalized [ɐ]) that are absent in Bangla (see Appendix – A).

In principle, all the vowels in Bangla can be nasalized. This is a characteristic of Bangla and some other Indian languages. However, each of them may be nasalized only in a word-initial syllable (except in some very rare cases) which is not a standard feature of many languages. The following figure illustrates the location of Bangla vowels in the cardinal vowel structure with reference to the IPA symbols. Bangla vowels are shown in circles while Cardinal vowels are bold-lettered. Remaining symbols represent the IPA convention.

Bearing in mind the observation by (Ray, Hai, & Ray, 1966) that

“Each of the above (the Bangla vowels) may, but only in word-initial syllable, be nasalized by simultaneous opening of the passage to the nose in the back of the mouth. There is no suggestion of a nasal consonant or semivowel following the nasalized vowel. Also, no nasalized vowel is either contrastive or obligatory or even frequent before or after a nasal consonant.”
(6) Cardinal vowels (position of Bangla)

In this work I shall consider to put a nasalized counterpart for all vowels of Bangla following the IPA convention of transcription. The simple table below shows the Bangla vowels with their nasalized counterparts:

(7) Bangla Vowels with corresponding nasals

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unrounded</td>
<td>Rounded</td>
</tr>
<tr>
<td>Close</td>
<td>i</td>
<td>ũ</td>
<td>u</td>
</tr>
<tr>
<td></td>
<td>i̯</td>
<td></td>
<td>ū̯</td>
</tr>
<tr>
<td>Close-mid</td>
<td>e</td>
<td>ŵ</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>ẽ</td>
<td></td>
<td>ŵ̯</td>
</tr>
<tr>
<td>Open-mid</td>
<td>æ</td>
<td>æ̇</td>
<td>ɔ̇</td>
</tr>
<tr>
<td></td>
<td>æ̇</td>
<td></td>
<td>ɔ̇</td>
</tr>
<tr>
<td>Open</td>
<td>a</td>
<td>ã</td>
<td></td>
</tr>
</tbody>
</table>
Now, let us consider some examples of pure and nasalized vowels of Bangla. A comparative set of such cases are listed in the following illustration.

(8) Pure and nasalized vowels in Bangla.
1. \( i -- Ĭ \) ihar (of this) -- Ĭhar (of him/her-polite)
2. \( u -- ŭ \) uki (a hiccup) -- ŭki (a peep)
3. \( e -- Ė \) eke (to him/her-informal) -- Ėke (to him/her-formal)
4. \( o -- ō \) ora (they-informal) -- ōra (they-formal)
5. \( æ – æ/combiningtildeaccent \) æk (one) -- hæ (yes)
6. \( ɔ – Ŕ/combiningtildeaccent \) Ŕkejo (useless) -- Ŕk (a nasal sound)
7. \( a -- â \) baʃi (stale) -- bāʃi (flute)

Here, most of the pairs are minimal pairs (except æ -- æ/combiningtildeaccent and Ŕ -- Ŕ/combiningtildeaccent). Among all the vowels in Bangla [a] (and [ã] from nasal ones) is the most frequent vowel. This set of pure and nasalized vowels provide the maximum number of minimal pairs in Bangla.

Very prominent nasalized vowels are also found in other major human languages in the world. For instance, French has nasal vowels like Bangla. But, compared to seven nasal vowels in Bangla, French has only four, viz., [e̞], [u̞], [ɔ̞] and [æ̞] ((Ghosh, 2003)).

(Bykova, 1981) has pointed out two important characteristics of the nasalization of Bangla vowels, namely, the frequency of occurrences of the nasalized vowels and the dependency of nasality.

A. The frequency of the usage of nasalized vowels in Bangla is much lower than that of the non-nasalized ones (i.e., the pure vowels). A calculation by (Ferguson & Chowdhury, 1960) (pp. 50-51) states that the total percentage of oral vowels is 44.72 while that of nasal vowels is hardly .87, a ratio of about 50:1. These figures are drawn on the basis of transcribed texts running to 10,130 phonemes and are counts of the relative frequency of individual phonemes in a running text. A similar statistics was found here when I checked for occurrences of these sounds in our present corpus.
(9) Frequency of occurrences of nasalized vowels

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>u</th>
<th>e + æ</th>
<th>o + ɔ</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-nasal (pure)</td>
<td>28199</td>
<td>12914</td>
<td>23511</td>
<td>36727</td>
<td>33768</td>
</tr>
<tr>
<td>Nasal</td>
<td>67</td>
<td>209</td>
<td>125</td>
<td>141</td>
<td>824</td>
</tr>
</tbody>
</table>

Although the grapheme to phoneme mapping is not so strong in this corpus, we get a fairly strong support of the data provided by (Ferguson & Chowdhury, 1960). We see the most frequent nasal vowel in Bangla is [ã] and the least frequent one is [ɔ̃]. These observations are almost identical to those found in the data presented by (Bykova, 1981) where [ã] and [õ] are reported as the most frequent ones.

B. The other aspect of Bangla nasal vowels is the dependency factor. It is essential to distinguish between dependent or positional and independent or phonological vowels in Bangla ((Hai, 1975)). Dependent or positional nasality of a vowel is caused by the influence of the preceding or (partly) following nasal consonant (of neighboring syllable). This is just an echo of the other nasal sound and not a phonological element of real vowel nasality.

On the other hand, we have pure nasal vowels which occur irrespective of their environment. (Hai, 1975) termed this type of events as phonological nasality. All the nasalized vowels shown in table 3 belong to this category. They can occur independently even in a single syllable.

2.4 Semi-vowels / Glides

By definition, a semi-vowel or glide is a sound that has the quality of one of the high vowels and that functions as a consonant before or after vowels. According to (Ray, Hai, & Ray, 1966) Bangla distinguishes four semi-vowels, viz., [ɨ], [ʉ], [ɜ] and [o̞], which may be described as non-syllabic varieties of [i u e o] respectively. For instances, let us consider the following instances:
(10) Usage of semi-vowels in Bangla

1. কাঁটা [kʰaj] -- I eat
2. লাড়া [laʔ] -- the bottle-ground
3. ভাগ [kʰaʔ] -- (he) eats
4. শাও [kʰaʊ] -- you eat

The observation by (Ferguson & Chowdhury, 1960) says the three low vowels [æ a ɔ] have no semivowel form of their own. And their occurrence is restricted solely as pure vowels and never with another vowel. On the other hand, [i u e o] occur post- and inter-vocally. A detailed study confirms that [u o] occur infrequently in prevocalic position when preceded by a consonant or juncture. Although [æ a ɔ] do not occur post or inter-vocally, they may sometimes occur with semivowels or glides.

The positions of the semi-vowels are very close to their vowel counterparts. Table 5 shows the locations of Bangla semi-vowels in the following vowel chart.

(11) Nasalized vowels in Bangla

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unrounded</td>
<td></td>
<td>Rounded</td>
</tr>
<tr>
<td>Close</td>
<td>i ì i̯</td>
<td></td>
<td>u ū u̯</td>
</tr>
<tr>
<td>Close-mid</td>
<td>e ê e̯</td>
<td></td>
<td>o ō o̯</td>
</tr>
<tr>
<td>Open-mid</td>
<td>æ æ̯</td>
<td></td>
<td>æ̯ æ̯</td>
</tr>
<tr>
<td>Open</td>
<td>a a̯</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to (Chatterjee, 1962) Bangla semivowels are non-syllabic, and predictably non-phonemic. He argues that all the four distinct vowel phonemes /i u e o/ have non-syllabic allophones in complementary distribution with the syllabic ones. But, (Ray, Hai, & Ray, 1966) gives a
different account on the syllabicity of allophones. According to this later work Bangla semivowels are non-syllabic, but phonemic and the non-syllabic phoneme /y w Y W/ (in our work, /i y u o/ ) can be distinguished from their syllabic counterparts /i u e o/. Although most of the linguists have accepted the view of (Ray, Hai, & Ray, 1966) on this issue, this controversy in the linguistic study of Bangla has still not ceased.

2.5 Diphthongs

The most important characteristic of a diphthong is claimed to be that it “… must necessarily consist of one semivowel” ((Jones, 1964)). Based on this principle (Sarkar, 1985) establishes a set of 17 diphthongs in Bangla. They are:

\[
\begin{align*}
\text{i} & \text{i} \\
\text{i} & \text{u} \\
\text{u} & \text{i} \\
\text{e} & \text{i} \\
\text{e} & \text{u} \\
\text{e} & \text{o} \\
\text{e} & \text{o} \\
\text{o} & \text{o} \\
\text{a} & \text{e} \\
\text{a} & \text{e} \\
\text{a} & \text{e} \\
\text{a} & \text{o} \\
\text{a} & \text{o} \\
\text{a} & \text{o} \\
\text{a} & \text{o} \\
\end{align*}
\]

But this list is not exhaustive. (Hai, 1975) describes a total of 31 diphthongs while (Chatterji, 1986) gives an account of 25 diphthongs in Bangla. So, it is not clear what the exact number of diphthongs in Bangla is. However, in the study by (Chatterji, 1986) the number of diphthongs are counted solely based on vowels, and not on vowel-semivowel (glide) combination like (Sarkar, 1985). And (Hai, 1975) has taken both vowels and semivowels (glides) into account at the second place of diphthongs.

Actually, Bangla has only two diphthongal letters in the alphabet. They are /bn ai/ [oi] and /bn au/ [ou]. But the basis of counting the number of diphthongs is phonetic and it results in numbers ranging from 17 to 31. And as a matter of fact, all diphthongs in Bangla are falling in nature, which means, they start with a vowel of relatively higher sonority and end in a vowel with relatively lower sonority.

Lists of diphthongs from all three works are given here for a comparative study. The first is according to the system of (Sarkar, 1985).
(12) Bangla diphthongs ((Sarkar, 1985))

<table>
<thead>
<tr>
<th>Vowels</th>
<th>i</th>
<th>u</th>
<th>e</th>
<th>o</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>ji</td>
<td>iu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>u</td>
<td>ui</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>ei</td>
<td>eu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o</td>
<td>oi</td>
<td>ou</td>
<td>oe</td>
<td>oo</td>
</tr>
<tr>
<td>æ</td>
<td></td>
<td></td>
<td>æe</td>
<td>æo</td>
</tr>
<tr>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>ai</td>
<td>au</td>
<td>ae</td>
<td>ao</td>
</tr>
</tbody>
</table>

Note that all the second members of the diphthongs are semivowels (glides) in this table. But the other two linguists do not accept the idea that the second member is compulsorily a semivowel.

But the table in (12) represents a fairly acceptable set of diphthongs where the second member is a falling vocoid (semivowels or glides). In every case, the second member is weaker than the first one. This is considered as the most recent and widely acceptable inventory on the diphthong issue in Bangla. But, (Chatterji, 1986) gives another set of diphthongs in Bangla that differs significantly from (Sarkar, 1985).

(13) Bangla Diphthongs ((Chatterji, 1986))

<table>
<thead>
<tr>
<th>1st member</th>
<th>i</th>
<th>u</th>
<th>e</th>
<th>O</th>
<th>æ</th>
<th>o</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td></td>
<td>ui</td>
<td>ie</td>
<td>Io</td>
<td>æ</td>
<td>o</td>
<td>ia</td>
</tr>
<tr>
<td>u</td>
<td></td>
<td>ui</td>
<td>ue</td>
<td>Uo</td>
<td></td>
<td></td>
<td>ua</td>
</tr>
<tr>
<td>e</td>
<td></td>
<td>ei</td>
<td>eu</td>
<td>Eo</td>
<td></td>
<td></td>
<td>ea</td>
</tr>
<tr>
<td>o</td>
<td></td>
<td>oi</td>
<td>ou</td>
<td>oe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>æ</td>
<td></td>
<td>æe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>oø</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td></td>
<td>ai</td>
<td>au</td>
<td>ae</td>
<td>Ao</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Here, we see a group of 25 diphthongs where no entry contains any semivowel (glide). Only the set of 7 regular vowels are used in both the X and Y-hands of the table to generate these diphthongs. However, this table is not exhaustive. On the other hand, (Hai, 1975) argued for a total of 31 diphthongs among which 19 are regular and 12 are irregular.

(14) Bangla diphthongs ((Ray, Hai, & Ray, 1966))

<table>
<thead>
<tr>
<th>Regular Diphthongs</th>
<th>Irregular Diphthongs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii, iu, ei, eo, eu, æo, æʃ, ai, ao, au, ae, o, æ, oo, ou, oi, oʃ, ui, uu</td>
<td>ia, ie, io, ea, eo, æa, ɔa, oa, oe, ue, ua, uo</td>
</tr>
</tbody>
</table>

It is clear that Hai includes pure vowels as well as semivowels in his list of diphthongs. In his work, diphthong [æ] is used as the second member in 4 regular diphthongs viz., [ææ, æe, æʃ, æo]. The other 27 diphthongs consist of only vowels.

It is evident from preceding tables and discussion that Bangla doesn’t have a uniform and standardized set of diphthongs. None of these approaches is considered beyond any controversy. Rather, they co-exist and are used by the scholars depending on the intention concerning the very purpose of specific studies. In the present work, we will follow the inventory of diphthongs presented by (Sarkar, 1985).

2.6 Consonants

Bangla possesses a total of 30 consonants. Twenty of these (thirty) consonants are either plosives or affricates. This two-third portion forms a block of regular consonants in Bangla. They can be divided into two categories of ‘voiced’ and ‘voiceless’ where each category can be further subdivided into unaspirated and aspirated categories.

In terms of the place of articulation, this block has five different classes. They are velar (k-class), Paleo-alveolar (c-class), Retroflex (ɾ-class), dental (t-class) and bilabial (p-class). Each class consists of four sounds: voiceless-unaspirated, voiceless-aspirated, voiced-unaspirated and voiced-aspirated. Other regular consonants, which can be found in most languages, are two fricatives [ʃ s] (considered as allophones), three nasals [m n], one lateral [l], three flaps [ɾ ɾʰ r] (among which the first two are uncommon) and one glottal [h].
Most of the consonants are very common in nature and can be represented in a table following the IPA standard. However, a few of them may need some elucidation for a better understanding. For instance, [ɽ] is a sound unfamiliar to non-native speakers of Bangla. According to (Ray, Hai, & Ray, 1966), this sound “is made by the underside of the tongue tip flapping down just once against the surface above the upper teeth ridge and not completely stopping the flow of breath down through the middle.” This sound is more like /rd/ in American /hardy/. [ɽ] has a very limited frequency of occurrence compared to alveolar flap [r]. On the other hand, [ɽʰ] is the aspirated counterpart of [ɽ]. This sound also has a very rare occurrence in Bangla. Let us have a look at the following table of frequency of occurrences of the three flaps in Bangla.

(15) Frequency of Flaps in Bangla in the corpus used here

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>ɽ</th>
<th>ɽʰ</th>
</tr>
</thead>
<tbody>
<tr>
<td>29921</td>
<td>1947</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

A detailed illustration of the place and manner of articulation of the consonants can be obtained from Appendix I.