

Original Research Article

Acquisition of Voicing Alternations in Bangla: A Morpho-phonological Study

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ABSTRACT

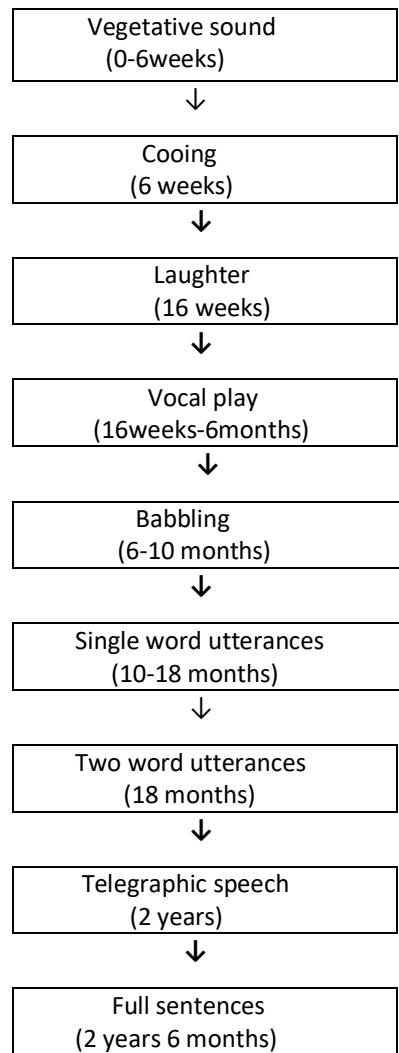
Voicing alternation is a linguistic terminology which is mainly discussed in phonology and morphology. Although it is a very potential research topic in linguistics, no comprehensive research has been found to investigate this area from Bengali language context. At present, it has been analyzed in different language perspectives. The purpose of the study is to know the phonological features of voicing alternations in the language of Bengali children. Simultaneously, this study actually attempts to assess the capacity of using voicing alternations. This thesis is mainly concerned with the acquisition of voicing alternation which is found in different morpho-phonemic contexts. In order to reveal the nature of voicing alternations of Bengali children, a qualitative research method was applied to collect and analyze the data. The result of this dissertation has been explored by collecting data from the participants through semi structured interview method because it is a highly flexible technique to collect qualitative data. Eighteen Bengali children were interviewed. The most common finding is that the production of voicing alternations even in known words remains difficult until at least 30 months of age in the speech of Bengali children. On the other hand, Bengali-learning children are able to produce voicing alternations earlier who have more MLU than their age. However, results indicated that the tendency of using voicing alternations increases with age. A study on the acquisition of voicing alternations has become an important part of study in the department of Linguistics. So this study may play an important role in this field of linguistics as it focuses on the phonological features of voicing alternations in the language of Bengali children. However, this research can be helpful for the students of Linguistics department. This study also contributes to the knowledge of those who are willing to conduct similar researches in the area.

1. Introduction

Bangla is an Indo-European language which is spoken predominantly in the Indian subcontinent. It is the national and official language of Bangladesh and the states of West Bengal, Tripura, Assam and Andaman Nicobar Island by approximately 200 million people. It is considered to be the seventh most spoken language in the world on the basis of population.

1.1. Language Acquisition

Language is an innate ability to human being. Usually children acquire language unconsciously after their birth. They start producing their first words around the age of 10 months. Gradually, children acquire the whole linguistic process. "Language acquisition refers to the learning of linguistics rule" (Crystal, 1985: 5). According to Chomsky, children are born with a special ability to acquire a language. This capacity of acquiring a language is known as universal grammar (UG). Trevor A Harley mentioned the development of child language acquisition in this way:



(Sources: Harley 2003: 92)

According to the above mentioned diagram, children acquire the ability to create sentences between 0-3 years. The preliminary stage of language acquisition is phonological development. It is considered as the preparation stage of word development. A child can understand that different expression of sound may differentiate the meaning in adult language from the first year of his birth. But in that time, they use only a few sounds to express their language. In this way, they develop the different stages of language like phonology, morphology, syntax etc.

1.2. Morpho-phonological Alternations:

Morpho-phonology denotes the interaction between morphology and phonology. It occurs due to the influence of phonological factors. This process may be described by various phonological rules and represented by double slash (// //). Morpho-phoneme indicates the morphological form that is affected by the phonological environments. It exhibits:

- The phonological structure of morpheme.
- The phonetic process of morpheme when they combine to form word.
- The alternative forms which serves a morphological function.

Morpho-phoneme takes place in different situations which indicate its nature. There are ten types of morpho-phonemic changes such as: loses of phonemes, addition, assimilation, dissimilation, synthesis, gradation, syllabic vowel change, and consonantal change etc. In Bangla, morpho-phonemic changes occur when the morpheme contains suffix such as: /ik/

[ʃɔmaj] – [ʃamajik]

[din] – [dɔinik]

On the other hand, morpho-phoneme also occurs in Sandhi like:

him+aloi → [himaloi]

biḍḍa+ aloi→ [biḍḍaloi]

Moreover, this process also takes place in synthesis process.

ʃɔm + dʰan → [ʃɔndʰan] (m+dʰ> n)

ʃɔm+lɔp → [ʃɔlɔp] (m+l>ɲ) etc.

Voicing alternation is a common process in phonological theory. Generally alternation occurs when the pronunciation of a morphological unit varies according to its contexts. It is a private features of language which is common to all human languages.

1.3. Objectives of the Study

This research will provide a systematic description and analysis related to the morpho-phonemic patterns of voicing alternations in the speech of Bengali children. This study was conducted following some distinct objectives. The main objective of the study is to know the phonological features of voicing alternations in the language of Bengali children. In addition, some specific objectives of this research are stated below:

- To provide a morpho-phonemic description of voicing alternations in the language of Bengali children.
- To explain the nature of their morpho-phonemic patterns on the basis of voicing alternations phenomena.
- To investigate the patterns of voicing alternations.
- To acquire knowledge about voicing alternations in Bengali children.

1.4. Rationale of the Study

Voicing alternation is one of the most prominent phonological process which is common to all human languages. It is thought that voicing alternations appear early in the speech of children. Generally, acquiring voicing is very difficult for children because it has no regular pattern. The purpose of the study is to to know the phonological features of voicing alternations. This thesis is mainly concerned with the acquisition of voicing alternation which is found in different morpho-phonemic contexts. The proposed research tries to investigate how and when voicing alternations are acquired by Bengali children. This study will help to know the ability to use and the frequency level of voicing alternations in the speech of Bengali children.

1.5. Outline of Research Paper

There are five chapters in this research. The chapter outline structure is as follows:

1.5.1. Chapter One

This is the introductory chapter which presents the overview of the whole study. It includes the introduction, objectives, rationale, limitations and conclusion.

1.5.2. Chapter Two

This chapter presents the theoretical analysis which uses mainly two theories such as acquisition theory and rule based phonology. This chapter also reviewed of literature from many sources which is related to voicing alternations. The purpose of literature review is to get information on what other scholars did before with the same subject.

1.5.3. Chapter Three

In this chapter I present the methodology of the research which included reason behind using qualitative method, epistemological basis of research, research questions, sample size, data sources, data collection techniques and the whole procedure of research.

1.5.4. Chapter Four

This chapter deals with the presentation and analysis of data assorted from the research area. At the end of this chapter the collected data were interpreted. This chapter also presented the findings, the morpho-phonemic patterns of voicing alternations in the phonology of Bengali children.

1.5.5. Chapter Five

In this chapter, I summarize the results and discuss the implications for the phonological analysis of voicing alternations. This is the final chapter of this research in which the recommendations and conclusions were discussed. The recommendations and conclusions were based on the objectives of the study. Mainly this chapter wrapped up the findings and provided some recommendations for finding ways to improve the current study.

1.5.6. Conclusion

This chapter presented the introductory knowledge about voicing alternations. It gives the ideas about the research problem and the justification of research. Here, we selected some objectives. And a clear idea about whole research paper is also given in this chapter.

2. Theoretical Perspective

2.1. Introduction

Voicing alternation is a dominant topic in phonological theory which is considered to be a natural process. It indicates the 'replacement of a voiceless consonant with the corresponding voiced consonant' (Martin, 1952, p. 48). Generally alternation occurs when the pronunciation of a morphological unit varies according to its phonological contexts. The linguistic term 'voicing' denotes the presence of vocal fold vibration during the production of sound. Voicing alternation is commonly available in different morphological contexts in different languages such as:

In Bangla, 1. **A. Voicing Alternations with Inflectional:** A. [balɔk] ~ [balɔgɔɖer]
k → g / -ɔɖer

B. Voicing Alternations with Compounding: A. [haɪgʰori] ~ [haɪgʰori]
t → ɖ / -g

In Dutch, 2. **A. Voicing Alternations with Inflectional:** A. [bɛt] ~ [bɛdən]
t → ɖ / -ən

In Japanese, 3. **A. Voicing Alternations with Inflectional:** A. [tofu] ~ [yudoofu]
t → ɖ / -u

In the first example, 1 (A) shows that the singular word 'balɔk' becomes voiced when it contains a possessive marker /-ɔɖer/. In the second example, 2 (A) Here voiceless obstruent /t/ becomes voiced /ɖ/ when it follows a voiced consonant. In the example 3 (A), the consonant is voiced by the preceding vowel / u /.

Cross linguistically, voicing alternation is a phonological process which is common to all human languages. The notion of voicing contrast is very important for acquiring voicing alternations which are mainly captured by a binary feature [+voice]. As voicing alternation is a natural process, so it must be acquired.

2.2. Acquisition of Voicing Alternations: A Psycholinguistic Intervention

Voicing alternation is a natural process which is nearer to universal. According to Chomsky (1959), children are born with a special ability to acquire a language. This capacity of acquiring a language is known as universal grammar (UG). Voicing is universally a private feature of a language which is an innate and universal process. This process of acquisition must be guided by innate principles. To acquire knowledge about voicing alternations Bengali children need to have both productive and perceptive knowledge about the Bengali voicing contrast. Voiced segment is marked as [voice] contrasting with either [-voice] such as [bakɔɖɔɖa] ~ [bagɔɖɔɖa] here, [-Voice → + voice]. It is thought that this process is very difficult for children to acquire because it has no regular pattern. In English, voicing contrast is acquired by the age of two. Kerkhoff (2007) stated, Dutch children have perceptive knowledge of the initial voicing contrast is around the age of two, whereas productive knowledge is around the age of three. According to Buckler (2014), German children are able to distinguish voicing alternations at 9 months of age. This research will examine how voicing alternations are represented in the children's mental lexicon. It is related to the concept of regularity, productivity and transparency. Generally, it is thought that regular, productive and transparent alternations appear early in the speech of children.

2.3. Phonological Acquisition: A Cross Linguistic Analysis

2.3.1. Productions of Voicing Alternations

Voiced sound is produced with the vibration of vocal cords. The vocal cords vibrate when there is enough air pressure below the glottis to force the vocal folds apart (Odden, 2005). On the basis of articulatory account, voicing is easy to pronounce for children. It is easier to produce /balɔg/ than /balɔk/ for Bengali children. The main difference between voiced and voiceless obstruents in languages has been represented in phonology with a binary feature [voice] (Keating, 1984, Kingston & Diehl 1994). This category represented as b, d, g is specified as [+voice] and other category represented as p, t, k is [-voice]. According to Lisker & Abramson (1964), there are some languages that tend to have contrastive categories of stops based on differences in VOT which defined as the 'timing relation between voice onset and the release of occlusion' (p. 387).

The voicing contrast is generally developed early in the speech. Haque (1994) stated, the most common sound in children's speech is bilabial consonant /p, b/ which children learn easily. They acquire /b/ before /p/ both Bengali and Dutch languages. On the other hand, children acquire voiced obstruents before voiceless obstruents, unaspirated before aspirated, stops before fricatives and fricative earlier affricate sounds (Jakobson, 1939).

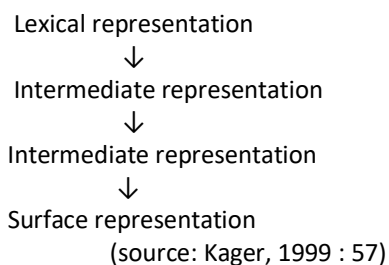
Decker & Halle (2007) studied at the rate of voicing alternations depending on large corpora in French. They published that the rate of voicing alternations becomes below 2% when it occurs in word internally and raises up to 90% in word endings. But in regressive assimilation context, it becomes high as 20%. On the other hand, Buckler & Fikkert (2015) studied on German and Dutch voicing alternations. In this study, they investigated how voicing alternations are represented in the children's mental lexicon. Typically, Dutch children exhibited overgeneralizations of voicing alternations and show more errors in devoicing whereas German children preferred to the correct pronunciation to mispronunciation (Buckler & Fikkert, 2015). On the other hand, German children show more errors in voicing contexts. So it can be said that, the acquisition of voicing alternations is influenced by language specific issues.

2.4. Voicing Alternations: A Rule Based Explanation

Voicing alternation is a common phonological process in generative theory. It will be discussed in the light of rule based phonology in the next section. In this current dissertation, Optimality theory (OT) will not be included because this research will mainly focus on acquisition as a result rule based theory is enough to under this acquisition process. It is a limited level of research. That's why optimality theory will not be included in this dissertation.

2.4.1. Acquisition of Rules

The key principle of rule based phonology is rewrite rules where rules are represented in a linear ordering (Kager, 1999). It takes the input as a linguistic representation which is transformed into the output by derivation such as,

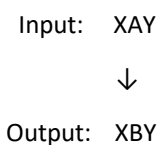


In this theory, rule can be mediated between two levels that can be presented,

$$\text{Underlying form} \leftrightarrow \text{distribution statistics} \leftrightarrow \text{surface forms}$$

Generally, underlying form indicates the mental phonemic level whereas surface form specifies the particular positional variants which realise the underlying phonemes.

Application of rewrite rules can be presented,



Here, XAY indicates the rules input and XBY indicates the rules output.

In Russian, alternation occurs in nominative and dative pair which is found in word final positions such as [grip] ~ [grib-u] and [prok] ~ [prog-u]. Here word final voiceless obstruents /p/, /k/ becomes voiced when they contain /-u/ morpheme. Here /p/ becomes /b/ and /k/ becomes /g/. We can formulate this alternation using a phonological rule as follows.

$$[-\text{voice}] \rightarrow [+ \text{voice}] / \text{v} - \text{v}$$

A consonant becomes voiced in the presence of a following vowel. Voicing also occurs in compounding such as [sat-mixaile] ~ [sad-mixaile] and [otkas-leni] ~ [otkaz-leni] etc. Here word final voiceless obstruents become voiced before a following sonorant. Moreover, Russian uses a voicing contrast for labial, alveolar, velar and fricative alveolar /p/-/b/, /t/-/d/, /k-g/, /s/-/z/ etc. Moreover, voicing assimilation occurs in different positions in words such as word initial, medial and final.

Typically, rewrite rules are language specific and their format is universal. In rule based approaches, rules have a specific format (A→B/ X–Y). Here,

A indicates the class of sounds affected

B indicates the change

X–Y is the context

The arrow [→] specifies the change operation.

Voicing alternation is also found in English suffix /-s/. It occurs after voiceless obstruents like Cats [kæts] and /z/ after voiced obstruent such as dogs [dɔgz] (Berko 1958, Derwig & Baker 1980). So English follows the rule of voicing assimilation,

$$[-\text{voice}] \rightarrow [+ \text{voice}] / [+ \text{voice}]$$

Another example of alternation is lexically conditioned typically known as irregular such as [knife] ~ [knives] and [wife] ~ [wives] (Zonneveld 1978 & Booij 1995).

2.4.2. Rule of Voicing Assimilation

In rule based phonology, the phenomenon of voicing assimilation has received much attention nowadays. Assimilation defines when the production of a sound is influenced by an adjacent sound (Devenport & Hannahs, 2011). A standard rule of voicing assimilation in Bangla,

$$\text{Obstruent} \rightarrow \text{voiced} / - \text{voiced obstruent}$$

$$[\text{k} \text{äp} \text{b} \text{e}] \sim [\text{k} \text{äb} \text{b} \text{e}]$$

The rule of voicing assimilation converts obstruents underlyingly specified as [+voice] into their [-voice] counterparts. Bhattacharja (2009) presented the regressive voicing assimilation in Bangla which occurs in compounding and inflectional positions such as, [futbɔl] ~ [fudbɔl] and [äkbe] ~ [ägbe] etc.

2.5. Parameters Setting

No comprehensive research is found on the acquisition of voicing alternations in Bangla. To acquire knowledge about Bangla voicing alternations, five parameters can be determined. These are:

2.5.1. Mean Length of Utterance

Mean length of utterance is a process by which children's morphological development is analyzed. It is considered to be a valuable estimate of children's early acquisition. Typically, a child's MLU corresponds closely to their age. The use of voicing alternations mainly depends on child's MLU. Children who have more MLU, they have tendency to use more voicing alternations in their speech. On the other hand, children who have less MLU, they produce less voicing in their speech.

2.5.2. Tendency of Doing Voicing Alternations

The phonological acquisition of child's mainly depends on their tendency. The tendency of using voicing alternations helps to assess the frequency level of the occurred voicing in a particular language. Early production will be studied to investigate how and when voicing alternations are acquired by Bengali children. It is possible to identify why voicing alternations are occurred just for articulatory or environmental factor.

2.5.3. Intervocalic Obstruents

Intervocalic obstruent occurs both in languages of the world and child's phonology which is prominent in child's early grammars. It is commonly available in different phonological environments which exist in the middle of a word. To acquire knowledge about voicing alternations in Bengali children, it is possible to recognize the intervocalic obstruents of voicing assimilations. We can also identify which obstruents are assimilated and which are not.. It will help to know the patterns of voicing alternations in the phonology of Bangla. Typically, it occurs in different positions in words such as word initial, medial and final etc.

2.5.4. Morpho-phonemic Features

Morpho-phonemic features arise in different morphological paradigms in a language. Voicing alternation is commonly available in different morphological contexts including inflectional, sandhi and compounding positions etc. To identify the phonological features of voicing alternations, we can provide a morpho-phonemic description of voicing alternations in the language of Bengali children.

2.5.5. Place of Articulation

Voicing assimilation occurs in different places of articulation such as bilabial, dental, velar and alveolar etc. With the help of this parameter, it is possible to assess in which places Bengali voicing assimilations are actually occurred.

These parameters will be used to acquire knowledge about voicing alternations in the current study. In this regard, by determining the appropriate research method using the necessary techniques of data collection, presentation and analysis will be determined in the next chapter.

2.6. Conclusion

Various theories of language acquisition discussed in this chapter. Usually, traditional model of phonology predicts that, rules are applied in certain contexts. Specific prediction for the acquisition of voicing alternations will be discussed in the next chapter. The data will be represented from the speech of Bengali children.

3. Research Methodology

For any research study, methodology is the most significant part to guide the whole process of conducting the study. Generally, methodology indicates how a particular research is conducted and what methods are used in the process of conduction. The proposed study needs a spontaneous and natural response from the participants. This research uses cross sectional study because it has two groups of children at the age of 24 to 36 months of age. Therefore, interview method has been used to collect data. I have selected qualitative method as a scientific research technique for this study. In this chapter, I have mentioned what are the main objectives, which approach I have followed to conduct this research and the whole procedure of research.

3.1. Research Questions

Voicing assimilation is generally considered to emerge early in the speech. It occurs at two word stages. Children are able to alternate morpho-phonemic pattern at this stage. The main objectives of this research are to provide a morpho-phonemic description of voicing alternations and to explain the nature of their morpho-phonemic patterns on the basis of voicing alternations phenomena. Considering the above-mentioned aims of this proposed work, we can formulate the following research question of this study as stated below:

- What are the phonological features of voicing alternations in the speech of Bengali children?

To answer this question, we have determined five parameters in the previous chapter. These are:

- Mean length of utterance
- Tendency of doing voicing alternations
- Intervocalic obstruents
- Morpho-phonemic features
- Place of articulation etc

Considering the above-mentioned parameters, we may get two types of answers:

‘The frequency level of voicing alternating pattern in the phonology of Bengali child is less than adults’.

So it can be said that acquiring voicing alternation is very difficult for Bengali children because it has no regular pattern.

On the other hand, we may get another answer:

‘Voicing assimilation is regular in the phonology of Bengali children’.

If we find that voicing assimilation is regular in Bangla language after collection and observation of data, then we may formulate the following research questions:

- How and when voicing alternations are acquired by Bengali children?
- How often Bengali children use voicing alternations in the phonology of Bangla?

3.2. Reason Behind Choosing Qualitative Approach

The main reason of conducting this research work is to find out the phonological features of voicing alternations in the language of Bengali children. The proposed research presents a descriptive analysis regarding the voicing assimilation of Bangla. I have chosen qualitative approach to conduct my research because if I choose any one method, quantitative or mixed method, then it would be difficult to find out the actual picture.

Research questions have played a vital role in determining the research method. These are determined on the basis of what the researcher wants to expose in his research. The main questions of this research are: what are the phonological features of voicing alternations and how often Bengali children use voicing alternations in the phonology of Bangla. To answer these questions, I collected data by using pictures and word stimuli which are related to qualitative method.

3.3. Participants

Participants of the present study comprised of 20 children. Among them 9 were boys and 11 were girls participated in the experiment. Two boys did not complete the test and was excluded from the analysis. In this current research, purposive sampling process has been used. The remaining 18 participants can be divided into two age groups. These are:

- 24 to 30 months and consisted of 5 children (5 girls)
- 31 to 36 months and consisted of 13 children (7 boys, 6 girls)

The reason for selecting this age limit is that it is considered as the standard for getting relevant data because Bengali children are able to alternate morpho-phonemic pattern with this age range. All of the child’s utterances were recorded, phonetically transcribed and later analyzed. Children had no known pathology in their linguistic or mental development.

3.4. Source of Data Collection

This research study followed qualitative approach and data have been collected from both primary and secondary sources.

3.4.1. Primary Data

Primary data indicate the raw data which are collected directly from the fieldwork. The proposed research needs a spontaneous and natural response from the participants. Therefore, primary data were collected from a standard sample size of 18 Bengali children with an age of 24 to 36 months. To ensure the quality of research, semi structured interviews were used.

3.4.2. Secondary Data

Secondary data are often in the form of second hand data and published materials. In order to prepare my study, secondary data were collected from many sources such as published books, dissertations, journals, literatures, websites etc. Moreover, relevant documents and articles available at different open sources were reviewed. Finally, I have analyzed and assessed secondary data relating to voicing alternations.

3.5. Procedure

In order to conduct this research, I have chosen a number of 15 words with medial obstruents taken from Bengali language which are my research materials. With the help of these materials I went to my study place. Data collection has been conducted from the field by using interview method. Data were collected from both rural and urban children. Through this way, I collected data from the participants. It took 8 days to complete the data collection.

Necessary task based tests were designed to collect data. Colorful pictures were selected for collecting data from children. In this task, every word was matched to picture that visually described it. Pictures were presented to each child separately. They were familiar with these pictures.

To elicit voicing assimilation of Bangla language, children were encouraged to perform a picture naming task that may reveal his or her knowledge of Bangla voicing alternations. Children first saw the pictures then they were asked to produce the name of the pictures. The child was praised after producing each word. Responses were varied from children to children specially rural to urban children. Sometimes children failed to give response of the naming task, in that case this word was excluded from the list. They were encouraged to repeat the stimulus until it was correctly pronounced. When two or more responses were given, the final one was taken in the analysis. For this a list of words and pictures are given in appendix.

Children were all tested in their home environment. During the production test, they were given chocolate as a reward. During collecting data, the parents of participants helped me cordially.

3.6. Data Collection Tools

A pilot survey was conducted with three children included more words to test whether the picture stimuli sufficed to express voicing alternations. After completion of the study, some words were excluded from the test. The final test included 15 words in the relevant phonological environment taken from Bengali language. For that, nouns, adjectives and verb words were chosen to collect data which are my research materials. The most common words were selected so that children would know them. A list of words is presented in Appendix (1). The test stimuli of the present study contained in a set of 14 pictures. I have collected data from the fieldwork by interview. Finally, responses were recorded on an electronic device and transcribed by IPA. Moreover, Audio video recorder, paper and pen were also used to collect data.

3.7. Ethical Considerations

Ethical consideration is an important part of any research. Thus, to conduct any research, the researcher should be careful about the ethical issues (Baker, 1999). At the time of data collection, I tried my level best to ensure the ethical standards in every step.

- Before starting data collection, I took permission from the parents of participants.
- I have informed all the parents about the aims of my research before interviewing.
- At the time of data collection, I did not force any children.
- In case of interpretation of data, I tried to provide an accurate account of the information.

3. Results and Discussion

In this chapter the data collected from participants are presented and analyzed on the basis of phonology and morphology. In the present dissertation, to know about voicing alternations, data were collected from Bengali children. The aim of this chapter is to find out the pattern of voicing alternations in the phonology of Bengali children by analyzing the obtained data.

4.1. Data Presentation

4.1. 1. Semi-structured Interview

In order to conduct this dissertation semistructured interview method was selected as a technique of data collection. Data have been collected from 18 children with an age of 24 to 36 months of age. The reason for selecting this age range has been presented logically in the previous chapter (third chapter). The aim of this selecting semi-structured interview was to explain the nature of voicing alternations in the language of Bengali children properly. As mentioned, data were collected from participants by using pictures and word stimuli. The list of words and pictures are given in the Appendix A (2). Responses were recorded on an electronic device. Data were transcribed manually to identify the pronunciation of word medial obstruents rather than the acquisition of morpho-phonological alternations. In this study three groups were participated.

Group	Participants Boys	Participants Girls	Total
1	0	5	5
2	7	6	13

Fig: number of total participants

4.1.2. Group: 1

4.1.2.1. Tendency of Using Voicing Alternations

- Children exhibited a weak tendency of voicing alternations.
- Voicing alternation was not regular in this group.
- Most children did not produce voicing alternations.
- There was a tendency for voicing alternations to co-occur after vowels.
- Two participants produced more voicing alternations.
- Three participants produced less alternations.

4.1.2.2. Way of Doing Voicing Alternations

The most common finding is that the production of voicing alternations even in known words remains difficult until at least 30 months of age in the phonology of Bengali children

- Only two participants were able to produce voicing alternations at 2;0-2;6 years old.

4.1.2.3. Mean Length of Utterance

- Participants who had more MLU, they were able to produce more voicing alternations.
- Participants who had less MLU, they did not produce voicing alternations.

4.1.2.4. Patterns of Voicing Alternations

- In medial obstruents, participants produced more voiceless obstruents.
- They produced less voiced obstruents in medial positions.

4.1.2.5. Place of Articulation

The list of words included voiceless stops at five places of articulation such as bilabial, dental, alveolar, velar and palatal sounds.

- Children produced voicing alternations in bi-labial sounds.
- They produced less use of voicing alternations in palatal, dental and velar sounds.
- Participants produced less use of voicing alternations. As a result, voiceless obstruents become voiced obstruents such as,
 - Voiceless velar stop /k/ becomes voiced velar /g/
 - Voiceless palatal stop /c/, becomes voiced palatal /j/
/ch/ becomes voiced palatal /j/ or /d/
 - Voiceless alveolar stop /t/ and /t^h/ become voiced alveolar /d/
 - Voiceless dental stop /t̪/ becomes voiced /d/

4.1.3. Group: 2

4.1.3.1. Tendency of Using Voicing Alternations

- Children produced more voicing alternations.
- Voicing alternation was regular in this group.
- It was more frequent in some phonological environment.
- There was a tendency for voicing alternations to co-occur after vowels.
- All Participants produced voicing alternations.

4.1.3.2. Way of Doing Voicing Alternations

The most common findings is that Bengali children are able to produce voicing alternations at 30 months of age.

4.1.3.3. Patterns of Voicing Alternations

- Voicing alternation occurs in compounding positions.
- Voicing alternation also exists in inflectional. In voicing, voiceless obstruent becomes voiced before the suffix /-be/.
-

4.1.3.4. Place of Articulation

The list of words included voiceless medial obstruents at five places of articulation such as bilabial, dental palatal, velar and alveolar. From obtained data,

- Data reveal that children used more voiced obstruents than voiceless obstruents.
- In medial obstruents, Participants produced more use of voicing alternations.

As a result, voiceless obstruents become voiced obstruents such as,

Voiceless velar stop /k/ becomes voiced /g/, /b/, /d/, /d/ stops

Voiceless bilabial /p/ becomes voiced /b/

Voiceless palatal stop /c/, becomes voiced palatal /j/

/ch/ becomes voiced palatal /j/ or /d/

Voiceless alveolar stop /t/ and /t^h/ become voiced alveolar /d/ or /b/

Voiceless dental stop /t̪/ becomes voiced /b/ or /d/

Medial /g/ was more frequent than /b/, /d/, /d/ stops. On the other hand, /d/ was more frequent than /b/ etc.

4.1.3.5. Mean Length of Utterance

The use of voicing alternations mainly depends on the amount of MLU which increases with age. That's why in this group the presentation of MLU is redundant. In these two groups, children are exposed to a large amount of variation in the first group. Result shows that the second group produced more voicing alternations than the first group and they maintain a regular pattern of alternations.

4.2. Data Analysis

In the present study to see the phonological features of voicing alternations, all obtained data were analyzed. The parameters mentioned in the second chapter were kept in mind. Four parameters that were used to determine the patterns of voicing alternations in the language of Bengali children. The following parameters were examined:

- Mean length of utterance
- Tendency of voicing alternations
- Intervocalic obstruents
- Morpho-phonemic features
- Place of articulation etc.

It is possible to analyze the phonological features of voicing alternations on the basis of parameter mentioned above. I have analyzed the data by keeping in mind several phonological components, Through the analysis I got particular features of voicing alternations.

4.2.1. Mean Length of Utterance

Mean length of utterance is a process by which children's morphological development is analyzed. It is considered to be a valuable estimate of children's early acquisition. According to Miller (1981), MLU indicates the sum of the number of morphemes in each intelligible utterance divided by the number of fully utterances. Typically, a child's MLU related to their age. Roger Brown described five stages of language development depending on MLU.

Stage	MLU	Approximate Age (In Months)
1	1.0-2.0	12-26
2	2.0-2.5	27-30
3	2.5-3.0	31-34
4	3.0-3.75	35-40
5	3.75-4.5	41-46
6	4.5+	47+

Source: compiled from Brown (1973)

Moreover, Williamson (2014) stated that, at 20-30 months of age utterances are typically two words long, at 28-42 months they are up to four words long, at 34-48 months they are up to six words, at 48 months of age they usually longer than six words.

The use of voicing alternation mainly depends on child's MLU. Research shows that children who have more MLU, they have tendency to use more voicing alternations in their speech. On the other hand, children who have less MLU, they produce less voicing in their speech.

4.2.2. Tendency of Using Voicing Alternations

The phonological acquisition of child's mainly depends on their tendency. The tendency of using voicing alternations helps to assess the frequency level of the occurred voicing in a particular language. As cross linguistic evidence shows that Dutch has a tendency to occur voicing alternations after vowels or nasals such as [blut] ~ [bluden] and [lamp] ~ [lamben]. Similarly, Bengali voicing alternations also occur after vowels like [papbar] ~ [pabbar]. Moreover, Russian occurs before sonorant. Kerkhoff, 2007; Zamuner, 2011; Vijver & Henney, 2011 studied on both German and Dutch languages to explore how children are accurate in producing alternatives in familiar words. They found that the production of voicing alternations even in known words remains difficult until school age. On the other hand, English children are able to acquire voicing contrast at the age of two. On the basis of articulatory account, voicing is easy to pronounce for children. Zamuner et al (2011) studied on Dutch 3 year olds and revealed that they have little difficulty in producing voicing segments. They use voiceless segments more reliably than voiced obstruents. Neijt & Schreuder (2007) argue, although voiced sounds are easier to produce by a child, they may be perceived as voiceless because of the slow speed of the child's articulation. The features that we observed from obtained data that voicing alternation occurs after vowels. Moreover, the production of voicing alternations remains difficult until 30 months of age.

4.2.3. Intervocalic Obstruents

Generally, Intervocalic obstruent exists in the middle of a word. It occurs both in languages of the world and child's phonology which is prominent in child's early grammars (Smith 1973, Stampe 1973, Edwards & Shriberg 1983, Bernherdt & Stemberger 1998). Kerkhoff (2007) studied on Dutch voicing alternations and found that voicing is predicted to occur in intervocalic positions or after nasals such as [lamp] ~ [lambə]. According to Kuijpers (1993), children are able to correctly identify medial voiced and voiceless obstruents in Dutch at 3 years old. He also stated that medial /d/ is more frequent than medial /t/. Voicing is easier to produce // than /d/ in Dutch (Van Alphen, 2004). On the other hand, Zamuner et al said that medial /d/ must have been acquired at 3;6 months of age. On the other hand, Decker & Halle, (2007) studied at the rate of voicing alternations depending on large corpora in French. They published that the rate of voicing alternations becomes below 2% when it occurs in word internally and raises up to 90% in word endings. But in regressive assimilation context, it becomes high as 20%. He also said that voicing is distinctive in word initial and word medial in French. Children generally prefer voiceless obstruents in codas and voiced obstruents in medial positions (Dinnsen, 1996).

It is possible to get ideas about intervocalic obstruents of voicing alternations in the language of Bengali children with the help of obtained data. These are:

- Bengali children are able to produce intervocalic obstruents at 30 months of age.
- Medial /d/, /j/ are more frequent than /t/ and /c/.
- Voiceless obstruents become voiced in intervocalic positions.

4.2.4. Morpho-phonemic Features

Voicing alternation is commonly available in different morphological contexts including inflectional, sandhi and compounding positions etc. As cross linguistic evidence shows that Dutch has past tense suffix /-de/ which is subject to progressive voicing assimilation. It becomes /-te/ when applied to roots ending in a voiceless obstruent. Analogously, Yiddish occurs only with a specific suffix /-zikh/ (Whitehead, 2012). Moreover, Turkish shows a set of suffixes which exhibit voicing alternations in the initial stop such as /-da/ -ta. A similar distinction is that of the English plural morph /s/ and /z/ perhaps most quoted example of allomorphy.

On the other hand, Bhattacharja (2009) presented the regressive voicing assimilation in Bangla which occurs in compounding and inflectional positions such as, [futbəl] ~ [fudbəl], [dakbo] ~ [dagbo], [kăpbe] ~ [kăbbe] etc. Moreover, Bangla also shows voicing in Sandhi such as [bipɔtʃɪkul] ~ [bipɔdʃɪkul] (Haque, 2002). The features that we observed from interview that voicing alternation occurs in compounding and inflectional positions.

4.2. 5. Place of Articulation

Voicing assimilation occurs in different places of articulation such as bilabial, dental, velar and alveolar etc. Dutch and German voicing contrast is neutralized word finally. Dutch maintains voicing contrast for labial, coronal obstruents and fricatives /p/ - /b/, /t/ - /d/, /f/ - /v/, /s/ - /z/ in word initial and word medial (Kerkhoff, 2007). Similarly, voicing is distinctive

for plosives such as /p~/b/, /t~/d/, /k~/g/ and for fricatives /f~/v/, /s~/z/ in French (Decker & Halle, (2007). In English, voicing is distinctive for labio-alveolar, fricatives such as /s/-/z/ and /f/-/v/.

The features that we observed in our collected interviews such as:

- Children initially produce voicing in bilabial sounds.
- Later they produce voicing alternations in palatal, dental and velar sounds.
- Voicing alternation may occur in Bangla at five places of articulation such as bilabial, dental, palatal, alveolar and velar obstruents.

According to above mentioned discussion and the features of data collected from participants, it can be said that the production of voicing alternations remains difficult until 30 months of age in the language of Bengali children. If they have more MLU than their age, this tendency may be started earlier.

4. Conclusion

In this current dissertation, the acquisition of voicing alternations discussed in the phonology of Bengali children in a limited range. Different aspects of voicing alternations have been explored from previous research and collected information. During the presentation of data, It is seen that Bengali children are not able to acquire voicing alternations before 30 months of age. Surprisingly, if the children have more MLU than their age, they are able to produce voicing alternations earlier. The goals of this study were to investigate the morpho-phonemic patterns of voicing alternations and to explore how and when voicing alternations are acquired by Bengali children in the speech of voicing alternations. The following are the main findings of this dissertation:

The production of voicing alternations remains difficult until 30 months of age. Voiceless obstruents become voiced in intervocalic positions. Voicing alternation may occur in Bangla at five places of articulation such as bilabial, dental, palatal, alveolar and velar obstruents. Children who have more MLU, they have tendency to use more voicing alternations in their speech. Children initially produce voicing in bilabial sounds. Later they produce voicing alternations in palatal, dental and velar sounds. There is a tendency for voicing alternations to co-occur after vowels.

Some limitations can be pointed out in the study. I have collected data from a small number of participants. So the sample size is not enough to allow for generalization of the finding. However, In this research I discussed voicing alternations in the light of rule based phonology. As a result, Optimality theory (OT) has not included. It is a limited level of research. On the other hand, this research is conducted by a qualitative method in this point of view, it has lack of quantitative analysis. Though there are some limitations, I believe this research may be a pathway for a big research. It may be called a window of new research.

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