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Phonological Process Analysis in Telugu Speaking Children with Dyslexia

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Abstract

Introduction: An underlying phonological deficit has been indicated as the best candidate for the cause of dyslexia or word decoding difficulties (Snowling, 2006). There is some evidence for concomitance of speech sound disorders in children with dyslexia indicating the need to study speech production abilities in children with dyslexia.

Aim: The aim of the study was to study the type and frequency of phonological processes occurring in the speech of Telugu speaking children with dyslexia and age matched typically developing children in the age range of 5-6.5 years.

Method: Thirty Telugu speaking children (15 children with dyslexia and 15 typically developing children) participated in the present study. Speech samples elicited from children with the help of picture cards of Telugu Test of Articulation and Phonology (TTAP; Vasanta, 1990) were subjected to phonological process analyses using the method described by Vasanta (1990).

Results: Children with dyslexia continued to demonstrate phonological processes in their speech even beyond six years of age. In comparison to typically developing children, majority of children with dyslexia showed the presence of processes in the categories of syllable structure, substitution and assimilation processes.

Discussion: The observation of presence of phonological processes in the speech of telugu speaking children with dyslexia even at the age of six and a half years are consistent with the findings of persisting phonological inaccuracy and processes among children with reading difficulties (Caravolas & Volin, 2001; Svensson & Jacobson, 2005).

Conclusion: Delayed phonological processes present in children with dyslexia when compared to age matched typically developing children supports the notion of an underlying phonological deficit leading to the deficits in different domains in dyslexia.

Key words: Dyslexia, Phonological Processes, Syllable Structure Processes, Assimilation Processes, Telugu

Introduction

The term *dyslexia* is derived from Latin and Greek. "**Dys"** means in Latin "Bad", "**Lexis"** is means for "speech" in Greek. The term dyslexia has been used to indicate impairment in reading ability. The scientific study of dyslexia first came into prominence in the late 1960's when one of the main issues of debate was whether "dyslexia" was different from plain poor reading. Dyslexia is a type of Specific Learning Disability. The International Dyslexia Association (IDA; 2002) and National Institute of Child Health and Human Development (NICHD) emphasize the word level deficits in their definition of dyslexia. The definition of dyslexia on the IDA website is as follows:

Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge. (IDA, 2002)

The difficulties in dyslexia have been thought to typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. An underlying deficit in the phonological aspects of language has been indicated as the best candidate for the cause of dyslexia (e.g., Snowling, 1995, 2000, 2006; Stanovich & Siegel, 1994). Manis, Custodio and Szeszulski, (1993) reported primary deficits in phonological processing of speech and print and secondary deficits in orthographic processing among children with dyslexia indicating that phonological and orthographical processing were distinct but reciprocally related components of word recognition and spelling.

Recent findings by Boets and colleagues (Boets, Wouters, Wieringen, & Ghesquiere, 2007) suggest that on an average, children showing both increased family risk for dyslexia and literacy-impairment at the end of first grade, presented significant pre-school deficits in phonological awareness, rapid automatized naming, speech-in-noise perception and frequency modulation detection. Children with dyslexia were found to show weak or distorted categorization, in addition to poor speech discrimination in comparison to their typically developing peers (Godfrey, Syrdal-Lasky, Millay, & Knox, 1981). A perceptual deficit of such a kind is thought to impair the ability to process speech and could in turn affect the development and use of phonological representations thus leading to phonological processing deficits. Such an underlying phonological difficulty may be caused by the underlying general impairments in ability to process sequences of rapidly presented brief sounds in children with dyslexia (Snowling, 2006).

Studies investigating speech production deficits in children with dyslexia have been very few. Children with dyslexia have been reported to exhibit difficulties with speech production in general (Snowling, 1981) and specific difficulty with non word repetition (Snowling, Goulandris, Bowlby & Howell, 1986) interpreted as a problem with the segmentation process mediating between speech perception and production. In a task involving rapid repetition of a series of phonologically complex and simple phrases, Catts (1986) found that children with dyslexia repeated the phrases at a significantly slower rate and with increased number of errors in comparison to typically developing children.

A concomitance of speech sound disorders in children with reading difficulties have been increasingly reported in recent investigations. Early deficits in phonological processing skills and the ability to repeat unfamiliar words, indicating early developmental problems in spoken language have been proposed as predictors of subsequent emergence of dyslexia in children (Pennington & Lefty, 2001). These findings have led to the hypothesis that speech sound disorders and dyslexia may share genetic determinants and have driven various genetic investigations to identify the genotype for speech sound disorders and reading disorders.

Need for the Study

Although various studies have investigated the phonological processing abilities in children with dyslexia, there are very few investigations of speech production abilities in children with dyslexia. The current study was planned to study the occurrence of phonological processes if any in the speech of Telugu speaking children with dyslexia.

Indian languages follow alphasyllabic writing systems. The alphasyllabic writing systems largely have characteristics of both alphabetic and syllabic systems. The rules of orthography and grapheme-phoneme correspondences in Indian languages differ from English leading to distinct features of reading disturbances in children. Syllable level

phonological deficits have been observed in Kannada speaking children with poor reading abilities (Nag-Arulmani, 2003). There is a need to study underlying phonological deficits and speech production deficits among children exposed to languages other than English.

Phonological development in typically developing children has been studied in various Indian languages. Phonological processes have been studied in typically developing Telugu speaking children from 2-to 3-years of age (Vijaya, 2005) and from 3- to 5-years of age (Srilakshmi, 2005). These studies have documented a decrease in syllable structure processes with age and increased number of substitution processes until the age of five years. A total of 18 phonological processes were identified in children until the age of five years. Examination of the types of processes showed that although there are universal tendencies in children phonological acquisition, language specific features play an important role in determining the phonological development of the children of a given language.

Objectives of the study

- To analyze the speech of children with dyslexia and typically developing children using phonological process analysis.
- To study the type and frequency of phonological processes in the productions of children with dyslexia and typically developing children in the age range of 5-6.5 years.

Method

Participants: A total of 30 Telugu speaking children in the age range of 5- to 6.5- years participated in the current investigation. Participants included two groups of children: children with dyslexia and typically developing children. Children in both groups were recruited from regular schools where the medium of instruction was Telugu. Academic reviews of all children studying in a particular class were sought from respective class teachers to ascertain the scholastic performance of children. All the children were informally screened for normal hearing and vision. The children were categorized into two groups using the following assessment tools:

- The NIMHANS (National Institute of Mental Health & Neurosciences) Neuropsychological Battery for Children (Kar, Shobin, Chandramouli, & Thamarasu, 2004) was administered to all the children by qualified and experienced clinical psychologist. The test comprises of a total 24 subsections including a test of reading abilities in addition to colored progressive matrices, visual memory test, and visual attention test among others. The test provides information on cognitive abilities and intelligence quotient. Children who met the criteria for dyslexia were included in the clinical group. Children whose scores were within normal range were included in the

control group of typically developing children. Children in this group exhibited increased reading abilities in terms of decoding Telugu letters (‘akshara’) and words in comparison to the children in the clinical group.

- Extended Receptive and Expressive Emergent Language scale (Extended REELS) was administered to screen the speech and language skills. Typically developing children had age appropriate speech and language skills in extended REELS. Children with difficulties in reading were often found to lag behind typically developing children by around 6 months on extended REELS.

Stimuli: The Telugu Test of Articulation and Phonology (TTAP; Vasanta, 1990) was used for this study. The test consists of a total of 100 picturable words consisting of speech sounds categorized into stops, affricates, fricatives, laterals/trills, semivowels and clusters. The test items include words borrowed from English such as ‘/spu:nu/, /braʃu/ etc which are commonly used in day to day conversation of native Telugu speakers.

Procedures:

***Test Environment*:** Children were seated comfortably and tested individually by the experimenter in a room within the school with minimum distraction. The productions of the children were audio-recorded using a SONY portable tape recorder with an Omni directional microphone.

***Recording Procedures*:** The pictures of the test words were all pinned on 6" x 4" cards and were presented to the children one at a time, with an interval of nearly 15 seconds. The children’s productions were recorded while naming the pictures in the order in which they were presented by the experimenter. Different random orders of the picture cards were prepared by shuffling the cards and were presented to children for naming. If the child could not identify the picture correctly, verbal prompts were given in the form of questions; descriptions etc, to elicit a naming response; but such instances were very few indeed. Very occasionally, when the children were unable to name the picture, they repeated the word after the experimenter.

Transcription of the Speech Materials: The recorded speech material was transcribed by the experimenter. The recorded speech material was listened to as many times as required by the experimenter to transcribe the material. The International Phonetic Alphabet (IPA revised edition, 1993) marker was used for phonetic transcription of the recorded speech material.

Analysis: An informal procedure for maximizing phonological process information from traditional picture-word articulation test analysis as described by Vasanta (1990) was used for

analysis of phonological processes. In Telugu, the consonants occur in only two positions in the word (initial and medial). Model and replica charts were constructed as two different tables for initial and medial positions. The frequency of occurrence of each phoneme in a given position in the words was listed for the entire test. Following the construction of the model and replica chart, the error responses were also listed on the model and replica chart. The data from the model and replica chart were used to analyze consonants of each stimulus word to identify phonological processes.

The definitions of phonological processes given by Ingram (1981) were followed for examination of the phonological processes present in the sample. In cases where the errors could not be examined using the list of processes given by Ingram (1981), the errors were described using the definition of phonological processes given by Grunwell (1985).

The transcribed samples were analyzed by two additional, post graduate students of speech-language pathology with experience in phonological process analysis. A copy of definitions of phonological processes was made available to the additional judges to use it in identification and categorization of phonological processes. In case of discrepancy between the three judges, the pattern identified by two of the three judges was used for analysis.

The phonological processes were tabulated and the total number of occurrence of each process was noted. The percentage of occurrence of processes were computed by dividing the number of occurrence of each process by the total number of opportunity for the process to occur as derived from the model and replica chart for initial, medial and final positions. The percentage of occurrence was computed only for those processes where it was possible to discern the number of opportunity for the process to occur. After the identification of the processes, the processes were organized into categories including syllable structure, substitution processes and assimilation processes.

Results

The processes were categorized into three categories namely the syllable structure processes, substitution processes and assimilation processes. All the processes were noted in terms of whether they occurred in the initial or medial positions in the word. The number of children showing the different processes under the categories of syllable simplification processes, substitution processes and assimilation processes in the groups of typically developing children and children with dyslexia are shown in Tables 1, 2 and 3 respectively. The number in parenthesis represents the range of the percentage of occurrence of the process or the range of the number of times the process occurred among the children who demonstrated the process. Examples of productions demonstrating the processes are also provided in the table.

Syllable Simplification Processes

Table 1. Number of children showing the different processes under the category of syllable simplification processes in two groups of children. Number in parenthesis represents the range of the percentage of occurrence of the process or the range of the number of times the process occurred among the children who demonstrated the process.

Processes	**Children with Dyslexia n = 15**		**Typically developing children n = 15**	
Position in word	Initial	Medial	Initial	Medial
Cluster Reduction. /drak□a/-/dak□a/, /cakram/-cakam/	**15** (33-100%)	**15** (33-67%)	5 (17%)	3 (17%)
Initial consonant deletion /ma:midi/-/amidi/.	13	-	2	-
Final consonant deletion /godugu/-/godu/.	-	13	-	3
Degemination /uyya:la/-/uya:la/	-	9 (4-26%)	-	1 (4%)
Epenthesis /kurci/-/kurici/,	-	14	-	1
Metathesis /vima:namu/-/winamamu/.	-	**15**	-	2
Syllable Reduction /ma□camu/-/ma□cam/	-	14	-	9

As seen from Table 1, cluster reduction occurred in most children with dyslexia in both initial and medial positions. The percentage of occurrence of cluster reduction among children with dyslexia ranged from 33-100%. The processes of metathesis, epenthesis, syllable reduction and degemination were seen in the medial position of words in most of the children with dyslexia in comparison to typically developing children. Greater number of children with dyslexia showed initial consonant deletion in comparison to typically developing children.

Substitution Processes

Table 2. Number of children showing the different processes within the category of substitution processes in the two groups of children

Processes	**Children with Dyslexia**		**Typically developing children**	
Position in word	**Initial**	**Medial**	**Initial**	**Medial**
Stopping of fricative /sanci/-/tanci/ /po:lis/-/po:lit/	**15** (10-40%)	**15** (9-63%)	2 (9%)	-
Stopping of Affricate /ci:puru/-/ti:puru/, /ma□camu/-/ma□damu/	8 (10-40%)	11 (33-88%)	1 (10%)	1 (10%)
Stopping of Liquids /lori/-/tori/, /bo□garamu/-/bongadamu/	11 (30-60%)	**15** (6-39%)	6 (10%)	5 (10%)
Velar Fronting /ku:ja/-/tu:ja/, /e:nugu/-/e:nudu/	13 (6-30%)	14 (6-30%)	1 (6%)	1 (6%)
Palatal fronting /□a:pu/-/sa:pu/,	**15** (6-33%)	**15** (6-18%)	1 (6%)	1 (6%)
Backing /la:ntharu/-/lankaru/	**15**	7	-	-

As shown in Table 2 above, the substitution processes of stopping of fricatives, stopping of liquids, palatal fronting and backing were present in the productions of all children with dyslexia in either initial, medial positions or both. Velar fronting and stopping of affricates were also observed in greater number of children in comparison to typically developing children. The processes of palatal fronting, velar fronting and stopping of affricates were demonstrated by only one typically developing child out of the total 15 children in the age matched control group. However, stopping of liquids was observed in more number of typically developing children.

Assimilation Processes

Table 3. Number of children showing the different processes in the category of assimilation processes in the two groups of children.

Processes	Children with Dyslexia		Typically developing children	
Position in word	**Initial**	**Medial**	**Initial**	**Medial**
Nasal assimilation /nimma/-/mimma/, /ba:namu/-ba:mamu/	-	15 (9-12%)	-	1 (3%)
Cluster Generation /u□garamu/ -/ungaram/	-	13	-	1

Nasal assimilation processes was demonstrated by all 15 participants with dyslexia and cluster generation occurred in 13 children with dyslexia. Both these processes were demonstrated by only one typically developing child.

Discussion

Overall the results of the current study showed that phonological processes were persisting in children with dyslexia in comparison to age matched typically developing children. Since the processes seen in children with dyslexia in the current study have been reported in typically developing children of younger ages (Srilakshmi, 2005; Vijaya, 2005), these processes may be identified as reflecting a delay in phonological development. These findings are in consonance with the study of Caravolas and Volin (2001) which also found persisting phonological errors in children with dyslexia and no deviant patterns were reported. Svensson and Jacobson (2005) have also reported persistence of phonological deficits in the speech of children with dyslexia.

Very few typically developing children demonstrated the processes observed in the speech of children with dyslexia. In addition, the percentage of occurrence of the phonological processes was much less among typically developing children in comparison to children with dyslexia. The current study extended the data on phonological development in typically developing Telugu speaking children provided by Srilakshmi (2005) and Vijaya (2005) to older children (5;0 – 6;6 years; months). It was clear that most processes observed in younger children of five years of age in the investigation by Vijaya (2005) were eliminated in children by the age of six years. The older children above the age of six years among the 15 children in the current study did not demonstrate any of the phonological processes.

The phonological deficits observed in children with dyslexia in terms of persistence of phonological processes may be attributed to possible deficits in phonological processing. Weak or distorted categorization, in addition to poor speech discrimination has been noted in children with dyslexia (Godfrey et al., 1981). It has been proposed that perceptual deficits such as above could impair the ability to process speech and in turn affect the development and use of phonological representations leading to phonological processing deficits. Boets, et al (2007) studied auditory processing, speech perception and phonological processing ability in pre-school children at high risk for dyslexia and found dysfunctional auditory processing and speech perception and phonological processing deficits as well. The current study provides support for the notion of a phonological deficit underlying deficits in reading and speech production.

In general, the identification of phonological processes in the speech of young children has been found to be efficient in clinical programs as they provide a means of classifying error patterns noted in disordered speech and suggest an economical and simple way to handle intervention. Although generalization from this data has limitations, the present investigation is an attempt to contribute to the small body of information available about the development of phonological production abilities in children with dyslexia within the Indian context. Further studies are needed which study the phonological skills in both perception and production in children with dyslexia to clearly discern the relationship of perception and production. Children's productions in continuous speech including conversation, narration must be studied in addition to sample from word level articulation tests. Future research should include larger sample of children in both cross sectional and longitudinal designs in order to assess more completely the developmental change in the phonological development in children with reading difficulties.

Conclusion

Persistent phonological processes observed in the speech of children with dyslexia when compared to age matched typically developing children indicates that underlying phonological processing deficit may manifest in different domains (speech production & reading) among children with dyslexia.

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