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**Does “reading” develop “phonological awareness” in Down’s
syndrome?**

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Abstract

The casual connection between learning to read and metaphonological awareness has been a much-researched but controversial issue. It has been argued extensively that phonological awareness is crucial for literacy development, and they even have a casual relationship for alphabetic scripts. Results discussed in this paper do not support this view as far as reading ability and phonological awareness go in Down's syndrome. The present study compared a sample of children with Down's syndrome (N=10, Age range 8.3 to 12.5 years, Mean age=10.5) with a group of younger, typically developing Oriya children (N=15, Age range 6.3 to 8 years, Mean age=7.2 Years) matched for their reading ability and investigated the relationship between phonological awareness and reading performance. 150 Oriya words and 47 Oriya letters were given to read and name respectively. For accessing metaphonological skills, tasks such as phoneme deletion, phoneme counting, syllable deletion and syllable counting were used. Children with Down's syndrome read and named letters well but performed poorly on all the phonological tasks, performing better in "syllable" based tasks than "phoneme" based tasks. The results indicate that children with Down's syndrome do not develop so called phonological awareness skills as part of their literacy development, and particularly, Oriya Down's syndrome children demonstrate greater knowledge of "syllables" than "phonemes" when measured.

Introduction

Down's syndrome (DS) is the most common chromosomal disorder and originates because of an extra chromosome 21. Its impact causes abnormalities occurring in the central nervous system (CNS) which result in varying degrees of cognitive and other intellectual impairments in children with Down's syndrome. Previous research on English speaking children with this condition (Buckley, Bird & Byrne, 1996) has shown that they learn to read and develop other language functions. There have been recent claims that the majority of children with DS can learn to read and that progress in reading could also be facilitative in the development of speech, language, auditory skills, and working memory functions--all those areas where children with DS generally display difficulties (Fowler,1990; Mackenzie,1992).

Phonological Awareness in Down's syndrome

Reading or efficient word recognition generally takes place through visual, phonological and contextual input. Children with DS have been found to be good "visual" readers, finding it relatively easy to establish sight vocabulary and grammatical knowledge (Fidler, Most & Guiberson, 2005). Phonological awareness or PA has been the single most important framework of literacy research since several decades, most particularly in the acquisition of alphabetic orthographies like English (Brynt & Goswami, 1987). Although, recently phonological awareness has been tested in many of the world's languages (Goswami, 2006; Carvolas, 2004). The casual relationship between phonological abilities and early reading abilities has been demonstrated with the specific example of children's sensitivity to rhyme and alliteration and their subsequent

achievements in reading. It has been consistently argued that awareness in rhyme makes a distinctive contribution to reading by helping children master the grapheme-to-phoneme conversion rules quite early in life. However different studies on phonological awareness in several Indian languages (Mishra, 2000, 2006b; Patel & Sooper, 1987) using different populations have revealed that in such orthographies (i.e., alpha-syllabic as in Indian languages) phonemic awareness may not be an important influence on reading development. And young readers often show greater “syllabic” knowledge than “phonemic” knowledge in such orthographies (Mishra, 2006b).

There have been recent claims that the majority of children with DS can learn to read and this progress in reading can also facilitate the acquisition of other speech-language skills (Fowler, 1990; Hulme & Mackenzie, 1992). But it has been observed that children with DS have superior visual perceptual abilities, stronger visual vocal channels, better visual sequencing abilities (Bilovsky & Share, 1965; Marcell & Armstrong, 1982; Pueschel et al, 1987) than their auditory perception and processing abilities (Marcess, Harvey & Cothran, 1988). Many studies on the reading acquisition of children with DS have shown that these children demonstrate almost same level of performance like other non-disabled children (Casey et al, 1998; Buckley & Bird, 1993). It has been suggested that children with DS graduate from logographic stage (sight vocabulary) to the alphabetic stage (words sounded out) at a much slower rate compared to normal children (Buckley, Bird & Byrne, 1996). When their language and vocabulary increase as a result of age, they start identifying new words and eventually learn to read. It has also been suggested that such children with Down’s syndrome may lack some fundamental processes that underlies metalinguistic ability and as a result acquire their grapheme-

phoneme representation system in an entirely different way. However there are few empirical studies to demonstrate this unique mode of learning in children with DS.

Studies that have explored phonological awareness in English speaking children with Down's syndrome have noted that such children do perform poorly on such tasks; but with some training, their scores improve, and this improvement is often considered to influence their performance in reading (Iacono & Cupples 2000). Although the exact amount of phonological awareness that is needed to read well in this population has been questioned and the necessity of linking phonological awareness with reading ability in Down's syndrome children has remained a controversial issue in alphabetic scripts (Cossu, Rosini & Marshal 1993). Moreover, different studies have found different levels of performance on phonological awareness tasks by subjects with Down's syndrome. For example, Cossu, Rossini & Marshal (1993) and Evans (1994) have noted that their sample of Down's children did perform very poorly on PA tasks. But other studies have found that children with Down's syndrome do have measurable or appreciable amount of performance on different PA tasks (Fletcher & Buckley, 2002; Cardoso-Martin & Frith, 1997). However, there is no study that shows that children with Down's syndrome possess phonological awareness skills like their normal counterparts. It is often complained that children with Down's syndrome perform low on commonly used PA tasks because those tasks put a lot of memory and cognitive demand on their systems and are not suitable for comparison (Byrne, 1993; Morton & Frith, 1993). These confusing results and interpretation of what a suitable definition of phonological awareness of children with Down's syndrome is make generalization difficult.

There have been many studies exploring the casual connections between metaphonological awareness and development of reading abilities in children with DS. It has been observed that such children do benefit in reading with an explicit training in phonological awareness (Kennedy & Flynn, 2003; Cupples & Iacono 2000). On the other hand, it has also been reported that children with DS do acquire reading as they grow but their explicit knowledge of phonological skills if tested on tasks, remains low (Cassu, Rossini & Marshall, 1993). Few studies have shown dissociations in performance on some phonological skills compared to other. However, our current knowledge of what precise cognitive-linguistic resources each task employs remains poor; for example, syllable reversal vs. phoneme deletion. Hence, making a hierarchy of performance in phonological tasks demands theoretical explanation in terms of the impaired condition on one hand and the precise resources these tasks require on the other. Pursuing the broad theoretical context above, the present study explores the relationship between phonological awareness and reading development in children with Down's syndrome having Oriya as their mother tongue. Oriya is a major Indo Aryan language spoken in the state of Orissa in India.

The Nature of Oriya Orthography

Writing systems and their pattern could have significant effect of the nature and type of reading acquisition. World's writing systems can be broadly divided into logographic, orthographic and syllabic types (Taylor, 1981). Oriya orthography has both alphabetic and syllabic properties. It consists of 47 letters of which 35 are consonants and 12 are vowels. Each letter has a name and that name is the phonic sound of that letter

which remains constant across different uses of that letter in spelling. This is a typical feature of Oriya orthography, like many other Indian language orthographies that separate Oriya from English, where this letter to sound transformation is not regular. So Oriya can be concluded as an alphabetic-syllabic type of phonetic orthography having invariant grapheme-phoneme conversion rules (Sahu & Kar, 1994). The vowel sounds in Oriya orthographies can be symbolically added to the consonants, and these symbols are called “*matras*”. The addition of matra changes the phonic sound of the consonant in the direction of the vowel represented by the symbol. The phonic sounds of a few consonants could be symbolically presented by attaching ‘phalas’. Moreover, a few consonants could be combined together to make a single complex character called a ‘yuktakshyara’. The phonic sound of a yuktakshyara, as in the case of addition of a ‘phala’ to a consonant, retains the phonemic representations of participating consonants. Consonants with phala and yuktakshyara could be viewed as conjunct consonants. These variations in Oriya orthography along with its highly regular grapheme-phoneme conversion process, makes the study of reading development in this language as contrast to English interesting.

Methods

Subjects

The experimental group included eleven subjects with DS who had Oriya as their mother tongue ranging in chronological age from 8.3 to 12.5 years (Mean Age = 10.5 years). Their mental age ranged from 6 to 8 years (Mean 6.8 years). The control group consisted of 15 normally developing children ranging in chronological age from 7.6 to 10.6 years (Mean Age = 9.5 years). All the children with DS were in a special help school

in a major city in Orissa. The school followed “Inclusive” model of teaching with the “whole word” method for teaching word reading. All these children with DS have been at this school and receiving intensive reading training at least since 4 years prior to data collection for this study. All children came from monolingual Oriya speaking families and did not have a sibling or parents with similar neuro developmental conditions. All children with medical problems, sensory impairments and demonstrated loss of vision were excluded from this study. Detailed interviews were conducted with the teachers and parents of these children to ensure that they did not have any other condition apart from DS and had achieved a level of language achievement so as to follow test instructions. Eleven children with DS were matched for reading ability with a group of fifteen normally achieving children. Normal children were recruited from a mother tongue school in the locality and none of them had any behavioral or neurological conditions.

Test Materials and Procedures

Reading Tests: Letter Naming and Word Reading

For the purpose of matching children on reading ability, all the 47 letters of Oriya scripts were given which included 35 consonants and 15 vowels. Subjects were instructed to read each word aloud and name each letter. For the purpose of measuring word reading skills, a battery of 150 bi- and tri-syllabic simple Oriya words (Mishra 2006) was used. Currently there are no standardized reading tests in Oriya which is validated and published and could be used for an experiment like this. These words did not have any consonant clusters and were thus quite simple. Many of these words were from a standard textbook of Oriya language, used for teaching language to primary school children. Each

stimulus (letter or word) was presented types in bold fonts on a single card. The subject was instructed to read the letter aloud. A score of 1 was given for each correct response. It was expected that these words should not be a problem to read for the children with DS as they have been receiving reading instructions since some years. Table 1 shows the performances of Down's syndrome group and controls on letter naming and word reading tests. There are no differences in both the group's performances.

Phonological Awareness Tests

A set of phonological awareness tasks was designed on the basis of tests developed by Mishra (2005) and used for assessment. Each test consisted of practice words and then test items. There were twenty five items in each test.

1. Phoneme Deletion

This test consisted of five practice words and twenty stimulus words. There were bi and tri syllabic Oriya simple words. Subjects were given extensive instruction about the task. The task required them to listen to a word and then deleting a target sound (phoneme) and then telling the rest. The tasks used here are similar to those used by Cossu, Rossini & Marshal (1993). Examples of the stimuli are given in Appendix 1.

2. Phoneme Counting

This task was similar to the task on phoneme deletion. It required the subjects to count the total number of phonemes that are in a word. There were twenty words in total

and subjects were given practice items and the task was demonstrated for easy comprehension. All words were simple Oriya words without clusters.

3. Syllable Counting

There were twenty bi- and tri-syllabic words in this test and five practice words. The task was to tell the remaining of a word after a syllable is deleted mentally. Words were auditorily given and the order of the target syllable was random across stimuli. First participant were given explicit instruction about what would be a syllable in a given word and about the nature of the task. A score of 1 was given for a correct response.

4. Syllable Deletion

There were twenty words in this test apart from practice words. The task demanded the production of syllables in a reverse order. There was a mixture of bi and tri syllabic words. Explicit demonstration was given on how syllables are reversed in a word. A score of 1 was given for a correct response.

Results

There was no significant difference between the Down's syndrome group and the normal control group in letter naming and word reading tasks (Table 1). Down's syndrome children named the letters and read the words quite effortlessly as normal controls. Their ability to read could be attributed to few years of intensive language training, which did not of course gave them any extra instructions on phonological awareness. However, this ability to decode letters and words was not related to their

having mastered the necessary metaphonological skills, as it was observed in the results of phonological awareness tasks (Table 2). On all the four phonological tasks, children with Down's syndrome performed poorly. The basic objective of this study was to see if children with Down's syndrome who are able to read words and letters and also do well on tasks that demand explicit metaphonological knowledge. Results suggest that children with Down's syndrome are quite poor in several phonological awareness tasks that require expert manipulation of sound units of words such as syllables and phonemes.

Among the phonological awareness tasks, there were tasks that demanded knowledge of "syllable" such as the syllable deletion task and the syllable counting task. The other two tasks, such as phoneme counting and phoneme deletion required explicit knowledge of "phoneme". The results on these different tasks suggest that Down's syndrome children's performance was poor on the phoneme based task compared to the syllable based task (Table 3).

Table 1

Mean and Standard Deviation for Word reading and Letter naming in Controls and Children with Down's syndrome

	Down's syndrome (N=11)	Controls (N=15)
Letter naming	46.5 (1.45)	48.3(1.23)
Word Reading	136.7(1.36)	138.9(1.82)

Standard deviations are in parentheses. Difference between the means is insignificant as

$p > 0.05$

Table 2

Table showing performance of children with Down’s syndrome and controls on different phonological awareness tasks. Mean and standard deviation scores are given.

	Down’s Syndrome	Controls	<i>t</i> value
Phoneme Deletion	1.8(0.78)	18.6(1.12)	-31.01**
Phoneme Counting	2.5(0.97)	18.8(0.94)	-44.4**
Syllable Counting	6.9(1.37)	19.1(1.12)	-21.14**
Syllable Deletion	4.8(0.84)	18.6(1.45)	-23.71**

** shows highly significant difference between the groups, i.e., $p < 0.001$

Table 3

Table showing performance of children with Down’s syndrome on ‘syllable’ based tasks in comparison to ‘phoneme’ based tasks

	Syllable based	Phoneme based	<i>t</i> value
	6.7 (1.2)	2.3 (0.23)**	-19.3

** $p < 0.005$

Discussion

This study explored the connection between reading ability and phonological awareness skills in group of children with Down’s syndrome and compared their

performance with age and IQ matched normal controls. There are few studies focused on reading development in such children and most particularly published reports of a study in an Indian language are quite rare. In this direction this is a first study to have found that children with Down's syndrome who speak Oriya can read words and identify letters but do not have corresponding and expected phonological awareness skills. This result is not similar to those obtained in studies on English speaking Down's syndrome children that have reported that such children have good phonological skills and which is casually related to their reading ability (Cupples & Iacono, 2000; Law & Gunn, 2004). It has also been claimed that training phonological awareness skills early to children with Down's syndrome improves their later reading and language skills (Kennedy & Flynn, 2003; van Bysterveldt, Gillon & Moran, 2006). But the results of this study did not find any strong presence of phonological skills in children with Down's syndrome. It may be the case that there is a significant impact of phonological training on reading development in children with Down's syndrome (and most importantly, for an alphabetic language like English and may not be for Indian languages). But such children who learn to read without being given instructions in phonological skills do not develop such skills later on. Although they continue to develop their literacy skills throughout life as they mature, phonological skills do not develop in them as a by product of literacy. Hence it is obvious to ask if phonological skills are the prerequisite for children with Down's syndrome who are learning to read. As the result demonstrates that children with Down's syndrome could do well on letter identification and word reading, it is important to ask if this reading ability has developed without any explicit phonological knowledge. There have been studies which show that children with Down's syndrome learn reading skills

visually and these literacy skills develop in them quite slowly and differently than normal children (Fidler, Most & Guiberson 2005). If that is the case, then children with Down's syndrome will never learn how to read appreciating the sound structures of language. It could be the case that a visual appreciation of words precede in children with Down's syndrome compared to phonological analysis, probably because of intellectual limitations.

A traditional measure of phonological awareness has been the test of reading non-words, because non-word reading does not depend upon lexical or semantic access. It has been shown that children with Down's syndrome could show the potential to read real words but not non-words (Verucci, Menghini & Vicari, 2006). This suggests that reading in children with Down's syndrome does not develop on any form of phonological awareness, nor does the ability to read in these children produce phonological awareness as a cognitive-linguistic byproduct. The results of this particular study seem to support this position as far as phonological awareness and reading in Down's syndrome are concerned.

Components of Phonological Awareness, Reading and Down's Syndrome

Another issue which needs clarification is the disparity in performance noted on different phonological awareness tasks in children with Down's syndrome in this study. Oriya being a regular, alpha-syllabic language, one would expect that readers in this language would have better "syllabic" awareness than "phonemic" knowledge (Mishra, 2006). There have been arguments that processing disparity exists between "syllable" and "phoneme" based processes, as phonemes are more abstract psycholinguistic entities than

syllables, which are more visible and immediately separable in speech. Moreover, many studies recently have shown that “syllable” is a more fundamental unit of speech production than “phoneme”. So it is natural to expect that there will be a hierarchy in processing demands on tasks that utilize a syllable based component to a phoneme based. Since the set of phonological awareness tasks used in this study manipulated “syllabic” and “phonemic” information differently, they demanded different processing abilities from the children with Down’s syndrome. Tasks such as syllable reversal and syllable stripping required knowledge of a “syllable” whereas a task like “phoneme” counting required the explicit knowledge of a “phoneme”. These components of any phonological awareness task determine variability in performance, as has been shown in earlier studies (Høien et al, 2005). But there are few studies that have shown this componential effect of phonological awareness tasks in children with Down’s syndrome. The results of this study clearly demonstrate that Oriya children with Down’s syndrome had very little “phonemic” skills as opposed to “syllabic” skills. And they performed much better on the task of rhyme recognition, which required neither the explicit knowledge of a syllable nor of a phoneme. For the control group, performances on all the four tasks were more or less similar. It could be argued, based on this result that since Oriya is an “alpha-syllabic” language it induces more “syllabic” knowledge in its beginning readers than “phonemic” knowledge. Such marked variation between “phoneme” based tasks and “syllable” based tasks has already been observed by this author in a study on Oriya speaking children with developmental dyslexia (Mishra 2006a, 2006b). But this initial generalization requires more comprehensive cross linguistic research with different types of populations. Though

these results are only preliminary, they could be further replicated with larger groups and more systematic tests to tap phoneme vs. syllable based knowledge in such children.

Conclusion

In summary, it could be tentatively concluded, based on the results discussed in this paper, that Oriya speaking children with Down's syndrome show appreciable word reading and letter naming abilities without the corresponding skills in phonological tasks. Among these phonological tasks, even if they do show some phonological talent, they have better 'syllabic' knowledge than "phonemic" knowledge.

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Appendix I

Examples of Phonological Awareness Tasks in Oriya

1. Phoneme Deletion

kabita (k) - abita [if /k/ is deleted]

khira (r) - khia

2. Syllable Counting

semane [se ma ne -3 syllables]

bahi [ba hi -2 syllables]

3. Phoneme Counting

pani [p, a, n, i - 4 phonemes]

kamala [k, a, m, a, l, a - 6 phonemes]

4. Syllable Deletion

pariba (ba) - pari [if /ba/ is deleted]

mana (ma) - na [if /ma/ is deleted]