IMPLICATIONS OF COGNITION ON LANGUAGE LEARNING IN CHILDREN WITH DYSLEXIA

R. Lalitha Raja

Introduction

Cognition is nothing but the conscious mental activities or processes which are involved in gaining knowledge and comprehension. These processes include thinking, knowing, learning, remembering, understanding, judging and problem-solving. These processes are high-level functions of the brain and cover up language, imagination, perception, and planning. So we can say that the features of the language are covered under cognitive functions. Moreover, when we say that the functions of language are covered under cognitive functions then we have a fundamental question,

- If a person has cognitive delay or impairment, will he also have at the same time language impairment too?
- Do the problems in cognitive processes have an impact on language learning and lead to language impairment?
- If the answers to previous two questions are yes, then what aspects of language are affected?

Yes, of course, this has been a hot debate for decades, and in line, researchers have investigated the relationship between language and cognition. Their research mostly lied on language development of infants and children. Contemporary observations hypothesize that specific mechanisms control language development. According to the perspectives of constructivist and biologist, the emphasis was on the gradual, experience-dependent emergence of complex skills, including language.

These theories postulate that domain-general cognitive capacities and processes are recruited to develop language. Approaches of constructivist and neuro-constructivist anticipate language-learning processes and products to show broad commonalities with non-linguistic learning. So, language and communication skills

are related to skills in other areas of development. According to Gedeon O. Deák (2014), "These theories postulate that domain-general cognitive capacities and processes are recruited to develop language. Approaches of constructivist and neuro-constructivist anticipate language-learning processes and products to show broad commonalities with non-linguistic learning. So, language and communication skills are related to skills in other areas of development".

Speech and language skills develop in childhood according to relatively well-defined milestones. If a child seems noticeably behind same-aged peers, then it might be a language delay or disorder. A language disorder is a delay in the use and understanding of spoken or written language. It is important to realize that a language delay is not the same thing as a speech or language impairment. Language delay is a prevalent developmental problem in fact; most commonly, affects 5-10% of children in pre-school. Due to language delay, children's language will be developing in the expected sequence, but at a slower rate. In contrast, children with dyslexia, hearing impairment, autism, Attention Deficit Hyperactive Disorder (ADHD) and developmental delay with good intellectual capacity, also have language disorders.

The children with dyslexia, hearing impairment, autism, intellectual disabilities, ADHD and developmental delay have had more chances for this language delay or disorder. According to American Speech-Language-Hearing Association (1993), the disorder may involve in all the forms of language (phonology, syntax, and morphology), and also in its content or meaning (semantics), or its use (pragmatics), in any combination. All above-said aspects or some aspects were found disordered in these children. This problem hinders them in language learning. Children with dyslexia, hearing impairment, autism, ADHD and developmental delay those who do have the good intellectual capacity, yet had the history of language disorders. Their normal life skills are affected because of the language problem. Mainly children with dyslexia, who were in the regular stream of schooling, faced lot of challenges in their academic life, as language is a base for any learning. Contrary to popular misconception, dyslexia is not characterized by letter or word reversal. In fact, dyslexia is a language-processing difficulty caused by the inability to break words into phonemes and morphemes and semantic processing.

Researchers estimate that dyslexia the most common reading problem affects nearly 10 to 30 per cent of the population.

This study highlights the language problems of Tamil children with dyslexia both in learning Tamil and English in all aspects of language relating it to their cognitive processes.

Dyslexia – A Reading Disorder

Dyslexia is a particular type of learning disabilities (LD) (one of the learning disabilities) involving impairment in reading ability that ranges from mild to severe affecting and disrupting person's language development and functioning. It is a neuro-processing deficit that is specifically related to the reading and spelling process. Dyslexia is generally defined as a reading and spelling difficulty discrepant with intelligence and educational opportunities. It has been characterized as a language based disorder, where 'language' is a term theoretical linguists would tend to call 'a setoff grammatical rules'. In addition to their relatively poor reading and written language skills, children with developmental dyslexia have been found to exhibit difficulties on a variety of language tasks, including speech perception, production, and syntactic sensitivity. This raises the question whether these language difficulties are secondary to a reading deficit or whether they partly cause dyslexia.

According to Critchley (1970), dyslexia as a disorder is evidenced by difficulty in learning to read irrespective of conventional instruction, adequate intelligence, and sociocultural opportunity; it is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin. As the central problem of dyslexics is reading, it is also otherwise called *Reading Disability*. The children have reading problems in all the stages of language development, i.e., phonology, morphology, syntax, semantics, and pragmatics. One way to sort out literacy and language factors are by looking at the language development of children who are at-risk of dyslexia; or children with a dyslexic parent or sibling. Such a starting point allows investigation of linguistic skills to assess the potential of dyslexia as a language-based deficit. Furthermore, this type of investigation might find linguistic precursors and lead to early identification of dyslexia.

Children with dyslexia have only reading problem with some extent of writing problem despite normal or high intelligence, and sufficient exposure to the language. Typically, children who fall under the category of dyslexia are bright and capable in other intellectual domain. Often children with LD are confused with slow learners due to their poor academic performance and behavioural
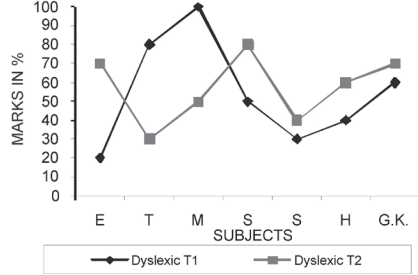
problems. This may mislead the educators in giving proper guidance for LD children.

Difference between SL (Slow Learner), and LD

The following graphs show a discrepancy between SL and LD children.
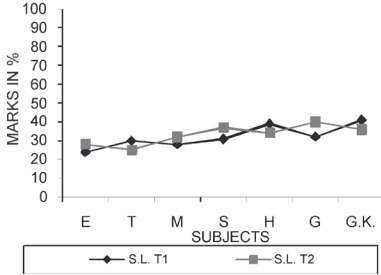
Graph 1   Graph 2

Graph 1 shows the score of a Slow Learner (whose intellectual capacity has sub-average IQ [from 80 -90]) in two consecutive tests for same questions. Graph 2 shows the score of a child with LD (whose intellectual capacity is average/above the average of IQ [from 90 and above]) in two consecutive tests for same questions. Children with subaverage intellectual capacity (slow learners) in both the tests perform more or less equally, and the scores are also between 20 and 40. However, the child with LD in the Graph 2 shows large variation which depicts the inconsistency in their processing skills. So, cognitive processing is much associated with their learning process.

Common Cognitive Deficits in Dyslexic Students

1. auditory processing (correctly processing the sounds of our language, including phonological awareness)
2. visual processing, short-term memory and working memory (including executive attentional skills)
3. long-term memory (placing information in and retrieving it from long-term memory)
4. processing speed (speed of thinking ability on simple visual or auditory tasks)
5. acculturation knowledge (knowledge of the language, concepts, and information of our culture)

6. fluid reasoning (problem solving and reasoning with unfamiliar information)

Strengths and weaknesses in these above said cognitive abilities affect the quality and rate of an individual's learning. As reading is much associated with the visual processing, short-term memory, working memory, long-term memory, processing speed, acculturation knowledge and fluid reasoning children with dyslexia who have issues in the above skills have reading difficulties. So reading difficulties as mentioned above are neurodevelopmental in nature as it's associated with processing skills. Neurodevelopmental problems do not go away, but they do not mean that a student (or an adult) cannot learn or progress in school and life. Neuroscientists have identified that their hemisphere function for reading differs from that of Normal Reading Age Children (NRAC). The figures 1 and 2 show how the activation of neural impulses in brain differs between children with and without dyslexia. Research has also proved that 90 per cent of children with LD has right brain dominance.

Figures 1 and 2 show the variation in brain activation. A reduction or absence of activity in the left hemisphere is seen in the occipitotemporal (OT) region which is important for *visual and orthographic encoding (whole word recognition)* and includes the visual word-form area and *temporoparietal region* (crucial for *phonological processing and phoneme-grapheme conversion*). So there is a deficiency in the processing pathways.

Also from a neurological perspective, different types of the writing system, for example, alphabetic as compared to logographic writing systems, require different neurological pathways to read, write and spell. As different writing systems need a different part of the brain to process the visual details of speech, children with reading issues in one language might not have that severity of reading difficulty in a language with a different orthography. The neurological skills required in performing the tasks of reading, writing and spelling can vary between different writing systems, and because of that, different neurological deficits can cause dyslexia problems concerning different orthographies.

Reading problems arise among children with dyslexia according to the complexity of language the child learns. The complexity of orthography/spelling system and morphology of a language make them struggle with decoding words correctly. The orthographic depth of a language has a direct impact on how difficult it is to learn to read that language. English has a deep orthography with
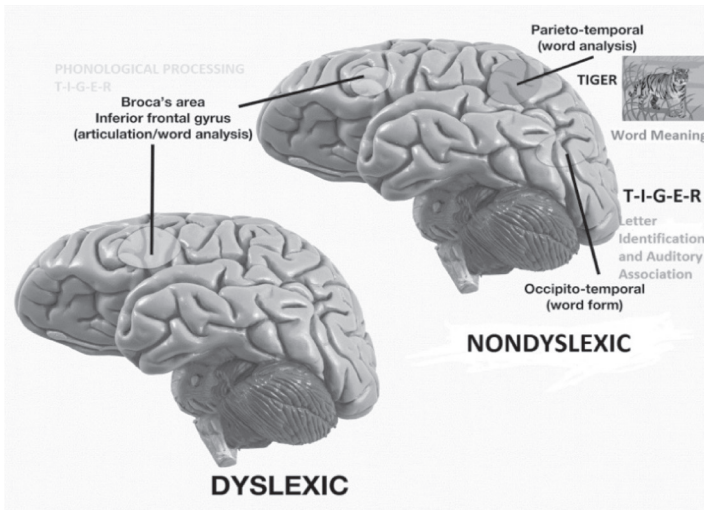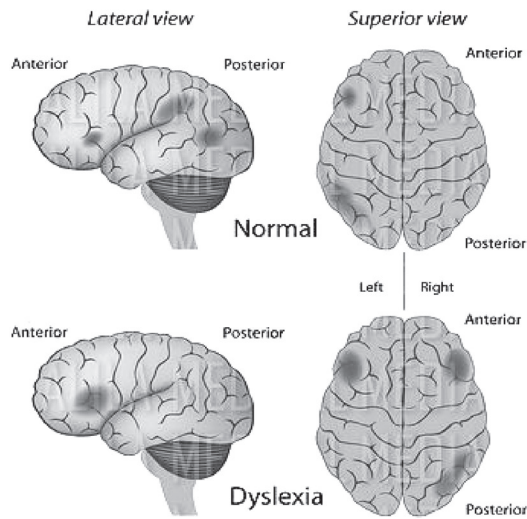
Figure 1

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Figure 2

a complex orthographic structure that employs spelling patterns at several levels: principally, letter-sound correspondences, syllables, and morphemes. However, Tamil has syllabic orthography that uses only letter-sound correspondences, so one can say that Tamil has shallow orthography. It is comparatively easy to learn to read the Tamil language when compared to English. Though it is easy to read the Tamil orthography, its complexity in alphasyllabary of secondary

symbols and the morphological system makes the children struggle in reading. They are slow in reading and make additions, deletions, and substitutions while reading morphologically complex words. Many children with reading difficulties can be taught reading strategies for success in school. When children's reading problems are identified early, they are more likely to learn strategies that will raise their reading to grade level.

Dyslexia and Reading

As mentioned earlier contrary to popular misconception, dyslexia is not only characterized by letter or word reversal. In fact, dyslexia is a language-processing difficulty caused by the inability to break words into phonemes. It is essential to understand how the brain conceptualizes language, to understand the specific reading problems related with dyslexia. The brain recognizes language in a hierarchical order. The higher levels of the hierarchy transact with semantics, syntax, and discourse. The lowest levels of the hierarchy deal with breaking words into separate small units of sound called phonemes. Thus, before comprehending the words at higher levels in the hierarchy, they must be decoded at the phonological level.

Problems with Phonemes

Phonological processing takes place automatically at a preconscious level in spoken language. A genetically determined phonological module automatically constructs words from phonemes for the speaker and deconstructs the words into phonemes for the listener. Speech is instinctive and is the typical biological human characteristic. The alphabet, on the other hand, was created 5000 years ago to give a concrete representation to speech at phonological level. Thus, reading is an invented piece that must be educated on a conscious level. Reading is a tricky task because anyone who reads must learn to listen through his/her eyes. The reader must understand that the orthography which is in the form of letters on a page sequenced to represent the phonological structure of words.

The phonological module of dyslexia opines that dyslexics have a disability in reading because they have a problem in phonological processing. The most convincing proof for the importance of phonological processing in reading ability is intervention studies indicating that phonological awareness training improves reading ability, while other language training programs do not. Bradley and

Bryant (1980) studied two groups of children: one given training on grouping words according to their sounds (phonological training), while the other given training on grouping words according to their meaning (holistic training). The reading ability of children who had phonological training improved significantly, whereas the reading ability of children in the holistic training group only improved marginally.

Many studies from the early 1990s have confirmed that phonological deficits are the most major and constant indicator of dyslexia in children. In all these studies, children with dyslexia were asked to delete a specific phoneme and to say the words with rest of the phonemes. For example, a child must delete "s" sound from "stool" and say the word as "tool". Children with dyslexia, as compared to children without dyslexia, have greater difficulty in phoneme deletion task. The results from earlier studies indicate that the deficiency in phonological awareness demonstrated by dyslexics is connected to their lower reading ability.

Problems with Morphemes

A morpheme is the smallest meaningful element of a word that functionally can change a word's meaning. It can be of a single letter, for example in English the letter '-s' at the end of a noun such as "pen", can change the word from singular to plural which is a suffix as in 'pens.' It can be of two letters as 'un' at the beginning of a word such as 'untidy,' acts as a prefix conveying the meaning "not." Understanding the morphological structure of words is very important for developing the reading fluency. At around third grade/ fourth grade, during the second stage of reading, morphological awareness becomes more important to decoding than phonemic awareness.

Morphological awareness is the ability to identify the parts of words and word segments that express meaning. At the point of the second stage of reading, students need to increase their reading speed, and letter-by-letter decoding is inefficient. Students who are good readers will have naturally acquired an excellent basic sight vocabulary of familiar words and will easily be able to transfer what they know to decode new words using morphological analysis. Morphology is the key to decoding polysyllabic words — for example, the word "decode" is a combination of the prefix "de-" and the familiar root "code".

A child with dyslexia will probably need extra help to gain an

understanding of morphology. It is important to begin to introduce these concepts to the child at the age at which other children are gaining these skills, even if he/she is still struggling with phonetic decoding. Otherwise, the child will struggle to progress beyond a second- or third-grade reading level.

Problems with Syntax

The syntax is the study of sentence structure. It refers to the way words are arranged in sentences. When used to describe language development, the syntax is the collection of words that specify the speaker to arrange words to make a sentence in a meaningful way. Syntax governs the structure of sentences, i.e., rules of combining words to form sentences. By learning the rules which are used to connect words, learners learn to create an infinite number of sentences. Thus, it is possible to create many sentences that the speaker has never come across before. A finite number of rules facilitate creating an infinite number of sentences by both the speaker and the listener in communication on context.

The reader must know the structural aspects of language (rules) known as syntactic processing, for comprehending what is read. Syntactic processing involves the order and arrangement of words in a particular way to form phrases and sentences. One has to depend on syntactic processing to know the difference between the sentences— "The pen is on the table" and "The table is on the pen"— that have two very different meanings despite sharing all the same words. Children with dyslexia have issues in syntactic processing. Studies by Byrne, (1981), Stein et al. (1984), and Plaza et al. (2002) have shown deficiencies in children with dyslexia in syntactic processing.

Problems with Semantics

Semantics in a general sense deals with meaning or content of words and word combinations (Owens, 2008). In the early stages of learning especially vocabulary learning, neural circuits are activated in piecemeal, incompletely and weakly. It is like receiving a glimpse of a partially exposed and blurry photo. With more experience, practice and exposure, the picture becomes more precise and more detailed. As exposure is repeated, less input is needed to activate the entire network. With time, activation and recognition are relatively automatic, and the learner can direct her/his attention to other parts of the task. To establish new neural networks and connections

between networks of words time is needed. The process of learning and word networking suggest that the neural mechanism for learning is essentially the same as the products of learning. Learning is a process that establishes new connections among networks and the new skills or knowledge that are learned are neural circuits and networks. So students need time and experience (practice) to consolidate new skills and knowledge to become fluent and articulated. After these stages, why specific children have difficulties in learning words, and there are differences in them? This is due to the deviations in semantic processing of the readers.

Semantic processing involves the meaning of words and sentences that one reads. One might depend in part on semantic processing to know that when they read "ball", it means or refers to that round, made of rubber/plastic, bounces when thrown and used to play. The primary goal of reading a text is to comprehend the context of the text. Semantic processing plays a vital role in reading comprehension which means extraction of meaning from printed text. So if there is an issue in the extraction of the meaning of a word or utterance, then the reading will become insensible. This problem is very much seen in children with dyslexia. There are a lot of lexical substitutions and lexical expansions seen in dyslexics in their reading and writing. Lexical substitutions are the substitutions of synonyms, antonyms, and hypernyms of the word. The lexical expansion is expanding the lexical item by its meaning, either in the form of sentence or phrase. Also, as they read the text, the meaning extraction of the content is also distracted.

The problems seen in all the levels of language are associated with the processing issues. The learning of different levels of language is associated with the cognitive processing skills (as in table 1) and due to cognitive processing issues children with Dyslexia have issues in any of the language levels. So *reading deficit can be seen as a result of a cognitive process deficit.*

From a cognitive point of view, information-processing theories occupy an important position in the study of children's reading development. Research has clearly shown information-processing factors to constrain children's word reading and reading comprehension processing (Radach, Kennedy, & Rayner, 2004).

1. Attention can be seen as a requirement for successful reading
   Importance of top-down attentional control of visual information processing and saccadic eye-movements in reading is seen Schuett, Heywood, Kentridge, & Zihl, (2008). Also, limitations in

the attention may cause reading problems (Adams & Snowling, 2001; Purvis & Tannock, 2000).

2. Perception and processing may also have an impact on children's reading acquisition.
   Problems in both auditory perception (cf. Tallal, 2000) and visual perception (Ramus, 2001) may lead to reading problems.

3. Working memory is one of the aspects of information processing studied most frequently in conjunction with children's reading development (cf. Seigneuric & Ehrlich, 2005).
   The processing of phonological information and morphological information along with semantics is a part of working memory. Word decoding problems are highly associated with problems in phonological awareness. Studies of Nation, Adams, Bowyer-Crane, & Snowling, (1999), Gathercole, Willis, Baddeley, & Emslie, (1994), Siegel & Ryan, (1989), and Baddeley & Della Sala, (1998) prove how important the working memory is for reading skills.

Table 1

Language levels	Processing Skills related to the Cognitive process	Cognitive Processes
Phonological	Phonological Segmentation Phonological Blending Visual Discrimination Visual Figure-Ground Visual Sequencing Long or Short-Term Visual Memory Visual-Spatial Visual Closure	Auditory Processing Visual Processing Processing Speed Short-Term Memory Long-Term Memory Working Memory
Morphological	Word Discrimination Word Memory Visual Discrimination Visual Figure-Ground Visual Sequencing Long or Short-Term Visual Memory	Auditory Processing Visual Processing Processing Speed Short-Term Memory Long-Term Memory Working Memory
Syntactic	Sentence Memory Long- or short-term visual memory Visual-spatial Visual closure	Visual Processing Processing Speed Working memory Acculturation Knowledge Fluid reasoning

Semantic	Word Discrimination	Visual Processing
	Word Memory	Processing Speed
	Auditory Comprehension	Working memory
	Long- or short-term visual	Acculturation
	memory	Knowledge
		Fluid reasoning

The Objective of the Study

As many researchers in the Western parts of the world indicate that majority of children with dyslexia have processing problems at all levels of language learning and particularly significant delays in reading, poor performance weaknesses on discrimination and identification tasks of phoneme and morpheme. Also the study of developmental language disorders among dyslexics is a new area of research on Tamil children and also rarely done. The present study tries its best to see the implication of cognitive processing issues in language processing.

The present study aims to test the issues in processing skills and then concentrates on the phonological, morphological, syntactic and semantic problems in the children with and without dyslexia at the level of reading Tamil and English.

Methodology

Sample Selection

For the present study, data has been drawn out from the study of the author's UGC Project —Identification and Remediation of Phonological Disorders among Children with Dyslexia and Samples from Centre for Speech and Language Disorder Studies, AU. Only Tamil mother tongue children were selected as the subjects for the study. Schools and remedial centres were selected on the criteria of best in education and service. The total sample size is 202. Of these, 101 were dyslexic children who were selected using the checklist for the identification of Learning Disability. The rest were 101 normal reading age control children selected for a comparative study. The distribution of samples according to the age, gender, and disability is represented in table 2.

Table 2

Age/Division	Boys		Girls	
	Dyslexia	NRAC	Dyslexia	NRAC
8 years – Class III	12	12	4	4
9 years – Class IV	15	15	3	3
10 years – Class V	16	16	2	2
11 years – Class VI	16	16	4	4
13 years – Class VIII	12	12	3	3
15 years – Class IX	10	10	2	2
17 years – Class XII	2	2	-	-
Total	83	83	18	18

A pilot survey was conducted in schools and remedial centres and subjects were selected by the following conditions:

1)   The degree of co-operation extended by the schools and remedial centres for data collection.

2)   Accessibility of schools and remedial centres and availability of a required number of students.

So the study has followed a Convenient Sampling Method.

Testing Procedure

The children were tested for verbal and non-verbal IQ, processing skills and reading skills. The children were selected on their IQ level ranges from average to above average when tested with Bhatia's Battery of Performance Test of Intelligence. Informal test was conducted to see the issues in cognitive processing skills (as listed in Table 3). Reading age for all children is measured by the reading evaluation materials both in English and Tamil.

Table 3

INFORMAL TESTS	
Auditory Processing Test	Visual Processing Test
• Word Discrimination • Word Memory • Phonological Segmentation • Sentence Memory • Phonological Blending • Auditory Comprehension • Numbers Forward • Auditory Reasoning	• Visual Discrimination • Visual Figure-Ground • Visual Sequencing • Long or Short-Term Visual Memory • Visual-Spatial • Visual Closure • Letter and Symbol Reversal

Materials for the Test of Reading Skill

- Materials were prepared for testing phonological, morphological, syntactic and semantic skills (Tamil).
- The following materials were used for testing:
  - Dolch Word List (English)
  - Individual Evaluation Procedures in Reading (by Thomas A. Rakes, et. al.)
  - Comprehension passages in English
  - Tamil Graded Word List for Tamil
  - Phonological Skills Test in Tamil (I & II)
    - Phonics and phonological awareness test
  - Morphological Skills Test in Tamil
    - Morphological awareness test
  - Comprehension passages in Tamil
  - Their text books

Method of Analysis

The quantitative and qualitative types of analysis were applied to describe the test of language processing problems. Qualitative analysis was used to compare the data of children with dyslexia and normal reading age controls.

a) Quantitative analysis

The mean scores for normal reading age controls and dyslexic children were arrived at to analyze qualitatively for the following hypothesis.

1. There is a significant difference between phonological problems in normal reading age control children and dyslexic children.
2. There is a significant difference in phonological deviations in Tamil and English.
3. There is a significant difference between dyslexia and normal reading age controls in morphological processing.
4. There is a significant difference in inflectional and derivational processing.
5. There is a significant difference in morphological deviations in Tamil and English.
6. There is a significant difference between dyslexia and normal reading age controls in syntactic processing such as simple, compound and complex sentences.

7. There is a significant difference between syntactic processing in Tamil and English.
8. There is a significant difference between dyslexia and normal reading age controls in semantic processing like proposition extraction and lexical accessing.
9. There is a significant difference in proposition extraction in Tamil and English.
10. There is a significant difference in lexical accessing in Tamil and English.

b) Qualitative analysis

The data were analysed and classified into phonological processing problems, morphological processing problems, syntactic processing problems, and semantic processing problems.

Results and Discussions

The results of the analysis of phonological processing, morphological processing, syntactic processing, and semantic processing of Children with and without dyslexia were done and the results are discussed.

a. Phonological processing

Phonological processing problems were classified according to the pattern given below:
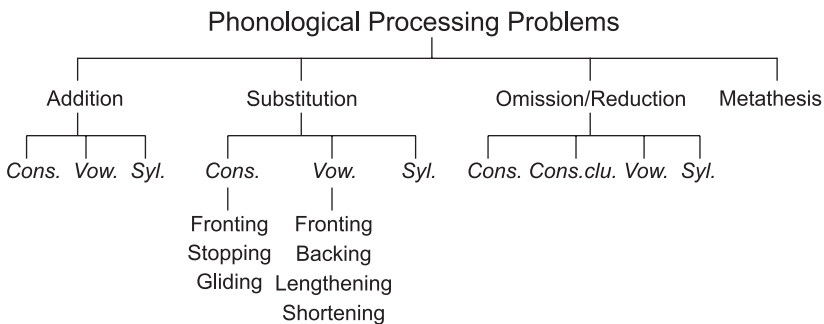   Figure 1 shows the method of classification of Phonological Processing Problems.

Phonological Processing Problems

Addition — Cons. Vow. Syl.

Substitution — Cons. Vow. Syl.
    Cons.: Fronting Stopping Gliding
    Vow.: Fronting Backing Lengthening Shortening

Omission/Reduction — Cons. Cons.clu. Vow. Syl.

Metathesis

Figure 1

The analysis of qualitative data of phonological processing represents the following:

i.   In addition:
   a.   Vowel addition seems to be more in English.
   b.   Syllable addition seems to be more in Tamil.
   c.   Percentage of syllable addition seems to be more or less same in Tamil and English.

ii. In substitution:
   a.   Syllable substitution seems to be more in English.
   b.   Vowel lengthening and shortening seems to be more in Tamil than in English.
   c.   Percentage of consonant fronting, vowel fronting and vowel backing seems to be more or less same in Tamil and English.
   d.   Problems in gliding are more in English than in Tamil.

iii. In deletion:
   a.   Consonant reduction seems to be more in English.
   b.   Syllable reduction seems to be more in Tamil also.
   c.   Vowel diagraphs seem to be more in English than in Tamil.
   d.   Consonant diagraphs seem to be more in English than in Tamil.
   e.   Consonant blends seem to be more in English than in Tamil.
   f.   Percentage of vowel reduction seems to be more or less same in Tamil and English.

iv. Percentage of metathesis seems to be more or less same in Tamil and English.

The results stated above is represented in table 4:

Table 4

	Addition	Substitution	Deletion	Metathesis
Vowel	E > T	lengthening and shortening T > E	T = E	T = E
		vowel fronting and vowel backing T = E		
Consonant	-	gliding E > T	Diagraphs and blends E > T	
Syllable	T > E	E > T	T = E	

b. The qualitative and quantitative data accepts the stated hypothesis 1 and rejects the hypothesis 2.

Hypothesis 1: There is significant difference between phonological problems in normal reading age controls and children with dyslexia is accepted which is represented in Graph 3.

Graph 3 shows percentage of errors in Phonological Processing between the Children with Dyslexia and Normal Reading Age Controls.

Phonological Processing in Children with Dyslexia and NRAC

	Dyslexia	NRAC
Series1	83.60%	32.40%
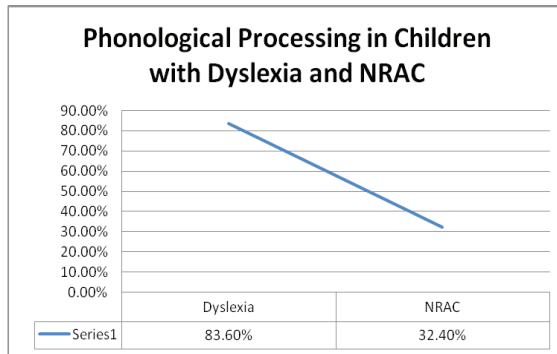
Graph 3

Hypothesis 2: There is a significant difference in phonological deviations in Tamil and English is rejected which is represented in Graph 4.

Graph 4 shows the percentage of errors in Phonological Deviations in Tamil and English by children with dyslexia

Tamil, 84.60%   English, 85.20%
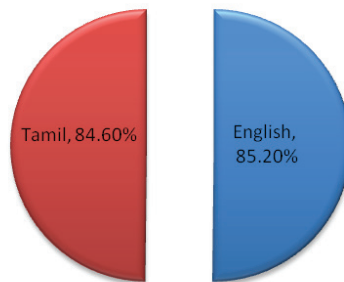
Graph 4

- In Tamil, the problem is more in vowel than in consonants. This might be because of the non-linearity of vowel diacritics in the Tamil language.
- Percentages of errors of normal reading age controls are comparatively very less than dyslexics. So it is proved that normal reading age control children are better in acquiring sound systems of language than dyslexics.

b. Morphological processing

Morphological processing problems found among dyslexics were analyzed and classified in the following way:

Figure 2 shows the method of classification of Morphological Processing Problems.
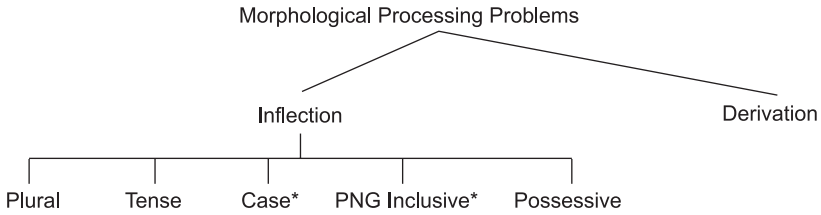
Addition, deletion and substitution are seen in all the above aspects.
*(not in the case of English)

Figure 2

a. The analysis of qualitative data represents the following:
    i.   In additions:
         a.   Additions are found in all case suffixes.
         b.   Additions are mostly seen in accusative, dative and locative cases.
         c.   Additions of the plural marker are found more in English than in Tamil.
         d.   Present participle marker addition is found in English.
         e.   Percentages of derivational marker additions are found to be more or less same in English and Tamil.
    ii. In deletions:
         a.   The only deletion is found in inclusive marker.
         b.   Deletions are found in all case suffixes.
         c.   In English PNG deletions are found.
         d.   Percentage of derivational marker deletions is found to be more or less same in English and Tamil.
         e.   Deletions of the plural marker are found to be more in English than in Tamil.
         f.   Deletions are found more in the ablative case.
         g.   Deletions of the possessive marker are found only in English.
         h.   Deletions of the inclusive marker are found only in Tamil.
         i.   Present participle marker deletion is found in English.
    iii. In substitutions:
         a.   Substitutions are found in all case suffixes except the

ablative case.
b. PNG substitutions are found more in Tamil than in English.
c. Substitutions are mostly found in locative, dative and instrumental; and both locative and dative substitutions are interchangeably found in more number.
d. Substitutions of the plural marker are found more in English than in Tamil.
e. Substitutions of the possessive marker are found only in Tamil.

The results stated above is represented in the table 5 below:

Table 5

		Addition	Deletion	Substitution
Inflection	Plural	E > T	E > T	E > T
	Tense	T > E Present participle	T > E Present participle	T > E
	Case* Only T	All Cases - More in accusative, dative and locative cases	All Cases - More in ablative cases	All Cases - Except in ablative cases
	PNG	T > E	E > T	T = E
	Inclusive*	Only T	Only T	Only T
	Possessive	T > E	E > T	
Derivation		T = E	T = E	E > T

b. The qualitative and quantitative data accepts the stated hypotheses 3, 4 and 5.
Hypothesis 3: There is a significant difference between children with dyslexia and normal reading age controls in morphological processing is accepted.
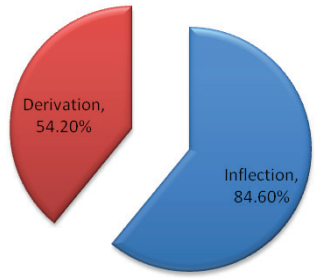Graph 5 shows the percentage of errors in Morphological Processing in Children with Dyslexia and Normal Reading Age Controls

Morphological Processing in Children with Dyslexia and NRAC

	Dyslexia	NRAC
Series1	80.30%	30.30%
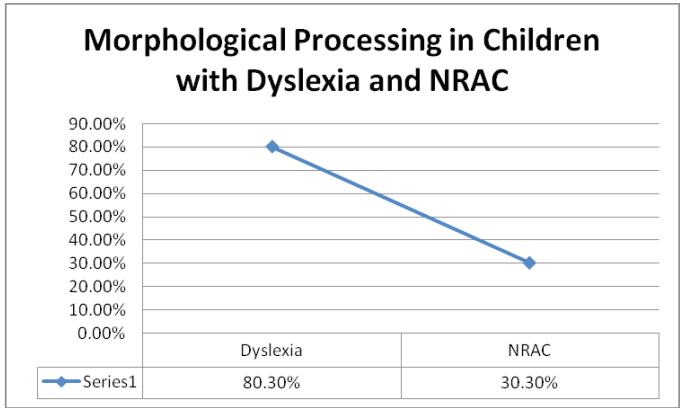
Graph 5

Hypothesis 4: There is a significant difference in inflection and derivational processing is accepted.

Graph 6 shows percentage of errors in Inflection and Derivation by Children with Dyslexia

Derivation, 54.20%

Inflection, 84.60%

Graph 6

Hypothesis: 5 There is a significant difference in morphological deviations in Tamil and English is accepted.

Graph 7 shows percentage of errors in Morphological Processing in Tamil and English by Children with Dyslexia

English, 65.80%

Tamil, 83.20%
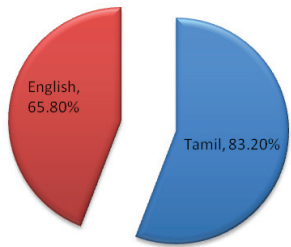
Graph 7

- A high percentage of errors is seen in the morphological processing in the reading process of dyslexic children when compared to normal reading age controls.
- Regarding derivation in Tamil all the three addition, deletions, and substitution are found but in English addition and deletion are found.
- All the three deviations, i.e., additions, deletions, and substitutions are found more in locative case.
- English tense marker all the three additions, deletions and substitutions more as in Tamil only substitutions are found.
- Plural deviations mostly occurred in English when compared with Tamil.
- Additions and deletions are found in English plural marker but additions, deletions, and substitutions are seen in Tamil plural marker.
- Morphological deviations seen in inflectional suffixes are more than those of derivational suffixes.
- Morphological deviations were mostly committed in Tamil when compared with English.

c. Syntactic processing problems

Syntactic processing problems found among dyslexics were analyzed and classified in the following way:

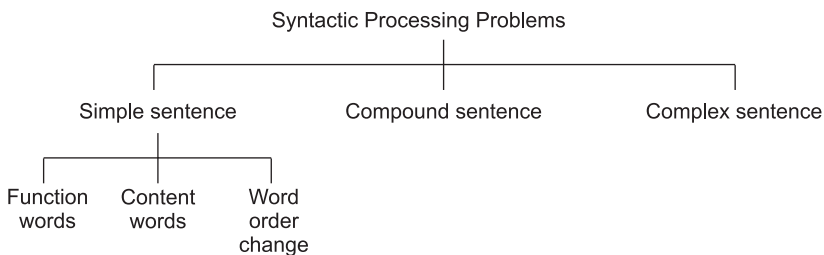Figure 3 shows the method of classification of Syntactic Processing Problems.

Syntactic Processing Problems

Simple sentence   Compound sentence   Complex sentence

Function words   Content words   Word order change

Figure 3

The analysis of qualitative data represents the following:

i. In addition:
    a. Content word additions are more in English than in Tamil.
    b. Function word additions are more in English than in Tamil.
    c. In Tamil, adverbs and adjectives are only added.

ii. In deletion:
   a. Regarding prepositions, only deletions are done.
   b. Content word deletions are more in English than in Tamil.
   c. Function word deletions are more in English than in Tamil.
   d. Functional words are more deleted than content words.
   e. Auxiliary verbs are like 'may', 'must', 'can', 'have' and 'has' in English and auxiliaries like /koṇṭiru/ 'present continuous marker,' 'viṭu' in Tamil are most often deleted.
   f. Deletions are found in compound verb; here the second verbs are mostly deleted.
   g. Lexical items denoting negations are often deleted.
   h. Pronoun deletions are mostly found in English; in Tamil, it is very less.
   i. Adjectives and adverbs are mostly deleted with limited deletions regarding verb and noun.

Only additions and deletions are the processing problems focused in sentence level, and the substitutions in the lexical level are dealt with in semantics.

The results stated above is represented in the table 6 below:

Table 6

		Addition	Deletion
Simple	Content Words	E > T In only adverbs and adjectives in Tamil	T > E
	Function Words	E > T	E > T
	Word Order Change	E > T	
Compound and Complex Content words, function words, word order change happens in clausal level		T = E	T > E

b. The qualitative and quantitative data accepts the stated hypothesis 6 and rejects hypothesis 7.

Hypothesis 6: There is a significant difference between dyslexia and normal reading age controls in syntactic processing such as simple, compound and complex sentences is accepted.

Graph 8 shows the percentage of errors in Syntactic Processing in Children with Dyslexia and NRAC

Syntactic Processing In Children with Dyslexia and NRAC

	Dyslexia	NRAC
Series1	84.50%	33.20%
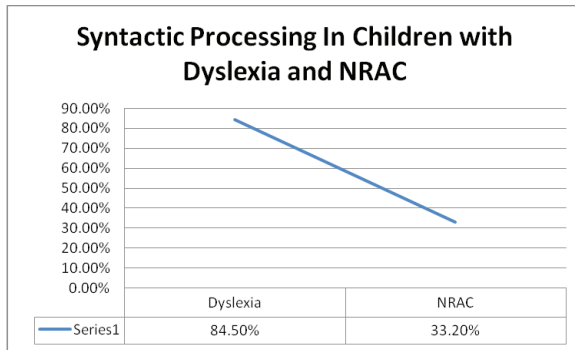
Graph 8

Hypothesis 7: There is a significant difference between sentence processing in Tamil and English is rejected.

Graph 9 shows the percentage of errors in Tamil and English by Children with Dyslexia

Tamil, 79.20%

English, 82.40%
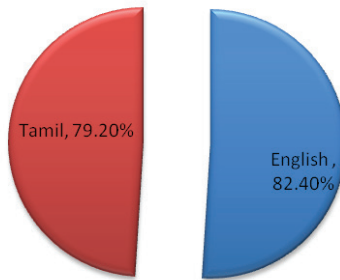
Graph 9

- Problems are found more in complex sentences than in compound and simple sentences.
- Additions and deletions are found while reading conjunctions.
- Both additions and deletions are mostly found in articles.
- Changing the word order is more in reading complex sentences when compared to simple and compound sentences.

d. Semantic processing problems

Semantic processing problems found among dyslexics were analyzed and classified in the following way:

Figure 4 shows the method of classification of Semantic Processing Problems.
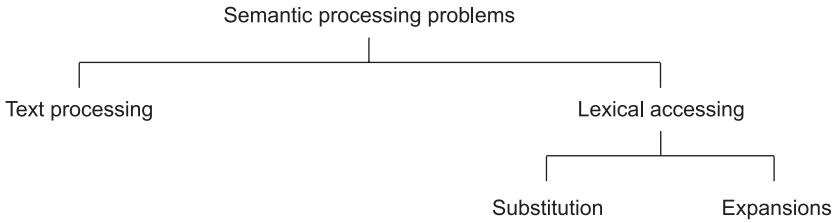
Semantic processing problems

Text processing   Lexical accessing

                                              Substitution   Expansions

Figure 4

The analysis of qualitative data represents the following:
- Subject of the sentence is often deleted and substituted.
- Compound NP is changed into simple NP.
- Meaning distraction is found more in English than in Tamil.
- Object deletions and substitutions are found.
- Verb substitutions are found more.
- The reader focused on N in NP while extracting proposition in reading.

> /*ovvo*ɾu *va:ɾa*mum o*ɾ*u pu*ʈij*a i*ʈaʈʈ*irku celʋo:m/
> "every week we will go to a new place"

has been read as /*va:ɾa va:ɾa*m i*ʈaʈʈ*irku po:ʋo:m/
    "every week we will go to place"

Here the noun phrase /o*ɾ*u pu*ʈij*a i*ʈaʈʈ*irku/ "to a new place" is substituted with /i*ʈaʈʈ*irku/ "to place" which is represented in the tree diagram below.

PP

NP   Case

Det   NP   ku

oru   Adj   N

puʈija   iʈam
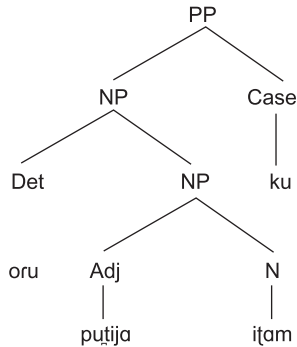
- Verb substitutions and deletions are found both English and Tamil.
- As the children's mother tongue is Tamil, they are able to get the context and are able to find out the related meanings though not the whole context.

- Regarding attending the comprehension exercises, children are
  - better in choosing the best and true or false than in fill in blanks and question answers.
  - very poor in question answer section.
  - able to comprehend better in Tamil than in English.

b. The qualitative and quantitative data given above accepts the stated hypothesis 8, 9, and 10.

Hypothesis 8: There is a significant difference between dyslexia and normal reading age controls in semantic processing like proposition extraction and lexical substitution and expansion is accepted.
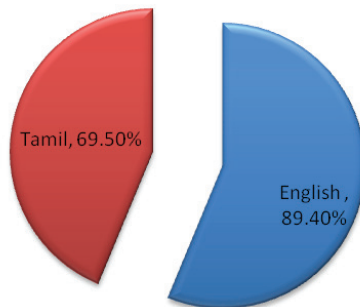
Graph 10 shows percentage of errors in Semantic Processing in Children with Dyslexia and Normal Reading Age Controls

Semantic Processing in Children with Dyslexia and NRAC

	Dyslexia	NRAC
Series1	50.30%	28.20%
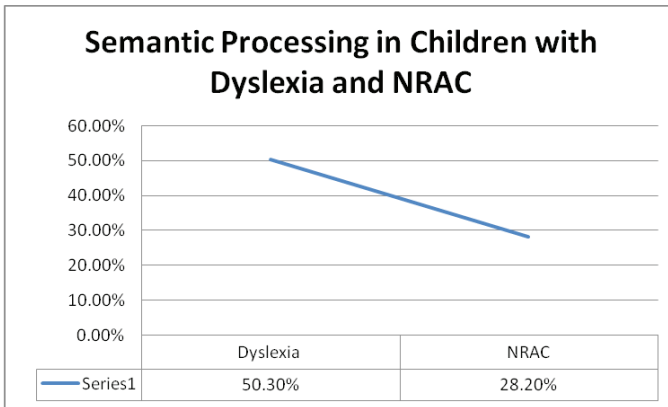
Graph 10

Hypothesis 9: There is a significant difference in proposition extraction in Tamil and English is rejected.

Graph 11 shows percentage of errors in Proposition Extraction in Tamil and English by Children with Dyslexia.

Tamil, 69.50%   English, 89.40%

Graph 11

Hypothesis 10: There is a significant difference in lexical substitution and expansion in Tamil and English is accepted.

Graph 12 shows percentage of errors in Lexical Substitution and Expansion in Tamil and English by Children with Dyslexia.

Tamil, 27.40%

English, 48.20%
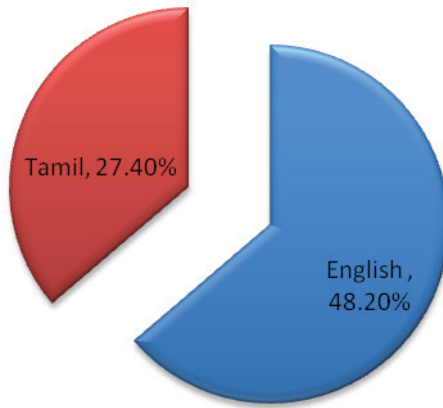
Graph 12

- Lexical substitutions
  - While accessing the lexical item in reading, lexical substitutions are seen in prepositions, articles, Wh-words, and demonstratives also.
  - The lexical items are also substituted with their synonyms, and antonyms, its hypernyms, by words in the same domain and also very rarely unrelated words.
- Lexical expansion:
  These types of errors were very rarely seen, but made only when these children read known texts. The findings reveal that problems are more in complex and compound sentences than in simple sentences.
- Proposition extraction:
  Proposition extractions found in reading single sentences (simple, compound, complex, affirmative, negative, interrogative and exclamatory sentences) and graded comprehension passages.

Discussion

The deviations/errors identified above are discussed below:

- Problems are seen more in phonological and morphological levels.
- Many have avoided reading complex sentences.

- Most of the additions and substitutions show assimilations (either regressive or progressive) of phonemes, morphemes found in nearby words or sentences.

  e.g. / ka:ʈʈil vaḷḷainʈa ko:ɳala:na *maram* iɾunʈaʈu/
     'in the forest, bent and twisted tree is there'

  has been read as

     /ka:ʈʈil vaḷḷainʈa ko:ɳala:na *marattil* iɾunʈaʈu/
     'in the forest, bent and twisted in the tree is there'

- Redundancy is found in substitutions.

  e.g. /pu:ŋka:ʋil *vilaŋkukaḷ*um paɾavaikaḷo:ʈu iɾunʈana/
     'in the park, along with birds, animals also were there'

  has been read as

  /pu:ŋka:ʋil *vilaŋkukaḷ*um paɾavaikaḷo:ʈ*um* iɾunʈana/
  'in the park, along with birds also, animals also were there'

- Deletions are the most systematic errors they make due to abnormal speed of eye-tracking.

- Emphasizing may be one of the reasons for adding suffixes as in the examples given below:

     /paɳɳaija:ɾ aʈai ɳanra:ka vaḷarʈʈu *canʈaijil* ʋirru viʈuva:r/
     "Farmer breeds that properly and sells in the market."

  has been read as

     /paɳɳaija:ɾ aʈai ɳanra:ka vaḷarʈʈu *canʈaikku* ʋirru viʈuva:r/
     "Farmer breeds that properly and sells to the market."

Concluding Remarks

This study followed a comparative study of two different groups of children (children with dyslexia and Normal Reading Age Controls) at the different stages of language processing, as due to the unavailability of standardized tests in the Tamil language. Earlier research evidence and the present study show that there is a relationship between attention, processing, perception and working memory with language learning. The children with dyslexia scored very low in processing skills test when compared to NRAC. Children of NRAC group who are good at processing skills have limited reading problems which are found to be significantly more in Children with Dyslexia who have processing problem. Problems are found both in Tamil and English learning. The methodology of language teaching for these children should adopt the techniques that involve the explicit teaching of the rules of the language with multisensory techniques that includes processing skills.

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