SEMANTIC AND PHONOLOGICAL PRIMING IN CHILDREN WITH LEARNING DISABILITY: A WORD READING TASK

Registration No.: L0480008

A Dissertation Submitted in part fulfillment of
Master's Degree (Speech Language Pathology),
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Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MANASAGANGOTHRI
MYSORE-570 006

MAY-2006

SADAR PRANAM

I DEDICATE THIS DISSERTTION TO PAPA AND MAMMA.

I EXTEND MY THANKFUL PRAYERS TO NANAJI AND DADAJI FOR BEING THE STRENGTH OF MY FAMILY.

I DEDICATE THIS STUDY TO MY DEAR GUIDE, SUBJECTS, MY BELOVED COUNTRY, INDIA AND TO BHAGWAN JI.

Certificate

This is to certify that this Dissertation entitled **"SEMANTIC AND PHONOLOGICAL PRIMING IN CHILDREN WITH LEARNING DISABILITY: A WORD READING TASK"** is a bonafide work in part fulfillment for the degree of master of (Speech Language Pathology) of the student (Registration No. L0480008). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This Dissertation entitled **"SEMANTIC AND PHONOLOGICAL PRIMING IN CHILDREN WITH LEARNING DISABILITY: A WORD READING TASK"** is the result of my own study, and has not been submitted earlier in any other University for the award of any Diploma or Degree.

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May, 2006 Register No. L0480008

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Rams jaan.Can you imagine the state of a computer without UPS? I foresee myself as that computer without your essence and support in my life.Be there,whatsoever.you

have given me a lot in these short 6 years. You are that 'HERO' who can 'kiss away the pains'. At least now you will never forget this line. Right?

Krans~you was,you are and you will always remain my strength.Pucha...thanks for always being with me.GOD bless u .

Tej~you are a smart friend.Keep my secrets with you like this.0rii-Thanks for being my bindaas partner in last time works. I will miss you during my tea times. *Pow~* would like to thank you on behalf of whole class for being the feviquick of our class.Thanks a lot for changing yourself to some extent. Vedsss-Thanks for those silent appreciation and care you had for me.i always realized it.If nothing you learnt one thing from me,"_____________"Maha-Thanks for beinga sportive friend.I will always miss those TT matches we played together.Dee...-Even being silent,you taught me a lot.Thanks a lot. *Sumiii..* .-Thanks a lot for giving me your laptop for data collection.Though,you are easily convincible but that is your greatest strength. *Raja...*-Thanks for giving me memorable moments I shared with you.I will miss those rides and corridor hungamas. *Sanjayji-Thanks* for giving me so many ways of appreciating self.Keep that attitude with you. *Rahul-Thanks* for making me laugh at times when I used to be stressed out."yeh mujhe achha laga"...hows that? Prafull ~Buddham Sharanam Gachhaami...! had good time with you and learnt a lot too.Thanks..Aashir ~The real gentleman of my class.Thanks very much for always being ready to help me.Aise log kam hote hai.Keep it up. Noor-Thanks for that 'Basic Lesson'.Thanks for being a constant support. *Rima-Thanks* for being a truthful friend.
Shiva ~You possess your relationsl like that. Baba-Thanks for waking me up by knocking my door suddenly. *Sujit,Sudeepto,Kushal* and Pravin-Thanks for bearing me and my teasings.

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Thanks *to* ***all***

```
           h          w          w      "W             l k
Onegay, Jo n anp Bop   n  froa  a k.   hatwo        ou i e
                     e t          l               ulpy

t  o   a                        n'tk           r
 op  op y?, Boq  ske  John. "I do     ow, J     ed  ed,
    t           a   p                n      onh    li

                k                  I         o     c
 hatwo lpyo  li e ot go?" It  in    mi  ten  yw at    g a
w      u    u                h  k      gh   j       hin

             sd c  l y       c
 o i  nTV, e  e ia l  fiw e     av es me do  ron. "Wow,"
m v eo                     anh       o      dc

               q   n!      g                    e k   e
saip Jonh, "Po c       hat   eati       Let's     c  t
                 or   W   a r    pea!         ch      h

 uq   r t   e                          o
c  qoa    o s e fim y m the     gh   s      he stalt im    e wetn
       d                 o   rpou   t    met               esh

s   in                             u       n
 hodb   g." "Look," hey e  ep, "af l       pit's  r il e
                          ll          lpoxa        O v  l

e                yf a  r                        u         t'sc   k
R pqenqocker! M     o  te!"     eat!" Bopsho   eq, "Le       o  t.
                  v  i     "Gr                 t                o

          i r wa
udi          c o        nqs  e woh ti truns
   nt hem        vea       e                tou."
```

Trying to read this passage, you will experience the kind of difficulty a dyslexic reader faces when deciphering normal typeface (Almeida).

from p. 98, in: Capossela, T.L. (1998). The Harcourt Brace Guide to Peer Tutoring. Orlando, FL: Harcourt Brace & Company.

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CHAPTER I

INTRODUCTION

Reading is a crucial skill for academic and occupational success. Reading is the process of retrieving and comprehending some form of stored information or ideas. These ideas are usually some sort of representation of language, as symbols to be examined by sight, or by touch (for example Braille) (Keeney and Keeney, 1968). Reading is a process that requires co-ordination of a series of sub-functions, which include visual functions, verbal functions and other cognitive functions like memory and attention (Kim, and Davis, 2004). Reading can be impaired when any of these functions are affected. In simple terms reading failure in children, in spite of normal intellectual functioning, normal hearing, normal vision, adequate motor skills and adequate learning environment can lead to *'Learning disability' or 'Dyslexia'*.

Learning Disabilities (LD) are the most common in the general population. The definition according to the Learning Disabilities Association of America says that: "Learning disabilities are defined as neurologically-based processing problems. These processing problems can interfere with learning basic skills (Cossu, 1999) such as reading (Stuart, and Coltheart, 1988) writing, or math. They can also interfere with higher-level skills such as organization, time planning, and abstract reasoning. The types of LD are identified by the specific processing problem. They might relate to getting information into the brain (input), making sense of this information (organization), storing and later retrieving this information (memory), or getting this information back out (output). Learning disabilities are an 'umbrella' term describing a number of other, more specific learning disabilities." The familiar term dyslexia, which is a reading and language disorder, is only one of the learning disabilities that fall under this large umbrella.

The term *dyslexia* was introduced by Berlin, a German ophthalmologist in 1884. He coined it from the Greek words *dys* meaning ill or difficult and *lexis* meaning word, and used it to describe a specific disturbance of reading in the absence of pathological conditions in the visual organs. About 10% of the population has some form of dyslexia. About 4% are severely dyslexic, including some 375,000 schoolchildren in American context.

Individuals with learning disability (LD) fail to achieve normal reading skills despite adequate intelligence, educational opportunities, and socioeconomic status (Shaywitz, Shaywitz, Fletcher and Escobar, 1990). Several studies have reported that children with SLI and LD cannot differentiate between rapidly changing consonant-vowel (CV) syllables when presented at normal speed (Tallal, Miller and Fitch, 1993; Tallal, 1996). While effortless for a practiced reader, the visual (and tactile) recognition of words involves extensive cognitive processing. This ranges from encoding orthographic features, to retrieving phonological, lexical, and semantic memories, to using context in ways that maximize recognition speed and comprehension. Given this complexity, the factors influencing visual word recognition have received remarkable attention recently (Ferrand and Grainger, 1993).

Marshall and Newcombe's (1973) "functional analysis" of the processes involved in reading out loud, based upon an extended series of clinical observations of acquired dyslexics. When reading individual words, the "visual addresses" of those words have to be excited by some sort of raw image within the "visual register". In turn, these visual addresses have to be associated with both "semantic addresses" and "phonological addresses". The critical point is that all this processing is modular. The phonological, semantic, and syntactic aspects of words are each provided by "functionally separable performance systems", and once the combined excitation exceeds the necessary recognition threshold word perception can be said to have taken place. The lexical unit in question can then be associated with an output articulatory process which determines the final response, i.e. saying the word.

The role played by a to-be-recognized word's semantic context or phonologic context is one such focus of the present study. In examining such effects during word recognition, researchers often implement tasks where participants categorize a string of letters as a "word" or "nonword". During this *lexical-decision task* (LDT), "word"/ "nonword" key-press reaction times (RTs) and accuracy serve as dependent measures. Generally, a participant's speed and accuracy of response to a target vary depending on the relation of the *prime* item preceding it. Thus, the target *robin* is recognized more quickly and accurately when preceded by the related prime *BIRD* than by the neutral prime *XXX*. This is termed *facilitation*, whereas slower target response when reading *BIRD...arm* compared to the neutral prime condition *{XXXX...arm)* shows *inhibition* (Neely, 1977).

Priming is believed to occur without intention and is described as an 'automatic' process. It also seems to occur without awareness and is therefore described as an unconscious process (McCarthy, and Warrington, 1990; Posner, and Snyder, 1975; Peereman, and Content, 1995; Parkin, 1996: Harley, 2001). Since priming can occur in tasks where memory for previous information is not required, it can sometimes have detrimental effects. Jacob (1983) showed that priming is related to perceptual processing.

One of the original demonstrations (Meyer and Schvaneveldt, 1971) of priming occurred in a textual decision task in which a series of decisions is made about whether letter strings are words or not. Research by Ratcliff and McKoon (1981) showed that reaction times to target words primed with closely associated words were faster than target words primed with distantly associated words. Priming was shown to occur in cases where two successive letter strings were semantically related words. For example the decision that 'doctor' is a word was faster when the preceding letter string was 'nurse' as compared to 'north' or the non-word 'nuber'. This semantic priming effect was explained by a mechanism termed spreading activation that had been proposed by Collins and Loft (1975).

Although, research over the past two decades has made enormous progress in trying to understand children with LD, numerous confusions and speculations exist among which, difficulty in word recognition is one of them. There are equivocal reports regarding such deficits in LDs to be consequence of a phonological coding deficit or semantic coding deficit. Some investigators favored and concluded that dyslexics have weak functioning phonological coding system and this was considered to be the probable cause of reading difficulties in such children while others attributed it to semantic coding deficit especially in the older readers, thus revealing meaningful insights into how phonological and semantic coding function in children with learning disability in Western context. To date, however, there are very few published studies using an experimental semantic and phonological priming paradigm involving 8-15 years of children in Indian context.

Hence, the present investigation aims:

- The aim of the present study was to focus on the relative performance of children with learning disability (LD) in comparison to normal children on semantic and phonological priming tasks
- It also aims at exploring the nature and level of breakdowns in lexical processing in dyslexia due to the interfering primes resulting in lexical recognition problems. In other words, it aims to study the nature of word recognition deficits in Children with Learning Disability (LD) as the disorder is explored relatively lesser than any other clinical population in Indian context.

CHAPTER II

REVIEW OF LITERATURE

Reading, one of the remarkable expansions of human intelligence involves component processes that extract the meaning of a text and penetrate a representation in the reader and mind (Gernsbacher, 1994). Reading principally differs from other forms of language comprehension with respect to the medium in which processing occurs. It is a process that requires co-ordination of a series of sub-functions, which include visual functions, verbal functions and other cognitive functions like memory and attention. Reading can be impaired when any of these functions are affected. Dyslexia is one of several distinct learning disabilities. It is a specific-based disorder of constitutional origin characterized by difficulties developing the phonologic skills needed to map phonemes to graphemes and to effectively and automatically decode and encode words while reading and writing. In addition to problems with reading, a conspicuous problem with acquiring proficiency in writing and spelling, dyslexia manifests varied difficulty with different forms of language, often including affected short-term memory, mathematics, concentration, personal organization and sequencing.

Reports in United state sates of America (U.S.A) shows that Dyslexia or reading disorder affects 5-10% of the population (Gernsbacher, 1994). Individuals with dyslexia fail to achieve normal reading skills despite adequate intelligence, educational opportunities and socioeconomic status (Shaywitz, Shaywitz, Fletcher and Escobar, 1990). According to the temporal processing deficit (TPD) hypothesis, individuals with developmental dyslexia are unable to process rapidly changing and serially ordered brief speech signals such as formant transitions, spectral noise associated with plosives, differences in voice onset time (VOT) in voiced and unvoiced consonants, and the like. Several studies have reported that children with SLI and dyslexia cannot differentiate between rapidly changing consonant-vowel (CV) syllables (Tallal, Miller and Fitch, 1993; Tallal, Gram, Reddy and Richardson, 1996). It has been suggested that this ability is important for language acquisition and the development of phonological awareness and reading skills (Talcott, 2000; Tallal, Curtiss and Miller 1993) and that deficits in this domain may result in impaired language facility including reading. Amongst a host of functions relevant to reading process, visual word-recognition in children with dyslexia is widely investigated.

Word recognition is one aspect of reading for which the use of visual perceptual channel has the largest impact on the comprehension process (Miller and Eimas, 1995; Ferrand, and Grainger, 1993; Frost, Katz, and Bentin,1987). Various theoretical models that have been proposed over the years have driven word recognition research. Word recognition models describe how to find word meanings in memory. They are obviously pertinent to the process of recoding since word recognition is the most important part of the reading process. This starting point in the reading process is the visual input stage; but from there tracts to meaning diverge, depending on the model in question. One such model, the classic version of the dual-route model that provided the focus for the Patterson, Marshall and Coltheart (1985). The dual-route model assumes that meaning can be accessed directly from visual input or indirectly through a phonological recoding stage (Joy, 2002).

The classic dual route model (Coltheart, 1978; Coltheart, Cartis, Atkins and Holler, 1993; Coltheart, Rastle, Perry, Langdon and Ziegler, 2001 ;Patterson, 1990) proposes few independent coding systems that access word meaning. One route uses words to directly access lexical representation (lexical or whole word access) and the second uses grapheme to phoneme conversion (GPC) rules to access them indirectly (phonological or sub lexical access). A recent version of the Dual Route Cascaded (DRC) model of visual word recognition and reading aloud is illustrated in the figure 1.

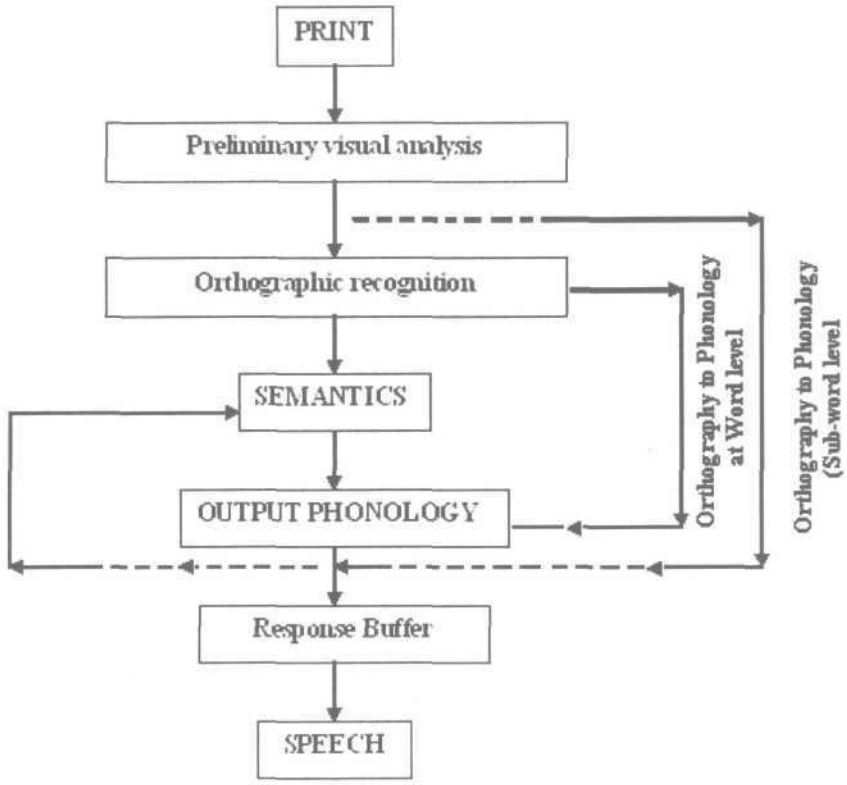


Figure 1: Dual Route Model (Patterson, Marshall, and Coltheart, 1985)

The direct grapheme to phoneme system is shown on the right of the figure 1, and the direct path to the lexicon, with or without meaning activation, is on the left.

A line of support for the dual route model comes from research in people with language disorders. Research on readers with different forms of acquired dyslexia seems to support the dual-route model of lexical access. Interest in acquired dyslexia can be traced to an important paper or the topic by Marshall and NewCombe (1973) in which they contrasted differences between its surface and deep forms in the form of postulated etiology and symptoms too.

1. Surface Dyslexia/Phonological Reading (Marshall and Newcombe, 1973; Shallice, Warrington and McCarthy, 1983; Shallice and Warrington, 1980)

   (a) Selective impairment of irregular words, regularization of irregular words, regular words and nonwords relatively normal.

   - Selective damage to lexical route.
   - Different degrees of damage to lexical route.

   (b) Most patients have comprehension problems (written and spoken) but the fact that some have preserved comprehension of spoken language

   - Coding of spelling to sound is independent of meaning comprehension.
   - Access procedures for spoken and written language independent.

   (c) Most patients no damage to visual word forms.

   (d) Levels of regularity effect and correct assignment of stress

   - Coding units bigger than phoneme-grapheme (Shallice, Warrington and McCarthy, 1983).

2. Deep Dyslexia (Marshall and Newcombe, 1966, 1973).

(a) Selective impairment of sound-spelling correspondences: impaired on nonwords; no clear difference between regular and irregular words. Characterized by semantic errors *(cycle* for *tandem);* poorer on abstract than concrete words; function word/ morphological errors.

(b) Two hypotheses of deep dyslexia: (1) Damage to transcoding route and to parts of semantic system. (2) Damage to transcoding system and to semantic system (extensive), therefore use of right hemisphere, which has limited reading ability. (Warrington and McCarthy, 1983; Ellis and Young, 1981).

Readers with deep dyslexia have impaired phonological decoding. They still can read words by finding them directly in semantic memory without relying on phonological decoding. Deep dyslexics can also read real words but not pseudo words (e.g. trope), indicating that direct route is available. Patient produces response, which is semantically related to the stimulus word (semantic errors). For example, 'forest' read as 'trees' visually similar to the stimulus word for example 'signal' read as 'single' and sometimes, the errors produced are a combination of semantic and visual errors, for example, 'sympathy" (via symphony) read as orchestra. The visual concreteness of the word is also important for word recognition. Deep dyslexics can identify concrete words better than words that are abstract as low in image ability (concreteness effect). The deep dyslexic finds these kinds of concrete words without taking a phonological route. For them, it is as though the phonological route is not functional. Along this line of reasoning, they are better at identifying content words than functional words (Rayner and Pollatsek, 1989). Deep dyslexics also exhibit derivational errors for example 'I' word as 'me'.

Performance in deep dyslexia also depends on part of speech (nouns>adjectives>verbs>function words) and word concreteness (concrete>abstract) (part of speech affect). Patients with deep dyslexia have reading problems that are opposite to those experienced in surface dyslexia. Readers with surface dyslexia show a different pattern of reading errors. They rely almost entirely on phonological recoding to find word meaning. Surface dyslexics can decode pseudo words and regularly spelled words; however, they have trouble with irregular words (e.g. epoch) and those with unusual presentation patterns (e.g. sew). The pattern of errors in surface dyslexics shows that they are trying to find the relationship between 'graphemes' and 'phonemes'. Their errors look like those examples:

'Disease' read as 'decease'

'Guest' read as 'just'

The words that the dyslexic pronounces are phonologically approximate to the target words.

Porster and Chamber (1973) proposed that we might use the direct route for familiar words and the indirect route and sounding out for words that are less familiar. There are various strategies to study this aspect of lexical processing. One of the widely used methods in the literature is the lexical decision task (LDT) paradigm.

The LDT (lexical decision tasks) can be of four different types:

1) Visual pair-wise decision paradigm: It refers to the standard LDT in which subjects make decisions about visually presented letter string targets preceded by a single prime.
2) Auditory pair wise LDT: This is similar to the above except that primes and targets are presented auditorily.

3) Auditory triplet LDT: In such a task, subjects make lexical decisions about a single target word or non-word that is preceded by two consecutively presented primes, auditorily.

4) List priming LDT: In this task, visual letter strings are presented in a continuous list format, not pairs, and the subjects make lexical decisions about both primes and targets.

Semantic priming paradigms, which generally employs visual pair wise LDT task, are most often accounted for Posner and Snyder's (1975) dual process theory of priming. The central tenet of this theory is that priming can either occur by two processes:

(1) Automatic processes

(2) Attentional processes i.e. strategic processing.

(1) Automatic Priming Process

Automatic Priming Process effect is discussed in terms of automatic spreading activation (ASA). Priming induced by ASA occurs early on, occurs without a person's intention or awareness, and is not under person's conscious control (Jay, 2003). The concept of ASA as a semantic primary mechanism is based on the assumption that semantically related word nodes are stored or linked closely together in lexical memory. It is presumed that each node has a resting state, and a maximal level of activation that can be triggered if a particular activation threshold is activated. The presentation of a prime activates the threshold for a corresponding node in memory, which then automatically spreads to the nodes of related words to activate their threshold. Once triggered, the maximum level of activation decays rapidly, to **return** to its resting state. As this spread of activation only occurs between word nodes that are semantically related, the presentation of a prime does not impact the processing of words unrelated to the prime. Therefore, ASA can account for facilitating affects, but not for inhibitory affects.

(2) Strategic or Attentional Processes

Strategic processes contrast with automatic processes in that they are slow acting, they are dependant on the subjects' conscious attention to the prime, and they can account for inhibitory and facilitatory effects. Two types of mechanism have been considered to account for strategic priming effects: 'expectancy' and 'post-lexical checking'. Expectancy accounts posit that subjects use the prime to generate a set of expectations about the forth-coming target (Becker, 1980; Posner and Synder, 1975). If the subsequent target is indeed in this 'expectancy act', reaction times are facilitated, if not, reaction times are inhibited because subjects must devote more attentional resources to activate the mode for a word not present in the expectancy set. An alternate view is that strategic effects reflects post lexical processing and that expects targets and unexpected targets are successed at the same rate, but the subsequent decision to accept or reject the target as a word is inflectioned by subject expectations.

To summarize automatic and strategies process are imperative for effective learning of academic skills. Although achieving the best academic learning skills, both the strategies have different basic rationales. In Automatic processes an individuals participates passively while on the other hand active participation of an individual is advocated in strategies process

Factors that influence automatic and strategic processes

The assumption that priming mediated by ASA is enacted as soon as the prime is presented, and decays rapidly, predicts that the effects of ASA should be observed at short SOA (Sadock, and Sadock, 2000). In contrast strategic priming affects are expected to occur with longer SOAs because presumably they result from the subjects' conscious appreciation of the prime, a process **that** takes time. The relatedness proportion (RP), which is defined as the proportion of related prime-target trials out of all prime target trials also influences automatic and strategic processing. It has been shown that when the relatedness proportion is larger cine more related word pairs than correlated in an experiment), the semantic priming effect is larger than usual.

Over the past several decades, psycholinguists and cognitive psychologists have shown substantial interest in the processes and representation underlying language comprehension during reading and listening. However, comparatively little emphasis has been placed on determining the locus or extent of common language processes across the modalities (Bradley and Forster, 1987; Bilis and Young, 1988; Radeau et al. 1992; Shallice, 1980). On the one hand, it seems obvious that written and spoken words place unique demands on the reader/listener and that each modality must therefore enlist a set of its own "modality specific" processes during comprehension. However, it is equally clear that at some point after initial encoding operations, a shared "'common" set of processes and / or representations must be employed during reading and listening.

Priming is generally believed to be localized to specific perceptual systems. Priming refers to a mechanism affecting a response to a target by presenting a related item prior to it; priming can have either facilitatory or inhibitory effects. Although most theories of perception posit discrete modules for each sensory system, recent neuroscience and perception research demonstrate that perceptual system may interact. In the priming literature, this is examined by manipulating perceptual modality. For example, participants may study two lists of words, one visually and one aurally. At test, studied items may be presented within (e.g. visual study, visual test) or across modality (e.g. auditory study, visual test). Cross modal priming has been extensively examined discretely in either semantic priming or phonological priming paradigms with obviously different stimulus. The present study examines cross modal priming for both semantic and phonological paradigms using the same set of word stimuli. Two main factors influence the academic learning one is facilitatory, which has more impact compared to inhibitory factors.

In general, overview of reports has focused mainly on various types of priming and its affect on learning academic skills. To further strengthen the review of literature has been discussed under the following sub-sections:

- Research on Cross Modal Priming
- Research on Phonological Priming
- Research on Semantic Priming:

Research on Cross Modal Priming.'

Alternative accounts of cross-modal priming have stemmed from the idea that perceptual processing of a stimulus may not be limited to the nominal presentation modality used by the experimenter. The general hypothesis is that a stimulus presented in one modality can be recoded in terms of other modalities (e.g., Downes et al., 1996; Kirsner, Dunn and Standen, 1989; McClelland and Pring, 1991). For example, if TRUCK is studied visually, a person could experience its auditory form through (possibly covert) naming processes. Similarly, the stem TRU could be encoded in terms of its pronunciation. Support for this hypothesis is provided by McClelland and Pring (1991).

A number of studies have found evidence of between-modality priming using reaction time measures. These measures have been reported in both word pair tasks (Marslen-Wilson, 1987; Swinney, 1979) and in sentence tasks (Onifer and Swinney, 1981; Seidenberg, Tanenhaus, Leiman, and Bienkowski, 1982; Swinney, Onifer, Prather, and Hirshkowitz, 1979; Zwitserlood, 1989) where the sentence is usually presented in the auditory modality and a target word is presented visually.

In cross-modal paradigm target and stimulus are introduced in more than one mode such as visual and graphic. Visual and auditory, visual, graphic and tactile etc. combination are used to elicit faster and effective and responses from the participants. Whatmough, Arguin, and Bub (2005) conducted a study in which subjects were asked to indicate which item of a word/nonword pair was a word. On critical trials the nonword was a pseudohomophone of the word. Reaction times (RTs) of dyslexics were shorter in blocks of trials in which a congruent auditory prime was simultaneously presented with the visual stimuli. RTs of normal readers were longer for high frequency words when there was auditory priming. This provides evidence that phonology can activate orthographic representations; the size and direction of the effect of auditory priming on visual lexical decision appear to be a function of the relative speeds with which sight and hearing activate orthography. Children, age less than 6 months, can recognize the concordance between auditory and visual speech sounds and are influenced by visual input when interpreting auditory speech

(Rosenblum, Schmuckler, and Johnson, 1997; Kuhl and Meltzoff, 1982). This reciprocal relationship strengthens during development depending on the specific language environment (Desjardins, Rogers, and Werker, 1997; Massaro, Cohen, and Smeele, 1995; Massaro, Thompson, Barron, and Laren, 1986) and is prominent in adults (McGurk and MacDonald, 1976). Reading-disabled children, on the other hand, have been shown to be impaired in audiovisual speech integration (Degelder and Vroomen, 1998). When children are actually learning to read, the requirement for rapid sequential cross modal processing becomes even more obvious. Visual and auditory processing abilities are related to grapheme to phoneme conversion (GPC), the application of correspondence rules between printed letters and letter combinations and their phonological equivalents. However, this is not the only cross modal processing involved in reading. When reading aloud, for example, one has to program, retain, and execute at a millisecond level the eye movements needed for sequentially deciphering the printed characters. In parallel with this process, a conversion from vision to phonology and semantics takes place.

Swimmey (1979) used a cross modal priming task to examine the problem of conflict effects. In this task, subjects have to listen to a sentence (auditory mode) that contains an ambiguous word, for example, bug. Immediately after the subjects hear the ambiguous words, they are (visual mode) one of the associates of the word (e.g. ant and spy) or unrelated word (e.g. sew) projected on screen. They must perform a lexical decision task on the projected word.

The cross-modal picture-word inference task has been employed to study the process of word generation in adults (e.g. Schriefers, Meyers and Lovett, 1990; Meyer and Schriefers, 1991; Collins and Ellis, 1992). In this task, participants are presented with pictures to name. While they are looking at these pictures, they hear words presented auditorily via headphones. The participant's task is to name the pictures as quickly as possible, while ignoring the auditorily presented distracters. In studies using this task, phonologically related interference words (IWs), such as 'snake' when presented with 'snail', have been found to produce less interference than phonologically unrelated IWs, such as 'snake', when presented with 'house' (Schriefers et al. 1990).

Research on Phonological Priming:

Different types of primes in picture naming have been used by researchers to address various theoretically driven research questions for example, Brooks and MacWhinney (2000) reported that younger children when compared to older children and adults, were more apt to "speed up" or shorten their SRT when primed by the whole word rather than the word's onset, findings that address development of holistic versus incremental processing.

One means of using phonological priming during picture naming task (Wijnen, and Boers, 1994; Kroll, and Stewart, 1994; Levelt, and Wheeldon, 1994; Mcnamara, and Healy, 1988; Gordon, and Baum, 1994; Katz, and Lanzoni, 1992 ;Perfetti and Bell, 1991; Berent,1997) is to study phonological encoding in young children would be to prime the speaker just prior to the process of phonological encoding (e.g., hearing [bɔ] [i.e. the prime] just before seeing/naming a picture of a ball. This procedure is based on the notion that hearing the acoustic representation of a word -initial CV or CCV of a picture to be named just prior (150 to 500 ms prior) to the presentation of that picture results in an activation of its phonological representation within the participant's mental lexicon. Thus, if the CV/CCV onset related prime and word-initial aspects of the target are related in form, some of the target segments are already activated at the time the person attempts to name the target. This supposedly facilitates the phonological encoding of the target so that a shorter naming latency (to me measured and hereafter described in this study as SRT) occurs than when an unrelated prime is presented. Based on the principle that the "highest activated units get selected first"(Levelt, 1989), when the participant attends to name the actual word that has been primed, he/she is more likely to quickly and accurately select the primed word than competing words.

Brooks and MacWhinney (2000) examined phonological priming in children and adults, using a cross modal picture-word interference task. Pictures of familiar objects were presented on a computer screen, while interfering words (IWs) were presented over headphones. In terms of their relation to target pictures, IWs were phonologically related, unrelated, neutral (the word 'go'), or identical. In experiment I, related IWs shared onset consonants with the names of the pictures. Across ages, participants named pictures faster with related IWs than with unrelated IWs. In experiment 2, related IWs rhymed with the targets. Here, only the youngest children named pictures faster with related IWs than with unrelated IWs.

Melnick, Conture, and Ohde, 2003; Humphreys, Evett, and Taylor, 1982; Slowiaczek,Nusbaum, and Pisoni, 1987 assessed the influence of phonological priming on speech reaction time (SRT) and results indicated that all children exhibited faster or shorter SRTs during the related condition compared to the no prime condition. Similarly, SRT was influenced with advancing age for all children, with 5 year olds exhibiting faster SRTs than 3 year olds.

Research on Semantic Priming:

A common paradigm for the investigation of on-line language processing is the semantic-priming task. In this task, participants are shown a word pair that is either related *(cat-dog)* or unrelated *(bulb—dog).* Numerous studies have found that college-aged adults are faster to pronounce or make a lexical decision about the second word in a related word pair than they are for the second word of an unrelated word pair (Neely, 1991; Von Studnitz, and Green, 1997; Pellowski, and Conture, 2005; Smith, and Wheeldon, 2001). These studies have yielded information about the word-recognition process and about basic cognitive mechanisms that accompany word recognition (e.g., spreading activation).

Word recognition is facilitated when presentation of the target word is preceded by presentation of a word related in meaning (Van Orden, Pennington, **and** Stone, 1990 Van Orden and, Goldinger, 1994; McNamara, and Holbrook, 2003). Meyer and Schaneveldt (1971) in a lexical decision task, found faster response times to a 2nd word when the 1st word presented was related in meaning than when it was not; e.g. faster recognition of 'butter' as a word than 'doctor' when prime was 'bread' (or faster recognition of 'doctor' when the prime is 'nurse'). Ben-Dror, Havazelet and Vardimon (1991, 1993) examined the vocalization latency of words and pseudo words and regular and exception words in 20 college students with dyslexia. They were compared with equal number of controls matched for chronological age (CA) and reading age (RA), within the classical dual route word reading paradigm of Coltheart (1972, 1985). These researchers showed that the college students with dyslexia were much slower than their controls in naming words and especially in accessing pseudo words.

In semantic priming paradigms for lexical decisions, the probability that a word target is semantically related to its prime (the relatedness proportion) has been confounded with the probability that a target is a nonword, given that it is unrelated to its prime (the nonword ratio). This study unconfounded these two probabilities in a lexical decision task with category names as primes and with high- and low-dominance exemplars as targets. Semantic priming for high-dominance exemplars was modulated by the relatedness proportion and, to a lesser degree, by the nonword ratio. However, the nonword ratio exerted a stronger influence than did the relatedness proportion on semantic priming for low-dominance exemplars and on the nonword facilitation effect (i.e., the superiority in performance for nonword targets that follow a category name rather than a neutral XXX prime). These results suggest that semantic priming for lexical decisions is affected by both a prospective prime-generated expectancy, modulated by the relatedness proportion, and a retrospective target/prime semantic matching process, modulated by the nonword ratio (Neely, Keefe and Ross, 1989).

In the relatedness proportion effect, semantic priming increases with an increase in the probability that a word prime will be followed by a semantically related word target. This effect has frequently been obtained in the lexical decision task but not in a pronunciation task. In the present experiment, relatedness proportion was manipulated in two pronunciation tasks, one with and one without nonword targets, using category names as primes. In both tasks, a relatedness proportion effect occurred for high-dominance category exemplars but not for low-dominance category exemplars. These results converge with recent lexical decision results in suggesting that semantic priming in pronunciation is affected by a prospective prime-generated expectancy that is modulated by the relatedness proportion (Keefe and Neely, 1990).

Semantic priming paradigms have been employed to study lexical encoding in adults with typical (McNamara and Healy, 1988) as well as typical (Baum, 1997; Del Toro, 2000) speech language production abilities. These studies suggest that reaction time measures of lexical encoding can be used to "make inferences about the dynamics of information processing and the architecture of the processing system" (Coles, Smid, Scheffers, and Otten, 1995).

Although, research over the past two decades has made enormous progress in trying to understand children with dyslexia, numerous confusions and speculations are among which, word retrieval difficulty is one of them. There are equivocal reports regarding such deficits in dyslexics to be consequence of a phonological coding deficit or semantic coding deficit. Some investigators favored and concluded that dyslexics have weak functioning phonological coding system and this was considered to be the probable cause of reading difficulties in such children while others attributed it to semantic coding deficit especially in the older readers.

NEED FOR THE STUDY

Reading is a complex cognitive process. It involves the co-ordination of a series of functions which include visual functions such as configurational (feature) and orthographic (word form) analyses and verbal or language functions such as phonological, semantic and syntactic coding and decoding and other cognitive functions like memory and attention and motor skills. Reading can be hindered by faulty mechanisms in any or several of these functions involved (Lachmann, 2001).

The recognition of words and its relation to reading is one of the central topics in reading research and has been studied intensely in recent years (Besner, Waller & MacKinnon, 1985; Coltheart, 1987). It is considered important to study this aspect because identification of a word entails the activation of several types of associated information or codes, *phonologic* and *semantic',* each of which contributes to the interpretation of the text material. Word recognition is also important to study because acquiring this skill is among the first tasks confronting the beginning reader, moreover, deficits at the level of word-recognition are characteristic of children who fail to acquire age-appropriate reading skills (Perfetti, 1985; Stanovich, 1986). However what is more interesting to study is, what better aids in learning to read in children. In other words, what primes the best for learning to read in children, phonologic or semantic priming.

To date, phonological and semantic priming in a word reading task has been used to study the phonological and semantic encoding respectively in different disordered population in the adults with different sizes of stimuli. But there is a need to study the same in children as well who are in the developmental stages of acquisition of reading skills. This makes way to establish the preference between phonological and semantic priming in normal children in their developmental stage. This also helps in exploring how it is established in children with dyslexia. The research to date suggests lexical information processing among dyslexic readers may be indicative of a more comprehensive, underlying disorder, yet this issue remains unresolved.

AIMS OF THE STUDY

The aims of the present study are as follows:

- To investigate the relative performance of children with learning disability (LD) in comparison to normal children on semantic and phonological priming tasks
- It also aims at exploring the nature and level of breakdowns in lexical processing in dyslexia due to the interfering primes resulting in lexical recognition problems. In other words, it aims to study the nature of word recognition deficits in Children with Learning Disability (LD) as the disorder is explored relatively lesser than any other clinical population in Indian context.

CHAPTER III

METHOD

While phonological and lexical/semantic priming have been extensively studied and reviewed relative to stuttering in children and adults (Conture, 1991; Ingham, 1998; Max & Caruso, 1997, 1998) and aphasics (Baum, 1997;Blumstein, Milberg & Shrier, 1982;Milberg & Blumstein, 1981) in American context, there appears to be growing sentiment that learning disabled (LD) population also warrant similar considerations (Helenius, Salmelin & Connolly, 1999; Ben-Dror, Bentin & Frost 1995). However, there is dearth of studies in the Indian context. Therefore, it seems reasonable to suggest that examination of lexical/semantic and phonological priming would contribute to our further understanding of how the various facets of speech and language planning and production may be associated in children with learning disability. The present investigation has focused on patterns of reaction time delays on priming tasks.

Participants

Seven participants ranging in age from 8.0 years to 15.0 years all of whom studying in English medium school participated in the study. None of the fourteen children had any known or reported hearing, neurological, developmental or emotional problems.

The following ethical standards were followed during the study

Before requesting for the consent from children and their biological guardians, they were provided information in the language he/she was capable of understanding. An informed verbal consent was taken from their biological guardians guardian and were explained the aims, method of research and approximate duration of testing.

Inclusionary criteria for experimental group:

- Seven participants ranging in age from 8.0 years to 15.0 years, all of them who studied in English medium school participated in the study.
- The mean age range of participants was 10 years.
- Children diagnosed as Learning disability (LD) by a Speech Language Pathologist (SLP) were included. Early Reading Skills (Loomba, 1991) was used as a tool to identify children with Learning disability.
- All the LD participants were assessed by a clinical psychologist for their Intelligence quotient (IQ), and was reported to be average or above average.

Four children were in 7^{th} grade, one in 6^{th} and two in the 3^{rd} grade. All participants were enrolled on a remediation programme.

Inclusionary criteria for control group

Equal number of normal children were matched for age, school grade, handedness and medium of instruction with the experimental group participated in the study.

Common Inclusionary criteria for both the groups

Subjects with no significant history of any neurological, psychological and or sensory deficits.

Test Material

Two sets of linguistic stimuli were prepared, one as the target list and the other as prime list.

1. Target list consisted of 15 words taken from 3 semantic categories (5 in each semantic category i.e. animals, vegetables and fruits). Speech Language Pathologist assessed the selected stimuli for their familiarity and semanticity. The stimuli with 90% familiarity and with high semanticity were only included in the study

2. Prime list consist of 2 sets of words with 30 words in each set.

   - First set consisted of 15 semantically and 15 phonologically related words to the target list consisting of another 15 words with no overlapping phonemes in any position. A total of 45 related stimuli were included in the list (See Appendix I).

   - Second set consisted of 15 semantically and 15 phonologically (non-meaningful/ pseudowords) unrelated words to the same target list with 15 words mentioned above. Thus, a total of 45 unrelated stimuli were included in the list. (See Appendix II).

So, in total, the list consisted of 90 words. The target and prime stimuli were matched for the syllable length, familiarity and semanticity. These stimuli were randomized using DMDX before beginning with the actual task.

Tools

- The Screening Checklist for Auditory Processing (SCAP) (Yathiraj and Mascarenhas, 2002) was administered to screen for any central auditory processing disorder.

- Pentium 200 MHz computer with a 20-inch monitor and microphone with flat frequency response was used.

- DMDX software (Version 3.0).

Instructions

Before placing the headphones, the experimenter told the participants 'now you will hear words over the headphones while you name the words on the computer screen. Your job is to ignore the words as much as possible and to concentrate on reading (as fast as possible and in a loud voice) what you see, and not what you hear'.

Recording and Segmentation procedures for Stimulus Primes

A young adult male (23 years) with no known speech and hearing problems served as the speaker for recording the test stimuli .The stimuli were recorded in a quiet room with a high quality recorder and microphone positioned approximately 3 inch from the participant's mouth. The frequency response of the microphone was flat to about 20KHz. Two repetitions of each stimulus were produced in a random order.

Note: DMDX software (Version 3.0) was developed by Kenneth I.Forster and Jonathan C.Forster at Monash University and at the University of Arizona. DMDX is Win 32-based display system used to measure reaction times to visual and auditory stimuli. Detailed information regarding this software is available at the following website:www.u.Arizona.edu/~kforster/dmdx/dmdx.htm

Procedure

In total, there were three different conditions of 30 words each (90 words total) that were responded to by each child in one sitting, with a brief (1-2 min) break between conditions to permit the preparation of the next condition. The prime words were presented at stimulus onset asynchrony (SOA) of 250ms. SOA was utilized to ensure that none of the auditory presented primes would temporarily overlap the visual onset of the target words.

- Participants were seated in a comfortable position facing a desktop computer attached to a 20-inch monitor in a quite room.
- The responses were recorded with a high quality microphone placed at distance of 10cm from the participant's mouth
- Testing was carried out in allay environment.

The priming experiment task was carried out in the following steps,

Step 1

The target words along with auditory prime were presented. The participants were instructed to ignore the auditory stimuli and respond only to the words appearing on the computer screen. The computer-controlled presentation of the target word and auditory prime, and the speech reaction time (in milliseconds) were recorded.

Note: Stimulus Onset Asynchrony (SOA) is the time period from the onset of the auditory prime to the onset of the target word

Before beginning with the actual test, participants were presented with five target words as a practice to name each target word, "'as fast as you can and as soon as you see it, and in a loud voice". The responses of participants to these five target words were not included in the final data set. To control for possible practice effects related to word presentation, the order of presentation for the words within a condition was randomized across the three conditions, whereas the order of presentation of the three experimental conditions was counterbalanced across the group of participants.

Using DMDX software, speech reaction time (SRT) were measured and analyzed in following 3 word-reading conditions which were employed in a counterbalanced order across participants:

***Step** 2*

Semantic Priming Task

The priming task was carried out in the following three conditions,

- No prime condition-in which no auditory stimulus were presented before word display.
- Related prime condition- in which a word semantically related (but not phonologically similar) to the target word was presented auditorily 500 ms before word display.
- Unrelated-prime condition, in which a word semantically unrelated (not phonologically similar) to the target word was presented auditorily 500 ms before word display.

CHAPTER IV

RESULTS

The aim of the present study was to focus on the relative performance of children with learning disability (LD) in comparison to normal children on semantic and phonological priming tasks. Broadly, two measurements were done and they were:

I. Accuracy of responses and

II. Reaction time (RT) measurements

The following statistical techniques were used to analyze the data obtained:

a) Percentage of accurate responses for each task within each condition was calculated to account for accuracy of responses. The percentage of responses obtained were listed separately for normal children and LDs and compared descriptively across groups.

b) *Independent sample t-test* was administered to compare the reaction time across normal children and LDs.

c) *Repeated Measure ANOVA* was administered separately for normals and LDs to compare the three conditions within each task.

d) *Paired t-test* was administered separately for normals and LDs to compare the tasks within each condition.

Step 3

Phonological Priming Task

The priming task was carried out in the following three conditions,

- No prime condition, in which no auditory stimulus were presented before word display.
- Related prime condition- in which a non-meaningful phonologically similar (same initial syllable and syllable length) to the target word was presented auditorily 500 ms before word display.
- Unrelated-prime condition- in which a word phonologically unrelated (no similar syllable but same syllable length) to the target word was presented auditorily 500 ms before word display.

Errors

Word reading responses were considered in error and the associated speech reaction time was excluded from further analysis if the participant's response met any one of the following criteria:

(a) Was preceded by or associated with any type of speech dysfluency (e.g.,"um...bulb");

(b) Was preceded by or associated with any type of extraneous noise or sound (e.g. tongue click);

(c) Failed to trigger the gating switches on the voice-activated microphone (e.g., participant responded too softly)

(d) Generated a speech reaction time less than 250ms or greater than 2000ms.

Results obtained were tabulated and appropriate statistical analysis was carried out to further understand the intrinsic details of the present study.

I. Accuracy of responses

Percentages of accurate responses within each task and in each condition, for normal children and LDs were listed separately in the following table. The maximum number of valid responses in each case was 210.the percentage of accurate responses is calculated using the following formula -

$$\frac{\text{Total number of accurate responses}}{\text{Total number of responses}} \times 100$$

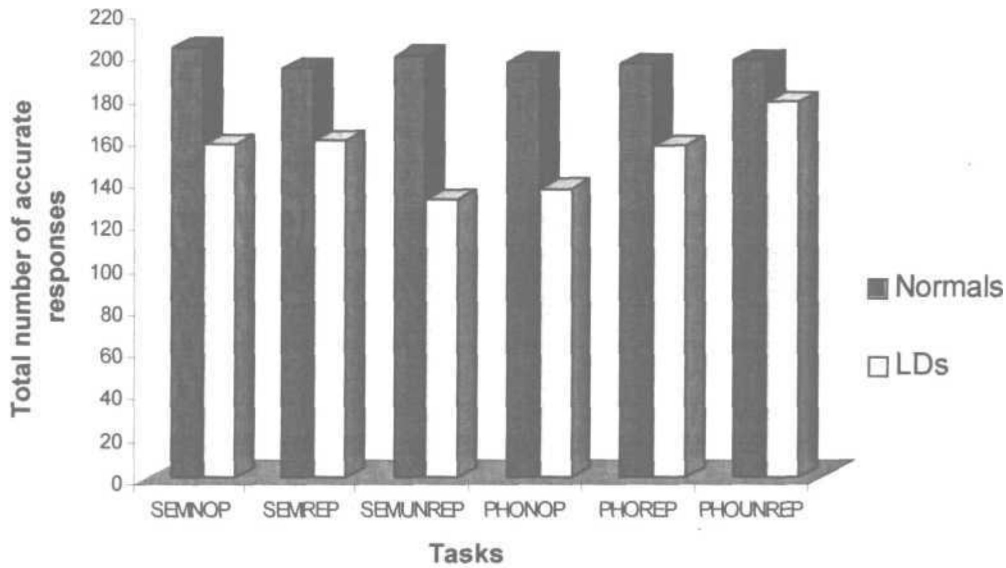
Table 1. Percentage accurate responses across all the tasks and conditions in both the groups

GROUPS	ACCURATE RESPONSES			
	Total number of accurate responses		Percent	
	NORMALS	LDs	NORMALS	LDs
PHONOP	196	136	92.5%	64.2%
PHOREP	195	156	92.0%	73.6%
PHOUNREP	197	177	92.9%	83.5%
SEMNOP	203	157	95.8%	74.1%
SEMREP	193	159	91.0%	75.0%
SEMUNREP	199	131	93.9%	61.8%

Note. SEMNOP=Semantic No-prime condition, SEMREP=Semantic Related-prime condition, SEMUNREP=Semantic Unrelated-prime condition.

Graph 1 shows the total number of correct responses in both normal children and children with LD across both the tasks i.e. semantic & phonological priming tasks and across all the three conditions i.e. prime, related-prime and unrelated-prime conditions.

Total Number Of Accurate Responses Across Tasks and Conditions



Graph 1: Total number of accurate responses by normals and LDs across tasks and conditions

Both, Table 1 and Graph 1, clearly shows that the total number/ percentage of accurate responses are consistently more in normal children than in children with learning disability (LD) across all the three conditions i.e. no-prime, related-prime and unrelated-prime in both the tasks i.e. semantic and phonological. In the phonological priming task, number of accurate responses in normal children for phonological no-prime condition (PHONP) was comparatively more than the phonological related-prime condition (PHOREP) and phonological unrelated-prime condition (PHOUNREP). However, the graph does not show any evident difference in the performance of these children among the above three conditions. Similarly, on semantic priming task, the performance of normal children across the three conditions was not so evident i.e. semantic no-prime condition (SEMNOP) was comparatively more than the semantic related-prime condition (SEMREP) and semantic unrelated-prime condition (SEMUNREP).

However, the performance of children with LD was found to be different compared to the normal children. Graph 1 shows a remarkable difference in the performance of normal children and children with LD across both the tasks and across the three conditions i.e. PHONOP, PHOREP, PHOUNREP, SEMNOP, SEMREP and SEMUNREP.

n. Reaction Time Measurements

A) Comparison between normal children and children with LD on reaction time measurements

Independent sample t-test was done to compare the reaction time across normal children and children with LD, across phonological priming and semantic priming tasks.

Table 2 shows that children with LD take relatively longer reaction time (RT) compared to normal children on both semantic priming and phonological priming task in all the conditions i.e. no-prime, related-prime and unrelated-prime condition.

Table 2: Mean and Standard Deviation for Normals and children with LD

CONDITIONS	NORMALS		LD		t-value	Sig. (2-tailed)
	MEAN	SD	MEAN	SD		
SEMNOP	587.871	67.701	937.066	344.630	2.631	.022*
SEMREP	655.809	102.791	790.119	230.070	1.410	.184
SEMUNREP	662.347	108.324	884.585	343.074	1.634	.128
PHONOP	677.780	90.163	1060.785	362.309	2.714	.019*
PHOREP	694.961	126.182	1027.014	352.369	2.347	.037*
PHOUNREP	714.647	112.635	967.804	254.395	2.407	.033*

•Significant at 0.05 level

Descriptively, the difference between the mean reaction times of normals and children with LD is more in 'phonological no-prime condition' (PHONOP) and 'phonological related-prime condition' (PHOREP).

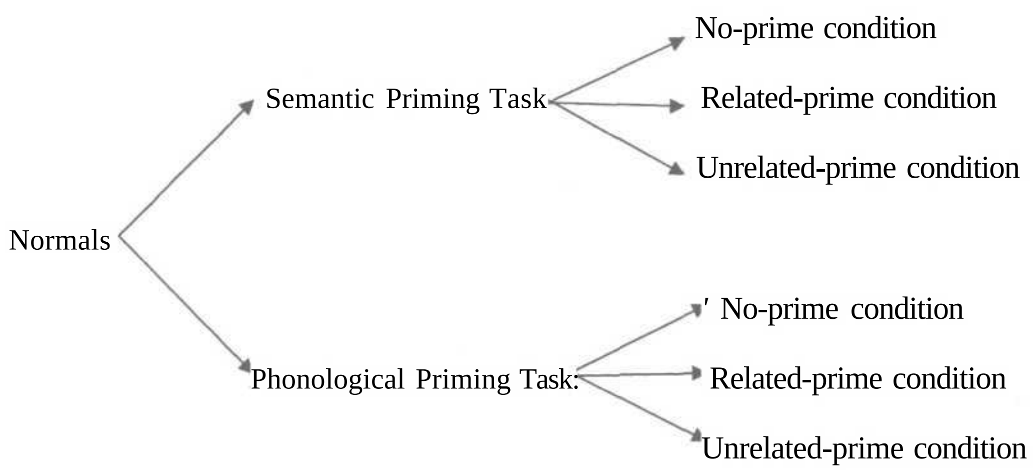
B) Comparison between normal children and children with LD across the tasks and across the conditions.

Table 2 shows the result of paired sample t-test applied to find the significant difference between normals and LDs across semantic and phonological priming task and respective conditions within each task.

The above table shows that there is a significant difference in the performance between normal children and LDs on semantic no-prime condition (SEMNOP), phonological no-prime condition (PHONOP), phonologic related-prime condition (PHOREP) and phonologic unrelated-prime condition (PHOUNREP). However, there was no significant difference in the performance between normal children and LDs on semantic related-prime condition (SEMREP) and semantic unrelated-prime condition (SEMUNREP).

The two groups i.e. normal children and children with Learning Disability underwent two tasks-phonological priming and semantic priming task. In turn, each task subdivides into 3 conditions:

- No-prime condition
- Related prime condition
- Unrelated-prime condition.



Similarly for Children with Learning Disability (LD).

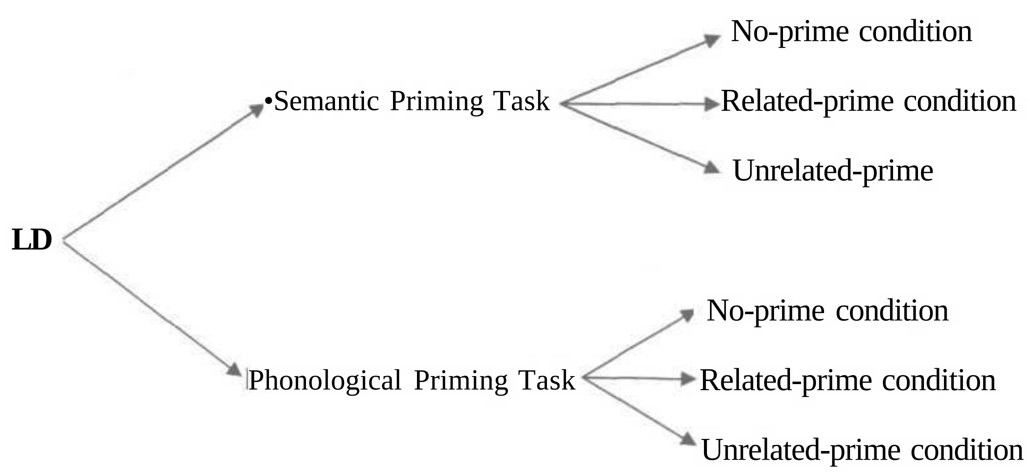


Figure 2: Groups, tasks and conditions

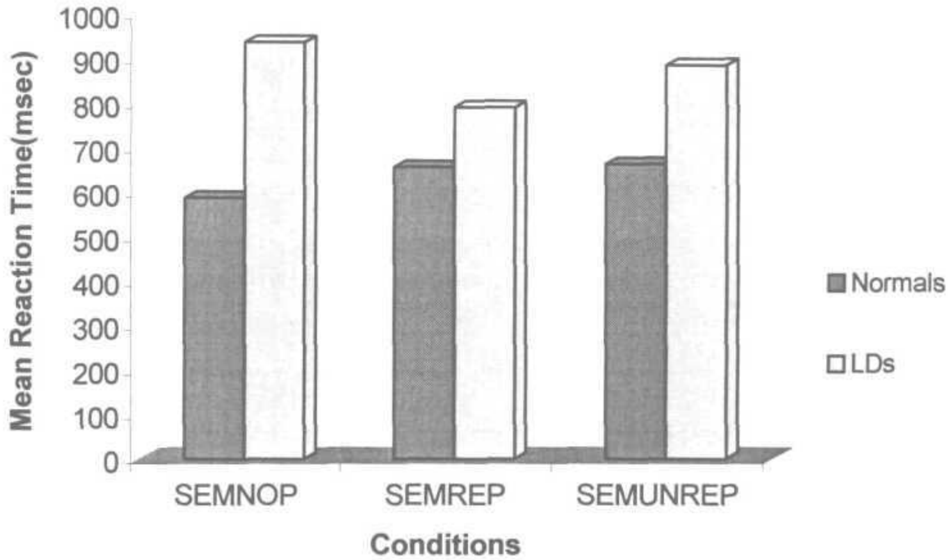
C) Comparison among three conditions within semantic priming task in normal children and children with LD

Repeated measures ANOVA were applied to see the difference among the three conditions i.e. no-prime, related-prime and unrelated-prime condition in normals, within semantic priming task.

Table 2 shows the results obtained from repeated measures applied in normal subjects across the three conditions in semantic priming task. Descriptively, the mean reaction time was found to be lesser in SEMNOP condition compared to SEMREP and SEMUNREP, however no significant difference across these three conditions was found in normal children. Repeated Measures ANOVA reveal that there is no significant difference observed between the three conditions in semantic priming task in normal children [$F(2,12)=2.055, p>0.05$].

Repeated measures ANOVA was applied to find out mean and standard deviation (SD) among the three conditions i.e. no prime, related-prime and unrelated-prime condition within semantic priming task in children with LD also.

Table 2 also shows the results obtained from repeated measures ANOVA applied in LDs across the three conditions in semantic priming task. As indicated, the longest reaction time is in no-prime condition and the least in related-prime condition with unrelated-prime condition with the mid value. Descriptive Statistics reveal that there is no significant difference observed between the three conditions in semantic priming task in LDs [$F(2,12)=0.334, p>0.05$].



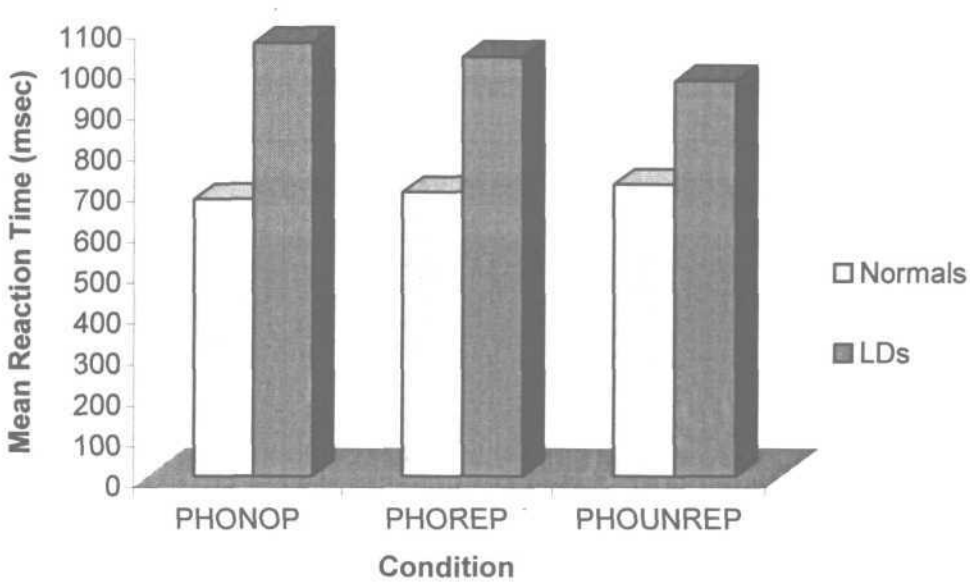
Graph 2: Mean Reaction Time (RT) of normals and LDs in semantic priming task

Graph 2 shows obvious larger reaction time taken by children with learning disability (LD) than normal children across all the three conditions i.e.no-prime.related-prime and unrelated-prime, within semantic priming task. It also clearly shows that the difference between RTs is most in no-prime condition (SEMNOP) than in unrelated-prime condition (SEMUNREP) and the least in related-prime condition (SEMREP).

D) Comparison among three conditions within phonological priming task in normal children and children with LD

Repeated measures ANOVA was applied to find out mean and standard deviation (SD) among the three conditions within phonological priming-task in

Table 2 shows the similar trend as seen in semantic priming task i.e. gradual increase in mean reaction time from no-prime condition (PHONOP) to related-prime condition (PHOREP) to unrelated-prime condition (PHOUNREP). Results of ANOVA reveal that there is no significant difference observed between the three conditions in phonological priming task in normal children [F (2,12)=0.736,p>0.05].



Graph 3: Mean Reaction Time (RT) of normals and LDs in phonological priming task

Table 2 also shows a gradual decrease in mean reaction time from no-prime condition to related-prime condition to unrelated-prime condition in children with LD. Descriptive Statistics reveal that there is no significant difference observed between the three conditions in phonological priming task in children with learning disability (LD)[F(2, 12)=0.163,p>0.05].

Graph 3 depicts the mean reaction time in normal children and children with learning disability (LD) in phonological priming task across three conditions.

Graph 3 also shows obvious larger reaction time taken by children with learning disability (LD) than normal children across all the three conditions i.e.no-prime.related-prime condition (PHOREP) and unrelated-prime condition (PHOUNREP), within semantic priming task. It also clearly shows that the difference between RTs is most in no-prime condition (PHONOP) than in PHOREP and the least in PHOUNREP.

E) Comparison between both the tasks within each condition in normal children and children with LD

Paired sample t-test was performed to find the significant difference between semantic and phonological priming task in all three conditions i.e. no-prime, related-prime and unrelated-prime condition in normals and LD (See Table 3 and Table 4).

Table 3: Comparison within each condition across both the tasks in normals

TASKS	t-value	Sig. (2-tailed)
SEMNOP - PHONOP	3.128	.020*
SEMREP - PHOREP	1.187	.280
SEMUNREP - PHOUNREP	1.490	.187

Significant at 0.05 level

Table 4: Comparison within each condition across both the tasks in LDs

TASKS	t-value	Sig. (2-tailed)
SEMNOP • PHONOP	.591	.576
SEMREP • PHOREP	1.532	.176
SEMUNREP • PHOUNREP	.414	.693

The results obtained in no-prime condition, for normal children indicated a significant difference between semantic no-prime condition (SEMNOP) and phonological no-prime condition (PHONOP). On the contrary, there is no significant difference obtained in the other two conditions i.e. related-prime condition (PHOREP) and unrelated-prime condition (PHOUNREP) in normal children (See Table 3). The results obtained for children with LD showed no significant difference between semantic and phonological priming tasks in all the three conditions(See Table4).

CHAPTER V

DISCUSSION

The aim of the present study was to focus on the relative performance of children with learning disability (LD) in comparison to normal children on semantic and phonological priming tasks. Broadly, two measurements were done and they were:

I. Accuracy of responses and

II. Reaction time (RT) measurements

I. Accuracy of responses

The results in Table 1 and Graph 1, shows that the total number/ percentage of accurate responses are consistently more in normal children than in children with learning disability (LD) across all the three conditions i.e. no-prime, related-prime and unrelated-prime in both the tasks i.e. semantic and phonological. The poor performance of children with LD on tasks of visual word recognition is generally attributed to the deficit in language processing abilities which further affects their reading ability too (Lahey, Edwards, and Munson, 2001). Research conducted in the past two decades have found that children with LD perform poorly on such tasks due to either a visual processing deficit or a general language processing deficit. A few others attributed that children with LD have shown delayed or immature pattern of reading development (Bryant, Nunes and Bindham, 1998; Booth and Burman, 2001). Thus, the finding of the present study supports the above theories on poor performance in children with LD compared to the normal children, as reading involves the basic process of word recognition ability and when this is affected, difficulty or deficit in reading ability follows.

Graph 1 showed a remarkable difference in the performance of normal children and children with LD across both the tasks (i.e. semantic priming task and phonological priming tasks) and across the three conditions i.e. for PHONOP, PHOREP, PHOUNREP, SEMNOP, SEMREP and SEMUNREP. This result supports research, which have shown that normal children are able to utilize both semantic and phonological routes in order to decode a string of letters while reading. However, children with LD do not use both or either of the routes as efficiently as the normal children. This notion has been proved using various models of reading in the literature (Interactive and competition model (IAC) by McClelland & Rumelhart 1981; Rumelhart and McClelland 1982; Dual Route Model By Patterson, Marshall, and Coltheart, 1985; Seidenberg and McClelland, 1989; Connectionist Model by Plauts, 1996). Thus, the results of the present study support the earlier findings on reading research in children with LD.

II. Reaction time (RT) measurements

The results obtained on reaction time measurements are discussed in the following sub-sections,

a) Comparison between normal children and children with LD on reaction time measurements across semantic and phonological priming tasks and across conditions.

b) Comparison between normal children and children with LD across both the tasks and across the three conditions in each task

C) Comparison between both the tasks within each condition in normal children and children with LD

a) Comparison between normal children and children with LD on reaction time** measurements across **semantic and phonological priming tasks.

Overall, the results in Table 2 showed that, children with LD took relatively longer reaction time (RT) compared to normal children on both semantic priming and phonological priming tasks across all the conditions i.e. no-prime, related-prime and unrelated-prime condition (Ferrand & Grainger, 1993). The results yielded evidence of a general temporal processing deficit seen in children with LD found by various researchers who studied processing abilities in children with LD (Shapiro. Ogden and Lind-Blad . 1991; Heim , Freeman , Eulitz and Elbert (2001). Thus, our hypothesis supports the findings that children with LD present with temporal processing deficit in the visual modality.

b) Comparison between normal children and children with LD across both the** tasks **and** across **the three conditions in each task

Results in Table 2 showed a significant difference for reaction time measurements between the performance of normal children and children with LD on phonological priming tasks across all the three conditions (i.e. PHONOP, PHOREP and PHOUNREP). Table 2 also showed that children with LD have longer RTs compared to normal children on all the three conditions in phonological priming task. This could be because normal children have a well established sub-lexical or phonological or grapheme-phoneme-conversion (GPC) route for word recognition compared to children with LD. The inability to read words faster in children with

LD indicates that these children utilize the GPC route less efficiently when compared to normal children (Beauvois and Derouesne, 1979). However, normal children process the strings of letters in words much faster, either through the semantic (lexical) or phonological (GPC) route. Thus the results of the present study is in consonance with other research findings (Coltheart, 1987; Ellis and Young, 1988) Ellis and Young (1988) who argued that reading takes place either via the semantic system or by GPC.

Results on semantic priming tasks for reaction time measurements between the performance of normal children and children with LD showed that children with LD have longer RTs compared to normal children on all the three conditions. However, a statistically significant difference was found only in one condition i.e. SEMNOP (See Table 2). In SEMNOP condition, the children under study were not primed for word reading and hence there was no cueing that helped these children in recognition. Normal children could however utilize either of the two routes i.e. lexical or GPC route to decode the target words and read them. But children with LD took longer time to decode the target words compared to the normal children. This difference could be due to slower lexical or semantic processing abilities in children with LD on semantic tasks. Probably if children with LD were provided with appropriate priming stimulus, they would have performed equally well as the normal children. There is general consensus amongst most of the researchers that, while reading development is taking place, normal children initially depend more on the lexical route, wherein they compare the target word with the already existing related lexical units, establishing a visual lexicon. With development, normal children become less dependent on the lexical route and utilize the sub-lexical or the

GPC route to read and learn novel words (Beech, 1987; Seymour and Elder, 1986). However, children with LD are comparable to the early normal readers who are dependent more on the lexical route. Thus, the results of the present study support the above view indicating a larger significant difference between normal children and children with LD.

Table 2 also shows no significant difference between the performance of these two groups on SEMREP and SEMUNREP conditions. This could be because children with LD are performing almost like the normal children as they are aided by priming cues on word reading tasks. From the above results we can infer that cueing can aid poor readers or children with LD to perform equally well as the normal children. Thus, the present study implicates the need to utilize the priming cues in remediating children exhibiting various reading disorders as well as children with LD.

c) Comparison between both the tasks within each condition in normal children and children with LD

The results obtained in no-prime condition, for normal children, showed longer RT for phonological no-prime (PHONOP) condition compared to semantic no-prime (SEMNOP) condition and this difference was found to be statistically significant (See Table 3). This could be because normal children are able to make use of both the semantic and phonological cues in order to decode the target words faster. However, no significant difference was found across the above two conditions in children with LD probably because of the absence of priming cues in these children. This hypothesis refutes studies which have shown larger semantic priming effects for LDs than for good readers (Schwantes, 1985, 1991; Elbro and Arnbak, 1996 ; Nunes & Bindham, 1998; Booth and MacWhinney, 1999). Plaut and Booth (2000) suggest that good readers show small semantic priming effects as their well developed spelling sound mapping allows them to decode words rapidly, thereby reducing the effects of semantics on word recognition. Poor readers in children with learning disability (LD) show more semantic priming because their underdeveloped GPC connections allow semantic information to compensate for their slow word recognition. Booth, Perfetti, Mac Whinney and Hunt (2000) also suggested that normal readers learn the regularities and irregularities between phonology and orthography in the phase of reading development. They rely less on semantic and more on interaction between orthography and phonologic representations for rapid word recognition (Wimmer and Goswami,1994). This is the general developmental trend in normally developing children.

From the above findings of the present study, we note that children with LD have performed poorly compared to the normal children on all the semantic and phonological priming tasks. However, larger semantic priming effects are seen in normal children as well as children with LD. These results do not agree with the above quoted studies wherein the subjects include those children in the western countries whose native language as well as medium of instruction is the same i.e. English. English is an alphabetic language and by nature has poor grapheme to phoneme mapping (Thomas, and Allport, 2000; Thirumalai, and Chengappa, 1986; Nas, 1983; Keatley, Spinks, and DeGelder, 1994; Kolers, 1966; Kirsner, Smith,Lockhart, King, and Jain, 1984; Mackey, 1968; Albert and

Obler, 1978; Altenberg, and Cairns,1983; Beauvillain,1992; Beland, and Mimouni, 2001; Brysbaert,1998). These children master the regularities and irregularities of English over a period of exposure. Hence, these normal children show larger phonological priming effects in word reading paradigms (Kotz, 2001; Grosjean,1998; Green, 1998b;Grainger,1993) However, this may not be true for Indian languages (like Hindi, Kannada, etc.) which are considered as semi-alphabetic languages and which have good grapheme to phoneme mapping. Thus, Indian children would probably show lesser phonological priming effects in comparison to the western children due to the differences in language orthographic structures learnt at school (like Kannada and English). Indian children would learn an alphabetic language like English use the semantic route more efficiently than the western children who learn to read English through the phonological route.

Overall, in the present study, similar pattern of differences was seen in children with LD and normal children, however, the former group showed deficit in temporal processing skills. Thus, this makes way for a need in the broader sense for future research in Indian languages and research on second language influence on Indian languages.

CHAPTER VI

SUMMARY AND CONCLUSION

The present investigation aimed at exploring semantic and phonological prime/cue processing at lexical linguistic level in children with learning disability (LD). In turn the study focused on the nature of recognition deficits and levels of breakdown in lexical processing in learning disability (LD) due to the interfering primes while reading a string of letters.

Reading is a process that requires co-ordination of a series of sub-functions, which include visual, verbal and other cognitive functions like memory and attention. Prior to reading a word correctly, it is the visual word recognition with its semantic context or phonologic context that involves an extensive cognitive processing. In other words, it is important for a child to understand the semantic or phonological components of letter strings in a word in order to accomplish a reading task.

Statistical analysis of the data revealed that on accuracy measurements, children with LD performed relatively poorer on semantic priming and phonological priming tasks. Children with LD took relatively longer reaction time (RT) compared to normal children on both semantic priming and phonological priming tasks across all the conditions yielding evidence of a general temporal processing deficit in children with LD. The inability to read words faster in children with LD indicated that these children utilize the GPC route less efficiently when compared to normal children (Beauvois and Derouesne, 1979).

Results on semantic priming tasks for reaction time measurements between the performance of normal children and children with LD also showed that children with LD have longer RTs compared to normal children on all the three conditions. However, a statistically significant difference was found only in one condition i.e. semantic no-prime condition. Also children with LD were found to have longer RTs compared to normal children on all the three conditions in phonological priming task as well.

To conclude, from the above findings of the present study, we note that children with LD have performed poorly compared to the normal children on all the semantic and phonological priming tasks. However, larger semantic priming effects are seen in normal children as well as children with LD which is not in consonance with the earlier findings of studies done in western population. Indian children would probably show lesser phonological priming effects in comparison to the western children due to the differences in language orthographic structures learnt at school (like Kannada and English). Thus, this makes way for a need for future research in Indian languages and research on second language influence on Indian languages in children who encounter learning problems. In the present study similar pattern of differences is seen in children with LD however, with larger temporal processing deficit in comparison to normal children.

IMPLICATIONS

The result that LDs perform significantly poorer in their word recognition and reading ability is been clearly stated in the present study. In turn, it also justifies the importance of implications too.

- First of all, the study adds on to the better understanding of visual word recognition in children with learning disability. It also attempts to unfold one of the other main issues yet unresolved is whether LD and the phonologic processing deficits that underlie it (e.g., Share, 1994; Stanovich, 1986; Torgesen, Wagner, & Rashotte, 1994) are related to temporal processing deficits or not.

- Secondly, the issue of 'orthographic difference' is an important variable too. In the present speculation, Indian children with first language (LI) as Kannada (a syllabic language) are supposed to read words in English (an alphabetic language), which is obviously a second language (L2) for them. Reading as fast as possible under the influence of 'orthographic difference' reflects the presence of precise timing mechanisms in humans. The present study highlights the integration of development of orthographic codes with phonological codes in a fast word reading task.

- It will be very much relevant to focus on clinical and educational implications of the present study. The results of accuracy measurement clearly indicate evident word recognition and reading deficits in young children with learning disability (LD). One approach to help young learners (also older ones) is to promote systematic and explicit teaching of word knowledge and spelling, based on morphological structure, word origin, and productive rules (Henry, 1990, 1993; Leong, 1989). This approach emphasizes the interaction of symbol sound correspondences, syllable and morpheme patterns, and layers of Indian languages with English. This approach not only helps the target poor readers but also their controls. Considering such approach and in turn, a consistent practice of the same establishes a strong implication of the present study.

LIMITATIONS

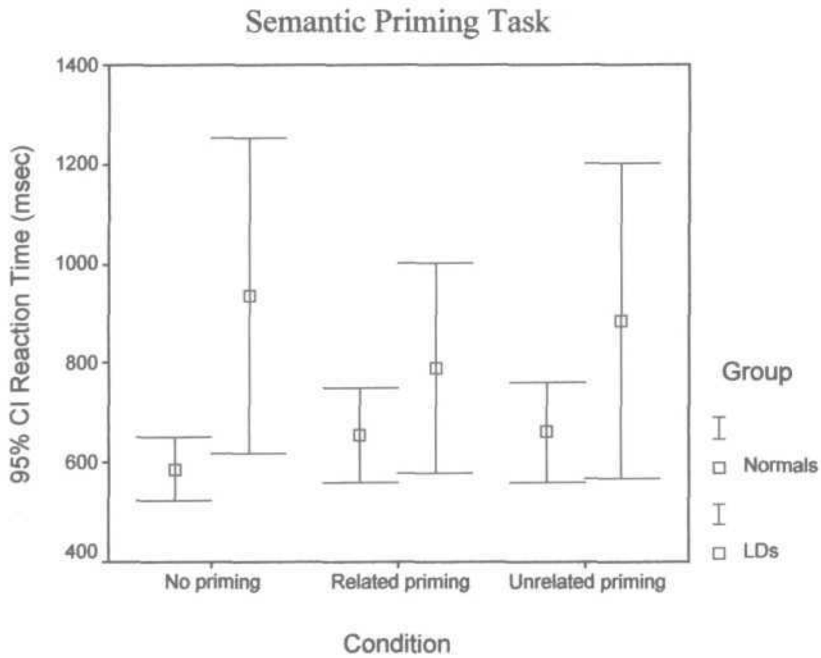
The present investigation makes a genuine attempt to explore phonological and semantic priming in cross-modal paradigm in bilingual school going children in Indian context. Besides this, the study has its own limitations like:

(1) Less number of subjects

Number of subjects taken for the study is limited and the results cannot be generalized as the number of subjects was less.

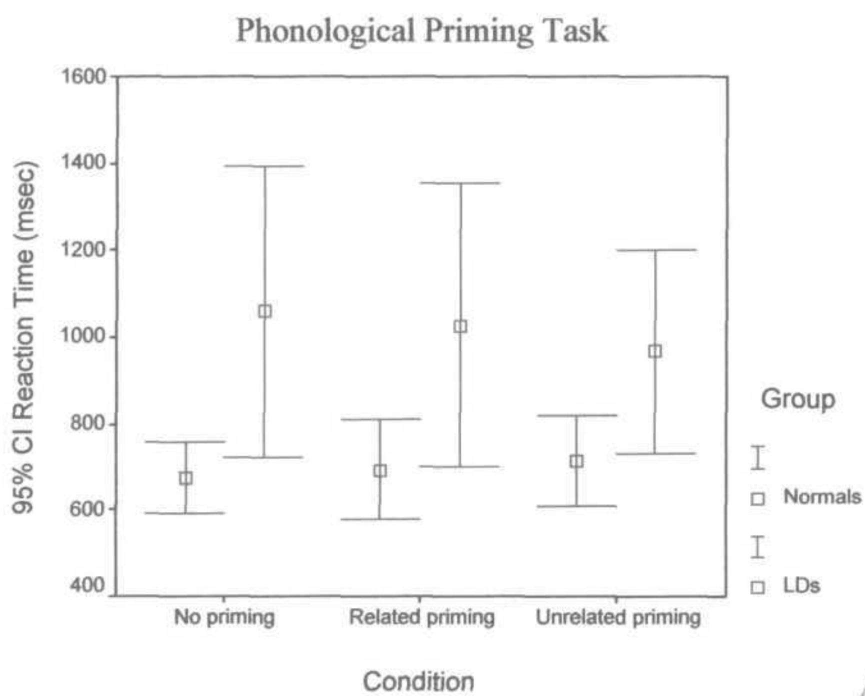
(2) Larger Standard deviation

Wide standard deviation is indicated in both the tasks i.e. semantic priming task and phonological priming task across all three conditions i.e. no prime, related-prime and unrelated-prime condition. The large range of standard deviation in semantic no-priming and semantic unrelated-priming condition doubts the familiarity of the words used in the experiment (See graph 4 and graph 5).



Graph 4: Standard deviation on Semantic priming tasks

Similarly, in phonological priming task, range of standard deviation is larger in no-prime and related-prime condition in children with LD.



Graph 5: Standard deviation on Phonological priming tasks

Although, poor language processing and other cognitive deficits can be the main cause of such varied responses but this also indicates on lack of control of dependant variables like environmental noise, homogeneity among the subjects (both chronologically and academically), medium of instruction, academic performance, socio-economic status, speech and language stimulation, exposure of English in environment, duration of therapy and the occurrence of stimulus words in the language.

FUTURE DIRECTIONS

Learning Disability is a developmental learning disorder whose primary cause remains elusive (McArthur & Bishop, 2001). Although the present study establishes the fact again that LDs perform significantly poorer in their word recognition and reading ability but it also gives scope to future directions too.

The cause of phonologic processing deficits in LDs is one of the main issues yet unresolved. Children with such deficits may have difficulties developing the phonologic skills needed to map phonemes to graphemes and to effectively and automatically decode and encode words while reading and writing. To unfold the issue further, a theoretical research on Temporal Processing Deficits (TPD) hypothesis will be a worth contribution.

Secondly, there are research that have shown that some LDs have poor performance on the task that require judgments based on rapidly presented visual stimuli (Stein, 2001;Talcott & Witton, 2002). On the other hand, there are other research that claims central deficit with phonological processing (e.g.Snowling, 2000). A research which follows, to find out the extent to which visual processing interacts with the phonological processing will be very fruitful in better understanding of the underlying cause of LD.

Thirdly, it will be interesting to further explore the strength of priming in a word reading task when both the target and the prime is in second language (L2) and not in mother tongue or the first language (LI). More importantly, in the present attempt, LI and L2 are two different language types as non-alphabetic

(Indian languages like Kannada in the present study) language and alphabetic language (English) respectively. This would further help in understanding the cognitive processes involved in the learning of a non-native global language like English by children in the Indian context with prevailing multilingual or bilingual scenario. Multilingualism and bilingualism and its relation towards understanding of LD is an emerging research question which has been receiving attention globally.

The results of accuracy measurement clearly indicate evident word recognition and reading deficits in young children with learning disability (LD). Lastly, the future suggestion is regarding the intervention approaches of children with learning disability. These approaches emphasize on the interaction of symbol sound correspondences, phonotactic rules of LI and L2, syllable and morpheme patterns, and layers of Indian languages with English (Walton, 1998; Mann, 1986; Seymour, and Elder, 1986). A clinical research, to quantify the prognosis of such treatment strategies in Indian context will be a commendable attempt.

References

Adlard, A., & Hazan, V. (1998). Speech perception in children with specific reading difficulties (dyslexia). *Quarterly Journal of Experimental Psychology,* 51A(1), 153-177.

Albert, M.L, and Obler, L.K (1978). *The bilingual brain: neuropsychological and neurolinguistic aspects of brain.* New York: Academic Press.

Altenberg, E. P., & Cairns, H. S. (1983). The effects of phonotactic constraints on lexical processing in bilingual and monolingual participants. *Journal of Verbal Learning and Verbal Behavior, 22,* 174 - 188.

Beauvillain, C. (1992). Orthographic and lexical constraints in bilingual word recognition. In R. J. Harris(Ed.), *Cognitive processes in bilinguals* (221-235). Amstrdam: Elsevier.

Becker, C.A (1980). *Semantic context in visual word recognition: An analysis of semantic strategies. Memory and cognition,* 5,493-512.

Beland,R & Mimouni,Z.(2001).Deep dyslexia in the two languages of an Arabic/French bilingual patient.Cogwf/ort,82,77-126.

Berent, I. (1997). Phonological priming in the lexical decision task: Regularity effects are not necessary evidence for assembly. *Journal of Experimental Psychology: Human Perception and Performance, 23,* 1727-1742.

Bijeljac-Babic, R., Biardeau, A., & Grainger, J. (1997). Masked orthographic priming in bilingual word recognition. *Memory & Cognition,* 25,447^57.

Brooks,P.J., & MacWhinney,B.(2000).Phonological priming in children's picture naming. *Journal of Child Lnaguage, 27,335-366.*

Brysbaert, M. (1998). Word recognition in bilinguals: Evidence against the existence of two separate lexicons. *Psychologica Belgica, 38,* 163-175.

Brysbaert, M. (2001). Prelexical phonological coding of visual words in Dutch: Automatic after all. *Memory & Cognition, 29,* 765-773.

Brysbaert, M., Van Dyck, G., & Van de Poel, M. (1999). Visual wordrecognition in bilinguals: Evidence from masked phonological priming. *Journal of Experimental Psychology: Human Perception and Performance, 25,* 137-148.

Buchanan, L., Hildebrandt, N., & MacKinnon, G. E. (1996). Phonologicalprocessing of nonwords in deep dyslexia: Typical and independent?JoMr«a/ *of Neurolinguistics, 9,* 113-133.

Cairns, H.S. (1999). *Psycholinguistics An Introduction.Texas:* Pro-ed.

Caramazza, A., Yeni-Komshian, G., & Zurif, E. B. (1974). Bilingual switching: The phonological level. *Canadian Journal of Psychology, 28,* 310-318.

Carter, H.L.J., Dorothy, J.M. (1970). *Diagnosis and treatment of the disabled reader.* London: The Macmillan Company.

Cestnick, L., & Coltheart M (1999). The relationship between language-processing and visual-processing deficits in developmental dyslexia. Cognition, 71, 231—255.

Chen, H.C. and Ng.M.L. (1989). Semantic facilitation and translation on priming effects in Chinese-English bilinguals. *Memory and Cognition,* 77,454-462.

Cohen,J.(1992).A power *pnmQT.Psychological Bulletin,* 12,155-159.

Collins,A.M., & Loftus,E.F.(1975).A spreading activation theory of semantic *process'mg.Psychological Review,82,*407-428.

Coltheart, M. (1978). Lexical access in simple reading tasks. In G. Underwood(Ed.), *Strategies ofinformation processing* (pp. 151-216). London:Academic Press.

Coltheart, M., Curtis, B., Atkins, P., & Haller, M. (1993). Models of reading aloud: Dual-route and parallel-distributed-processing approaches. *Psychological Review, 100,* 589-608.

Coltheart, M., Rastle, K., Perry, C, Langdon, R., & Ziegler, J. C. (2001).DRC: A dual route cascaded model of visual word recognition andreading aloud. *Psychological Review, 108,* 204-256.

Cossu, G. (1999). Biological constraints on literacy acquisition. *Reading and Writing: An interdisciplinary Journal, 11,* 213-237.

Cossu, G., Gugliotta, M., & Marshall, J. (1995). Acquisition of reading and written spelling in a transparent orthography: Two non parallel processes? *Reading and Writing, 7,* 9-22.

Cossu, G., Shankweiler, D., Liberman, I. S., Katz, L., & Tola, G. (1988). Awareness of phonological segments and reading ability in Italian children. *Applied Psycholinguistics, 9,* 1-16.

Dalrymple-Alford, E.C. (1985). Language switching during bilingual reading. *British Journal of Psychology, 76,* 111-122.

Del Toro,J.F.(2000).An examination of automatic versus strategic semantic priming effects in Broca's aphasia.Aphasiology, 14,925-947.

Dijkstra, A., & van Heuven, W. J. B. (1998). The BIA model and bilingual word recognition. In J. Grainger & A. M. Jacobs (Eds.), *Localist connectionist approaches to human cognition* (pp. 189-225). Mahwah, NJ:Erlbaum.

Ferrand, L., & Grainger, J. (1993). The time course of orthographic and phonological code activation in the early phases of visual word recognition.*Bulletin of the Psychonomic Society, 31,* 119—122.

Ferrand, L., & Grainger, J. (1993). The time course of orthographic and phonological code activation in the early phases of visual word recognition. *Bulletin of the Psychonomic Society, 31,* 119-122.

Ferrand, L., & Grainger, J. (1994). Effects of orthography are independent of phonology in masked form priming. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 47(A),* 365—382.

Field, J. (2003). *Psycholinguistics-A resource book for students.* London and New York: Routledge.

Frost, R. (1998). Toward a strong phonological theory of visual word recognition: True issues and false trails. *Psychological Bulletin, 123,* 71-99.

Frost, R., Katz, L., & Bentin, S. (1987). Strategies for visual word recognition and orthographical depth: A multilingual comparison. *Journal of Experimental Psychology: Human Perception and Performance, 13,* 104-115.

Gernsbacher. M.A. (1994). *Handbook Of Psycholinguistics.*California: Academic Press.

Glushko, R. J. (1979). The organization and activation of orthographic knowledge in reading aloud. *Journal of Experimental Psychology: Human Perception and Performance, 5,* 674-691.

GordonJ., & Baum,S.(1994).Rhyme priming in aphasia:the role of phonology in lexical access.*Brain and Language,* 47,661-683.

Grainger, J. & Beauvillian, C. (1987). Language blocking and lexical access in bilinguals. *Quarterly Journal of Experimental Psychology, 39A,* 295-319.

Grainger, J. & Dijkstra, T. (1992). On the representation and use of language information in bilinguals In R. J. Harris (Ed.), *Cognitive processes in bilinguals* (pp. 207-220). Amsterdam: Elsevier.

Grainger, J. (1993). Visual word recognition in bilinguals. In R. Schreuder & B. Weltens (Eds.), *The Bilingual lexicon* (pp. 11-26). Amsterdam: John Benjamins.

Grainger, J., & Ferrand, L. (1996). Masked orthographic and phonological priming in visual word recognition and naming: Cross-tasks comparisons. *Journal of Memory and Language, 35,* 623-647.

Green, D. W.(1998a). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition, 1,* 67-81.

Green, D. W.(1998b). Schemas, tags, and inhibition. *Bilingualism: Language and Cognition, 1,* 100-104.

Grosjean, F. (1997). Processing mixed languages: Issues, findings and models. In A. de Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 225-254). Hillsdale, NJ: Erlbaum.

Grosjean, F. (1998). Studying bilinguals: Methodological and conceptual issues. *Bilingualism: Language and Cognition, 1,* 131-149.

Harley, T. (2001). *The psychology of language.* New York: Psychology Press.

Harley, T.A. (1995) *The Psychology of Language.* Chapter 4 "Word Production and Dyslexia". Pages 111-130.

Humphreys, G. W., Evett, L. J., & Taylor, D. E. (1982). Automatic phonological priming in visual word recognition and naming: Cross task comparisons. *Memory & Cognition, 10,* 576-590.

Jared, D. & Kroll, J. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words? *Journal of Memory and language, 44,* 2-31.

Jay,T.B.(2003).77ie *Psychology of Language,*.NewJersey: Prentice Hall.

Katz, R. B., & Lanzoni, S. M. (1992). Automatic activation of word phonology from print in deep dyslexia. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 45(A),* 575-608.

Kay, J., & Marcel, A. (1981). One process, not two, in reading aloud: Lexical analogies do the work of non-lexical rules. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology,* 33(A), 397—413.

Keatley, C.W., Spinks, J.A., and DeGelder, B. (1994). Asymmetrical cross-language priming effects. *Memory and Cognition,* 22,70-84.

Keeney and Keeney (1968). *Dyslexia-diagnosis and treatment of reading disorders.* Saint Louis: The C.V. Mosby Company.

Kim, J., & Davis, C. (2004). Characteristics of poor readers of Korean Hangul: Auditory, isual and phonological processing. Reading and Writing, 17, 153—185.

Kirsner, K., Smith, M. C, Lockhart, R. S., King, M. L. and Jain, M. (1984). The bilingual lexicon: Language specific units in an integrated network. *Journal of Verbal Learning and Verbal Behavior, 23,* 519-539.

Kolers, P. (1966). Reading and talking bilingually. *The American Journal of Psychology,* 79, 357-376.

Kotz, S.A. (2001). Neurolinguistic evidence for bilingual language representation: A comparison of reaction times and event related potentials.

Kroll, J.F., and Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language,* 33,149-174.

Lahey, M., Edwards, J. & Munson, B. (2001). Is processing of speed related severity of language impairment? *Journal of Speech, Language, and Hearing Research,* 44,1354-1361.

Levelt,W.,& Wheeldon,L.(1994).the time course of lexical access in speech production: A study of picture naming. *Psychological Review,* 98,122-142.

Mackey, W.F., (1968). The description of bilingualism. In J.Fishman (Ed.), *Readings in the sociology of language* (pp.554-584). The Hague: Mouton.

MacNamara, J. (1967). The bilingual's linguistic performance-A psychological Overview. *Journal Of Social Issues*, 23, 58-77

Mann, V. A. (1986). Phonological awareness: The role of reading experience. *Cognition*, *24*, 65-92.

McCarthy, R. & Warrington, E.K. (1990) *Cognitive Neuropsychology: A Clinical Introduction.* London: Academic Press. Chapter 10 "Reading".

Mcnamara, T., & Healy, A.(1988).Semantic, phonological and mediated priming in reading and lexical decisions. *Journal of Experimental Psychology: Learning, Memory and Cognition,* 14,398-409.

McNamara, T.P., and Holbrook, J.B. (2003). Semantic Memory and priming. In A.F.Healy and R.W.Proctor (Eds.), *Handbook of Psychology: Experimental psychology* (Vol.4, pp.447-474). New York, NY: John Wiley and Sons, Inc.

Nas, G. (1983). Visual word recognition in bilinguals: Evidence from cooperation between visual and sound based codes during access to common lexical store. *Journal of Verbal Learning and Verbal Behavior, 23,* 526-534.

Nas, G. (1983). Visual word recognition in bilinguals: Evidence for a cooperation between visual and sound based codes during access to common lexical store. *Journal of Verbal Learning and Verbal behavior,* 22, 526-534.

Neely, J.H.(1991).Semantic priming effects in visual word recognition: A selective review of current findings and theories. In D.Besner &G.W.Humphreys(Eds.),Bas/c *processes in reading: Visual word* recogmY/o«(pp.264-336).Hillsdale,NJ:Erlbaum.

Paivio, A. & Lambert, W. (1981). Dual coding and bilingual memory. *Journal of Verbal Learning and Verbal Behavior, 20,* 532-539.

Parkin, A.J. (1996) *Explorations in Cognitive Neuropsychology*. Oxford: Blackwell. Chapter 8. "Reading and writing disorders".

Patterson, K (1990) Alexia and Neural Nets. Reproduced in Ellis, A. W. & Young, A. W. *Human Cognitive Neuropsychology: A Textbook with Readings.* Psychology Press: Hove. 1996. Page 557-568.

Peereman, R., & Content, A. (1995). Neighborhood size effect in naming: Lexical activation or sublexical correspondences? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 409-^421.

Pellowski, M.W., & Conture, E.D. (2005). Lexical priming in picture naming of young children who do and do not stutter. *Journal of Speech, Language, and Hearing Resaerch,* 48,278-294.

Perfetti, C. A., & Bell, L. C. (1991). Phonemic activation during the first 40 ms of word identification: Evidence from backward masking and priming. *Journal of Memory and Language, 27,* 59-70.

Posner, M.I. and Synder, C.R.R. (1975b). Facilitation and inhibition in the processing of signals. In P.M.A. Rabbit and S.Dornic (Eds.), *Attention and Performance,* (pp.55-85). New York: John Wiley and Sons.

Ratcliff,R.(1993).Methods for dealing with reaction time outliers. *Psychological Bulletin,1 14,3510-3532.*

Sadock, B.J. and Sadock, V.A. (2000). *Comprehensive textbook of psychiatry.* Philadelphia: Lippincott Williams and Wilkins.

Scarborough, D., Gerard, L., & Cortese, C. (1984). Independence of lexical access in bilingual word recognition. *Journal of Verbal Learning and Verbal Behavior, 23,* 84-99.

Schaerlaekens, A. (1998). Bilingualism in children: An introduction. *Psychologica Belgica, 38,* 129-148.

Segui, J., & Grainger, J. (1990). Priming word recognition with orthographic neighbors: Effects of relative prime-target frequency. *Journal of Experimental Psychology: Human Perception and Performance, 16,* 65-75.

Seymour, P., & Elder, L. (1986). Beginning reading without phonology. *Cognitive Neuropsychology, 3,* 1-37.

Shaywitz, S.E..Shaywitz, B.A., Fletcher, J.M., and Escobar ,M.D.(1990). Effect of intensive training on auditory processing and reading skills. *Brain & Language, 88,21-25.*

Slowiaczek,L.,Nusbaum,H., & Pisoni,D.(1987).Phonological priming in auditory word recognition. *Journal of Experimental Psychology: Learning, Memory and Cognition, 13,64- 75.*

Smith, M. C. (1997). How do bilinguals access lexical information? In A. M. De Groot & J. F. Kroll (Eds.), Tutorials in bilingualism: *Psycholinguistic Perspectives* (pp. 145-168). Hillsdale, NJ: Erlbaum.

Smith,M., & Wheeldon,L.(2001).Syntactic priming in spoken sentence production-an online study.Cognition,78,123-164.

Stuart, K. M., & Coltheart, M. (1988). Does reading develop in a sequence of stages? *Cognition, 30,* 139-181.

Thirumalai, M.S. and Chengappa (1986). *Simultaneous acquisition of two languages. An Overview.*Mysore: Central Institute of Indian Languages Press.

Thomas, M. S. and Allport, A. (2000). Language switching costs in bilingual word recognition. *Journal of Memory and Language, 43,* 44-66.

Thomas,M.S.C.(1997).Distributed representations and the bilingual lexicon:one store or two?In:J.Bullinaria,D.Glasspool, and G.Houghton(Eds.),Proceedings *of the 4th Annual Neural Computation and Psychology Workshop.Spnnger.*

Thorstadt, G. (1991). The effect of orthography on the acquisition of literacy skills. *British Journal of Psychology, 82,* 527-537.

Van den Bosch, A., Content, A., Daelemans, W., & De Gelder, B. (1994). Measuring the complexity of writing systems. *Journal of Quantitative Linguistics, 1,* 178-188.

Van Heuven, J. B., Dijkstra, T., & Grainger, J. (1998). Orthographic neighborhood effects in bilingual word recognition. *Journal of Memory and Language, 39,* 458-183.

Van Orden, G. C, & Goldinger, S. D. (1994). Interdependence of form and function in cognitive systems explains perception of printed words. *Journal of Experimental Psychology: Human Perception and Performance, 20,* 1269-1291.

Van Orden, G. C, Pennington, B. F., & Stone, G. O. (1990). Word identification in reading and the promise of subsymbolic psycholinguistics. *Psychological Review, 97,* 488-522.

Von Studnitz, R. E., & Green, D. W. (1997). Lexical decision and language switching. *International Journal of bilingualism,* 1, 3-24.

Walton, M. (1998). *Teaching reading and spelling to dyslexic children.* London: David Fulton Publishers

Wijnen, F., &Boers, I. (1994). Phonological priming effects in stutterers. *Journal of Fluency Disorders,* 19,1-20.

Appendix I

List of Stimuli

Target Stimuli	Related Semantic Prime List	Related Phonological Prime List
Buffalo	Kangaroo	Bupika
Leopard	Elephant	Leoki
Camel	Tiger	Casip
Mongoose	Deer	Molak
Jackal	Monkey	Jatin
Carrot	Pumpkin	Capum
Tomato	Potato	Tokila
Radish	Brinjal	Ralop
Garlic	Onion	Gamos
Ginger	Cabbage	Gipol
Coconut	Apple	Conilak
Lemon	Orange	Lekin
Banana	Chickoo	Bapilo
Mango	Litchi	Madi
Guava	Papaya	Guku

Appendix II

List of Stimuli

Target Stimuli	Unrelated Semantic Prime List	Unrelated Phonological Prime List
Buffalo	Apple	Conilak
Leopard	Orange	Lekin
Camel	Chickoo	Bapilo
Mongoose	Litchi	Madi
Jackal	Papaya	Guku
Carrot	Kangaroo	Bupika
Tomato	Elephant	Leoki
Radish	Tiger	Casip
Garlic	Deer	Molak
Ginger	Monkey	Jatin
Coconut	Pumpkin	Capum
Lemon	Potato	Tokila
Banana	Brinjal	Ralop
Mango	Onion	Gamos
Guava	Cabbage	Gipol

Famous People with the Gift of Dyslexia
Here are the names of some of the many individuals who are dyslexic, or had symptoms of dyslexia or related learning problems:

Actors & Entertainers:
Harry Andersen, Fred Astaire. Harry Belafonte, George Burns, Enrico Caruso, Tom Cruise, Dave Foley. Harrison Ford, Danny Glover, Tracey Gold, Whoopi Goldberg, Susan Hampshire. Jay Lena. River Phoenix, Edward James Olmos. Jill Pages, Oliver Reed, Billy Bob Thornton, Tom Smothers. Robin Williams. Henry Winkler
***Artists,** Designers, & Architects:*
Ansel Adams, David Bailey-photographers, Leonardo da Vinci, Ignacio Gomez-muralist, Pablo Picasso-artist, Robert Rauschenberg, Auguste Rodin-sculptor, Bennett Strahan, Robert Toth, Jorn Utzon-architect (designed Sydney Opera house), Andy Warhol.
Athletes:
Muhammad Ali-World Heavyweight Champion Boxer, Duncan Goodhew-Olympic Swimmer, Bruce Jenner-Olympic Decathlon Gold Medalist, Magic Johnson, Greg Louganis-Olypmic diving champion, Bob May-golfer, Diamond Dallas Page-World Wrestling Champion, Steve Redgrave-Olympic Gold Medalist (rowing), Nolan Ryan-Baseball Pitcher for the Texas Rangers, Jackie Stewart-race car driver.
Entrepreneurs & Business Leaders:
Richard Branson-Founder of Virgin Enterprises, John T Chambers-CEO of Cisco Systems, Henry Ford, William Hewlett-Co-Founder, Hewlett-Packard, Craig McCaw-Telecommunications Visionary, Paul J. Orfalea-founder of Kinko's, Charles Schwab-Investor, Ted Turner-Turner Broadcasting Systems, F.W. Woolworth
Filmmakers:
Nicole Betancourt-Emmy-winning filmmaker, Walt Disney, Soren Kragh Jacobsen-Danish film director)
Inventors & Scientists:
Ann Bancroft-Arctic Explorer, Alexander Graham Bell, Thomas Edison, Albert Einstein, Michael Faraday, Dr. James Lovelock, John R. Horner-Paleontologist, Archer Martin-Chemist (1952 Nobel Laureate), John Robert Skoyles-Brain Researcher, Werner Von Braun
Law & Justice:
David Boies-Attorney, Erin Brockovich-Investigator, Jeffrey H. Gallet-Judge
Military Heroes:
Thomas Jonathan "Stonewall" Jackson, George Patton
Musicians & Vocalists:
Cher, Brad Little, John Lennon, Nigel Kennedy-violinist, Bob Weir-Grateful Dead guitarist
Physicians & Surgeons
Harvey Cushing-Surgeon, Fred Epstein-Neurosurgeon
Political Leaders:
Winston Churchill, King Carl XVI Gustaf of Sweden, Michael Heseltine, Andrew Jackson, Thomas Jefferson, John F. Kennedy, Nelson Rockefeller, Paul Wellstone-US Senator, Woodrow Wilson, George Washington
Writers:
Hans Christian Andersen, Avi, Jeanne Betancourt-"My Name is Brain Brian", Steven Cannell-television writer & novelist, Agatha Christie, Fannie Flagg-"Fried Green Tomatoes at the Whistle Stop Cafe", Gustave Flaubert, Patricia Polacco-Children's Author and Illustrator, Elizabeth Daniels Squire-mystery novels, Bernie Taylor-Big Trout, Victor Villasehor, W.B. Yeats-poet