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**DIAGNOSIS AND REMEDIATION  
OF DYSLEXIA**

*An Empirical Study in Kannada - an Indian Language*

**RAMAA, S.**

# **DIAGNOSIS AND REMEDIATION OF DYSLEXIA**

*An Empirical Study in Kannada - an Indian Language*

*By*

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**Mysore**

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Dedicated to

*To my beloved Father and Great Teacher*

**Late Sri. S. Subbiah**



## FOREWORD

It gives me great pleasure to write the Foreword to this book. I first became acquainted with an earlier draft of it when I was asked to act as External Examiner for Dr. Ramaa's Ph.D. thesis. I have no hesitation in saying that the thesis was brilliant.

One of Dr. Ramaa's central achievements has been the way in which she has put dyslexia 'on the map'. In many parts of the world recognition that the dyslexia concept is of value has been slow to come; and her research has contributed to making the position of 'doubters' very uncomfortable. In particular she has shown that those whom she picked out as dyslexic behaved differently on a variety of tasks not only from normal readers but from poor readers who were probably not dyslexic.

This, however, was no isolated discovery but one which readily lent itself to a particular theoretical explanation. Dr. Ramaa's research coincided with a growing awareness in the U.S.A. and Britain, based on the work of a number of independent investigators, that dyslexia is basically a difficulty in the processing of language. Dr. Ramaa's research fully confirms this. Her dyslexic subjects were in general no different from her controls in tasks that called only for auditory or visual discrimination, they are distinctively weak, however, at tasks which involved language processing, for instance at recall of auditorily presented digits, Visual-verbal association, at word analysis and word synthesis.

Of particular interest is the fact that this particular research was carried out in the region of Mysore Karnataka State, India. Although it seems likely that dyslexia is a world wide phenomenon, it would hardly have been surprising if local conditions, including the use of the Kannada alphabet and language, had produced a situation very different from that which exists in English-speaking countries. This turned out not to be the case: dyslexia, it seems, can occur in different parts of the world and in countries which have widely differing writing systems.

One of the indicators of good research is whether those who read about it find it exciting. Dr. Ramaa's research fully satisfies this criterion. Not only were her experiments very carefully and scrupulously carried out, but they provide answers to important questions. I commend this book as a very valuable contribution to the study of dyslexia.

T.R.Miles

Dyslexia Unit, University College of North Wales, Bangor

August 1993

## PREFACE

The book is an abridged form of the Inesis 'Diagnosis and Remediation of Dyslexia-an Attempt' for which University of Mysore awarded the Degree of Doctor of Philosophy in education in 1985. Some of the important observations reported in the thesis were discussed in the 3<sup>rd</sup> world congress on Dyslexia held at Inland of crete, Greece, in 1987. An attempt has been made to update the work by discussing hte results of the study in the light of recent findings. I take this opportunity to express my deep sense of gratitude to all those who helped me in conducting the research study on which the book is based and also to those who helped in the publication of the book.

I hereby acknowledge my deep sense of gratitude to Dr.(Mrs) Lalithamma, M.S., Reader in Education, Department of studies in education, Manasagangothri, Mysore, who guided me in conducting the research study.

I express my heartfelt thanks to Dr. P.R. Nayar, Retired Professor, Department of Studies in Education, Manasagangothri, Mysore, who inspired and encouraged me to undertake the research work and also facilitated the task through valuable suggestions at different phases of the study.

My Sincere thanks to Dr. Mohan Madhyastha, Reader, Post-Graduate Department of Statistics, Manasagangothri, Mysore for his assistance in the Statistical analysis of the data of the study.

I am highly grateful to Educational Research Innovations Committee (ERIC), National Council of Educational Research and Training, New Delhi, for the financial assistance provided to publish the thesis.

I express my sense of gratitude to Dr. T.R. Miles, Professor, Dyslexia unit, University college of North Wales, Bangor, United Kingdom, for his valuable suggestions in refining the thesis. I am highly thankful to him for having written foreword to this book.

The Publishers, Vidyasagar Printing & Publishing House, Mysore have taken a bold step in publishing the thesis. I am highly grateful to them for their encouragement through publication of the thesis.

-S. RAMAA

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## INTRODUCTION

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### 1.0. INTRODUCTION

Dyslexia is a concept relating to difficulties on reading suggesting primary retardation. The children who are having dyslexia are known as dyslexics. The book is based on a study which was intended to diagnose dyslexics deficiencies in abilities relating to reading performance. In the study it was also attempted to remediate dyslexia of such children through a specially designed programme

This chapter is devoted to the discussions on concept clarification of dyslexia, theoretical and empirical bases for the study, objectives, nature and and scope of the study.

### 1.1. CONCEPT OF DYSLEXIA

The word 'dyslexia' is of Greek origin and means, loosely translated 'difficulty with words'. It was first coined by Berlin (1887), but it was introduced into literature by Orton (1937) and has since then been adopted in the place of the term 'word blind' which was first described by Morgan in 1896, but is generally attributed to Hinshelwood (1917) (cited in Pavlidis 1981, p. 103).

The term 'dyslexia' has been interchangeably used with many other terms like 'word blindness', 'Strophosymbolia', 'reading disability', 'reading difficulty', 'primary reading retardation', 'learning disability', 'poor reading', and 'inadequate reading'. The symptomatology and populations described by the above terms are variable, but they all share one main factor; a severe reading problem which cannot be explained by the factors which generally cause reading backwardness (Pavlidis, 1981).

The above comment by Pavlidis calls attention to two important questions in understanding the nature of dyslexia.

- i) If the symptoms described by the terms considered to be synonymous with dyslexia are different, apart from severe reading problem, what else does dyslexia include?
- ii) If dyslexia cannot be attributed to the same factors which cause reading backwardness, to which factors can dyslexia be attributed?

The ideas expressed by various authors in their definitions/descriptions/explanations of dyslexia may help in answering the above questions.

#### 1.1.1. Dyslexia-a Complex Syndrome

The definitions given by Orton (1925), Harris (1970) and Gunderson (1971) clearly indicate that they have considered 'dyslexia' as a disorder associated with reading alone. According to Orton, reversals, directional confusion and difficulties with orientation observed during reading are the essence of dyslexia. While Orton focussed on symptoms Harris and Gunderson define reading disability artificially with normative criteria, in terms of reading expectancy quotient (below 90) and reading age (below 90% of the expectancy level) (cited in Dunn, 1963, p. 544).

These definitions stress inadequate reading achievement but do not discriminate between dyslexic or nondyslexic poor readers. However, they help a teacher in identifying probable dyslexics, but only after failure in reading at school. Definitions given by recent authors, however include more and more behavioural symptoms of dyslexia. Their definitions suggest that dyslexia is a 'complex syndrome' and not just a 'specific reading disability'.

Myklebust and Johnson (1962) considered dyslexia "as a complex syndrome of associated psychoneurological dysfunctions, such as disturbances in orientation time, written language, spelling, memory, auditory



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and visual perception, motor skills and related sensory abilities". The definition given by Critchley and Critchley (1978) is relatively narrow compared to the above but still does not reduce dyslexia to a specific reading disability. They defined developmental dyslexia as "a learning disability which initially shows itself by difficulty in learning to read, and later by erratic spelling and by lack of facility in manipulating written as opposed to spoken words".

The idea that dyslexia manifests itself in written as opposed to spoken words is contradicted by Pavlidis (1981) who has substantiated the view that the disability manifests even in non-reading situation, since dyslexia is a central disorder. Pavlidis's view is supported by Rawson (1981, p.15) who quoted the case of a dyslexic boy who reported "I can think o.K., but what's wrong is my words. I forget them and I can't manage them".

The description by Critchley (1981) also supports the views of Pavlidis (1981) and Rawson (1981). Critchley (1981) has stated :

" Dyslexia implies vastly more than a delay in learning to read, which is but the tip of the iceberg. The etymology of the term dyslexia expresses admirably a difficulty not in reading -but in the case of words, how they are identified, what they signify, how they are handled in combination, how they are pronounced, and how they are spelt. All these constitute a handicap to a dyslexic and it usually happens that mere reading difficulties are later submerged by many other defects. The natural history of a dyslexic school boy is usually one of steady improvement in his ability to read, but the other troubles or epiphenomena are then highlighted"(p.2).

From the above description, it is clear that there is greater support to the concept of dyslexia as a 'complex syndrome', with increase in the depth of knowledge about the very phenomenon. The addition of more and more behavioural symptoms should help in identifying dyslexics even before school failure and in isolating them from those with other sorts of reading backwardness/disability.

### 1.1.2. Dyslexia-due to Central Factors

Some of the definitions given by various authors point to certain factors responsible for dyslexia, whereas some others indicate factors not responsible for the phenomena.

Harris (1970) stated: "Reading disability applies to retarded readers whose reading is significantly below expectancy for their age and intelligence and is also disparate with their cultural, linguistic and educational experience" (cited in Dunn, 1963, p. 539). Since Harris included dyslexia as an example of a reading disability (Dunn, 1963, p.539), the above definition implies that dyslexia is independent of adverse psycho- sociocultural factors. Though he has not pointed out the factors underlying dyslexia, the differentiation of reading disability made by him, into primary (constitutional in origin) and secondary (environmental in origin), gives a clue that he has considered dyslexia as a constitutional disability. However, this is not clearly expressed in his definition.

Critchley and Critchley (1978) also agree with Harris (1970) as far as the factors which are not responsible for dyslexia are concerned. They have pointed out that developmental dyslexia " is not due to intellectual inadequacy or to lack of sociocultural opportunity or to emotional factors, or to any known structural brain-defect".

The attempt of Harris (1970) to identify a type of reading disability which is not environmental in origin is also supported by Critchley and Critchley (1978) as they excluded emotional factors as a cause for dyslexia. Their additional contribution is the use of the term 'developmental dyslexia' and considering it to be independent of any known structural brain-defect. This lends support to Hinshelwood (1917) who had considered dyslexia as a "congenital defect occurring in children with otherwise normal and undamaged brains" (cited in Pavlidis, 1981 p.103). Though he had pointed out that dyslexia is due to pathologicval



conditions he has not specified its nature. Critchley and Critchley (1978) have, however, suggested that dyslexia "probably represents a specific maturational defect which tends to lessen as the child grows older, and is capable of considerable improvement, especially when appropriate remedial help is afforded at the earliest opportunity". This suggestion stresses the need for early intervention and creates optimism among educators that irrespective of the etiology, it is possible to correct the defect. But, the explanation that "dyslexia represents maturational lag" needs further support.

From the above discussion it is clear that there is considerable agreement among the authors as far as the factors to be excluded as the causes of dyslexia are concerned. What is responsible for dyslexia still largely an open question. But on the basis of the conclusions made by various authors that dyslexia cannot be attributed to environmental factors and the suggestions given by them regarding the probable causative factors, investigators like Pavlidis (1981) have inferred that 'dyslexia is a constitutional disability and should be caused by central factors'; he has objected to the use of the term 'specific reading retardation' in the place of dyslexia considering it as a 'complex syndrome'. Thus the explanations that 'dyslexia is a complex syndrome' and that it is 'due to central factors' are consistent with each other.

Though the indication of 'central factors' is too broad, it is a starting point in further diagnosis, which may ultimately help in knowing the real nature of dyslexia.

#### **1.1.3. Dyslexia-distinct from Alexia**

The behavioural symptoms included by various authors in their definitions of dyslexia considering it as a complex syndrome caused by central factors create two confusions which need to be clarified.

- i) The central factors responsible for dyslexia are affected not only by genetic factors but also by any damage to brain and manifest in the same set of behaviour symptoms. In that case, is dyslexia just a constitutional disability?
- ii) The behavioural symptoms considered to be indicative of dyslexia may be demonstrated by an individual at any period of his life time. Then does the term dyslexia denote only developmental dyslexia or acquired dyslexia also?

The extent of the impact of the above confusions in understanding the nature of dyslexia is further increased by the use of the terms like 'alexia'. A discussion which attempts to distinguish dyslexia from alexia also helps in the clarification of the confusions mentioned above.

In the older medical literature the term 'alexia' generally meant a total lack of reading skills while 'dyslexia' was used to refer to a partial lack of reading abilities; both terms, however, were meant to apply to reading difficulties occurring as a direct result of damage to the brain in previously normal individuals who could once read accurately. Since damage to the brain occasionally produce complete loss of reading skills (and even among such cases some reading skills may still be demonstrated with suitable stimulation), reading difficulties consequent upon brain damage are now generally termed 'alexia' irrespective of their severity, while the term 'dyslexia' is reserved for individuals who have difficulty in acquiring the skills of reading during childhood and/or later life (Benson and Geschwind, 1969) (cited in Meudell, 1981, p.67). In other words alexia is an acquired reading disorder resulting from organic damage to the brain, while dyslexia is a disability to learn to read arising from innate factors. The term 'acquired dyslexia' has also been used synonymously with 'alexia' (Marshall and Newcombe, 1973) (cited in Meudell, 1981, p.67). It seems advisable to use the two terms with the above differentiation in meaning to represent the two distinct disorders.

#### **1.1.4. Dyslexic - a Viable Definition**

From the above discussions, it is revealed that attempts have been made to describe the nature of dyslexia, although not in defining it specifically. Such attempts have been done from two view points which are complementary. Dyslexia has been viewed descriptively in terms of the behavioural symptoms that



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dyslexics manifest and there is now greater agreement to perceive it as a complex syndrome. Dyslexia has been analysed from etiological point of view also. There has not been much agreement on what would lead to dyslexia although there appears to be considerable consensus on factors which are not responsible for dyslexia. This implies that in the present context it is difficult to define the concept of dyslexia. But from the factors that are not responsible for dyslexia, an attempt can be made to describe a 'dyslexic child' by identifying a set of criteria based on such factors. Such a description would go a long way not only in identifying a dyslexic child but also in understanding the phenomenon of dyslexia.

Several investigators in their studies have tried to define dyslexics in terms of a set of criteria which screens out non-dyslexics. Such criteria have been found to be too general and subjective (Pavlidis, 1981). From practical point of view of identifying a dyslexic child, a definition that includes a set of criteria that are as valid, quantitative, objective and specific as possible will be more viable, than otherwise. Pavlidis (1981) asserting a similar view point has used the following set of criteria for identifying dyslexic children in his studies. Those were :

- 1) Performance or verbal IQ of more than 90.
- 2) At least 2 years retarded in reading if more than 10 years of age; and 18 months retarded if less than 10 years of age.
- 3) Normal vision and hearing.
- 4) From a middle-class socioeconomic back-ground (English- speaking).
- 5) Adequate motivation to read.
- 6) No lack of educational opportunities.
- 7) No more than two school changes (excluding normal transfer from nursery to primary to secondary schools).
- 8) Not been absent for more than 2 weeks per term.
- 9) No overt physical handicaps (that is, brain injury and /or tumour).
- 10) No overt emotional problems prior to commencing reading.

Though this is the only available approach to define dyslexics, it does not mean that this approach is foolproof. It is having two major limitations:

- i) It still considers dyslexics as just reading disabled and neglects other behavioural symptoms of dyslexics, which may help in identifying them before school failure.
- ii) It assumes that there are no dyslexics among sensory handicapped, emotionally disturbed, and children with adverse psychosociocultural factors, which leads to the negligence of such children.

Although it is admitted that the above attempt to define/describe a dyslexic child is narrow and less comprehensive, in the present context, this is the viable approach to define a dyslexic child.

### **1.2. STATUS OF RESEARCH IN DIAGNOSIS AND REMEDIATION OF DYSLEXIA**

From the conceptual analysis of dyslexia it is understood that dyslexia is a complex syndrome and is due to central factors. Therefore dyslexia can be considered to have three strata, the lowest holding the etiological factors, the middle one functional disabilities and the upper one behavioural symptoms of dyslexia. And each stratum has many separable segments cutting across the radii. This implies that, to get a full and clear perspective of dyslexia, all the aspects of it have to be studied, in isolation and in conjunction with the remaining aspects. (The process of diagnosis provides knowledge about) various facets of dyslexia whereas the remedial process makes use of that knowledge in attacking dyslexia.



## Introduction

The review of the whole mass of research work done so far, reveals that investigators from different disciplines—medicine, psychology and education—have attempted to both diagnose and treat dyslexia. For the sake of convenience the research work done so far can be discussed broadly under different categories depending upon the objectives and approaches to achieve those objectives, although there is considerable influence of studies in one category over the others. They are:

- i) Attempts to explain dyslexia
  - a) through etiological factors and
  - b) through behavioural disabilities.
- ii) Attempts to remediate dyslexia
  - a) through deficit-oriented approach,
  - b) through strength-oriented approach and
- iii) Attempts to identify dyslexics
  - a) through learning disabilities test battery,
  - b) through reading error analysis,
  - c) through developmental history and
  - d) through eye-movement pattern.

### 1.2.1. Attempts to Explain Dyslexia Through Etiological Factors

Till 1925 medical interest in learning disabilities had focussed almost exclusively on their diagnosis and classification. The objective of diagnosis was to identify the biological and neurological factors responsible for severe reading problems. The principal investigative procedure in such research was to examine the relationships between particular physiological conditions and success or lack of success in reading. Typically, samples of good readers and of poor readers (dyslexics) were examined to find whether or not the incidence of particular conditions differed between the two groups (Smith, 1974).

The physiological conditions that were most often studied (cited in Bateman, 1967, p.13) were:

- a) damage to or dysfunction of certain localized areas of the brain (Wernicke, 1874; Hinshelwood, 1917; Penfield and Roberts, 1959; Robinovitch, 1959),
- b) hereditary or developmental lag factors (Olson, 1940; Eustis, 1947; Drew, 1956; Harris, 1957; Hermann, 1959), and
- c) other factors such as lack of cerebral dominance, minimal brain injury, endocrine disturbance and chemical imbalance (Orton, 1928; Strauss and Lehtinen, 1947; Delacato, 1963).

After examining the research regarding neurological anomalies and reading from 1932 to 1973, Smith (1947) found that more than a few researchers believe that there is a close tie between neurological disorders of one kind or another and lack of achievement in reading. But, according to him, because of several limitations inherent in those studies their conclusions regarding the relationship between reading disability and neurological deficit are questionable.

Investigators' failure to go beyond speculation (Kleffner, 1962) and lack of definite correlations of brain pathology with reading processes were considered to be the basic reasons for the lack of success in following the neurological pathology or etiological approach (Bateman, 1967).

### 1.2.2. Attempts to Explain Dyslexia Through Behavioural Disabilities

Apart from the failure of etiological approach to explain dyslexia, the very fact that we cannot exchange parents or repair damaged brains has led to a behavioural and symptomatic approach rather than an etiological



one. This shift in approach has been appreciated as more fruitful in a practical sense.

Attempts to explain dyslexia through behavioural disabilities have been made in two different ways:

- a) by identifying the neuropsychological dysfunctions underlying dyslexia, and
- b) by identifying the information processing difficulties responsible for dyslexia.

#### 1.2.2.1. Identification of neuropsychological dysfunctions:

Considerable clinical and experimental evidence has indicated that dyslexic children do, in fact, have some significant deficiencies in auditory processing skills like auditory reception, auditory discrimination, auditory memory, sound blending; visual processing skills like visual discrimination, visual tracking, visual organisation and visual memory; auditory-visual association (Valett, 1980). These processes are found to be essential to learn reading, more specifically to recognize words (Valett, 1980; Faas, 1976; Vernon, 1979).

Various hypotheses have been formulated on the relationship between the above mentioned variables and dyslexia and have been investigated by several authors. To quote a few, visual discrimination (Stanley and O'Neill, cited in Goodacre, 1976; Fuller and Shaw, 1963; Waites, Lucius, 1980; visual memory (Naidoo, 1972; Trieschman, 1968; Vernon, 1977; Tiedmann, Joachim, Dieter, 1976); auditory discrimination (Steinhagen, Klans and Gutezeit, Gunter; 1971; Brandt, Jason and Rosen, Jeffrey, 1980; Johnston, 1982); auditory sequential memory (Golden and Steiner, 1969; Bryden, 1972; Badian, 1977); sound blending (Savin, 1972; Zigmund, 1966; Hammill and Larsen, 1974); and visual-verbal association (Vellutino, Stegar, Harding and Phillips, 1975; Ellis and Miles, 1981) have been studied.

Reviewing the research done in this area, Vellutino (1977) has pointed out that there have been four prevalent explanations for reading failure among dyslexics and there are theories on visual perception, intersensory integration, temporal order perception, and verbal functioning. But she has observed no consensus among investigators as far as each explanation for reading failure among dyslexics is concerned. But it does not mean that none of them is valid. It only implies that all the explanations may be valid if we hypothesize that there are different types of dyslexia. One such attempt at classifying dyslexics was made by Myklebust and Johnson (1962) who classified dyslexia as auditory, visual and auditory-visual.

Such an attempt to classify dyslexia does not in any way undermine the importance of identifying common deficiencies responsible for dyslexia. Thus, the spirit for searching common deficiencies responsible for all the problems of dyslexics is still persistent and the significance of such research is highlighted by investigators like Valett (1960) who has recommended that for planning any educational or remedial programme for dyslexic children, neuropsychological deficiencies must be considered.

#### 1.2.2.2. Identification of information processing difficulties :

The recent trend in the study of dyslexia is the study of specific functions involved in reading. The method of investigation and reasoning are used that of cognitive psychology. This approach involves the assumption that when an organism receives stimulation from the outside world or from within its own body there are mechanisms for transforming, reducing, elaborating, storing and retrieving particular characteristics of the original information, the generic term for such operations being 'information processing' (Neisser, 1967). Ellis and Miles have pointed out that the neurological structures of the mechanisms of information processing in questions are not open to immediate investigation, but their functions can be inferred from suitably controlled experimental studies.

According to this approach, reading aloud is assumed to involve four types of stimulus representations- the 'visual information store' (VIS) and the visual, lexical and articulatory codes. The reading process is thus conceived of as follows. When a person looks at a written or printed word, a representation of that word is stored temporarily in the VIS. The stimulus traces in the VIS are thereafter analysed so as to form a 'code'



in which the stimulus pattern is represented conceptually, that is irrespective of handwriting, typescript, case etc. This code is 'grapheme' in the sense that it represents the basic units of writing; and, as a result of the activation of a pattern recognition unit, items in the lexicon are accessed and the entry in the lexicon corresponding to the stimulus pattern is retrieved (Ellis and Miles, 1981).

Several investigators have conducted experimental studies which involved 'artificial reading' tasks, for example, by requiring the subject to find the letter 'b' hidden among a page of 'a' s or by requiring him to say which of the following letter-strings are words: zupt, carrot, coff, frog, pea. Investigators following this approach have assumed that the time taken by different subjects to carry out such tasks and the types of errors which they make could, with suitably designed experiments, throw light on the underlying mechanisms; for example, the first task is relevant to the study of mechanisms for pattern recognition and the second to the study of mechanisms for the storage and retrieval of words (Ellis and Miles, 1981).

Several functions involved in reading aloud in case of dyslexics have been explored. To quote a few: visual information store (Stanley and Hall, 1973; Ellis and Miles, 1978a); Visual code (Ellis and Miles, 1978b; Subramanian and Audley, 1976; Baddeley 1971; Done and Miles, 1978); lexical encoding (Coltheart, 1972; Ellis, 1978, 1980); articulatory code (Cohen and Nettley, 1977; Baddeley, 1979) (cited in Ellis and Miles, 1981) have been investigated.

After reviewing various studies following the approach specified above (Ellis and Miles, 1981) found that several investigators have independently reached similar conclusions. On the basis of these studies they concluded that dyslexic children show a deficiency at the level of lexical encoding and they tried to explain many interesting features of developmental dyslexia which have been observed clinically.

But Zangwill, in his foreword to the book by Pavlidis and Miles (1981) has suspected the adequacy of this information processing model of dyslexic handicap in explaining all the features of dyslexia, such as Oculo-motor abnormalities, slow learning and rapid forgetting of spelling. However, he has concluded that in spite of the objections raised against it, the information processing model undoubtedly contributes to the understanding of dyslexia and further he considers that this 'new wave' of cognitive psychology has convincing practical applications.

### 1.2.3. Attempts to Remediate Dyslexia

The discussion about the diagnosis of dyslexia has revealed that in the beginning researchers working on the problem of dyslexia were interested in identifying the biological factors and only recently they have shifted their attention to behavioural effects of dyslexia, only after such a shift it was possible to make progress in the remediation of dyslexia.

Though both the approaches i.e., identification of neuropsychological dysfunctions and of information processing difficulties have been followed for explaining dyslexia and are considered to be of practical value, almost all the attempts to remediate dyslexia have followed the neuro-psychological model only. The attempts thus made have adopted three approaches which are of course not mutually exclusive:

- i) deficit-oriented approach attempting to remediate dyslexia by correcting the underlying neuropsychological deficiencies first and then teach reading;
- ii) strength-oriented approach with direct attempt to teach reading through strategies developed on the neuro-psychological strengths of dyslexics; and
- iii) multisensory approach seeking to improve the reading performance of dyslexics through many senses.

#### 1.2.3.1. Deficit-oriented approach :

In educational practice, Maria Montessori (1964) was one of the first workers to hypothesize that the mind



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can be made to grow and develop through the use of special educational methods, such as manipulative cognitive games and related sensory-motor games, but it was not for many years that special education was aimed more directly at neurological intervention and remediation.

The fundamental premise in sensory-motor education and treatment is that human nervous system that is impeded in its development may and must be given opportunities to strengthen its functions if serious developmental and reading problems are to be prevented (Valett, 1980,p.92)

Research studies were conducted by Delacato (1966), Doman(1960) to improve body organization; Miracle (1966), Mariam (1966), Painter (1966), Faustman (1968), Heber (1972)to improve sensory discrimination; Ayres (1972, 1973) and Cratly (1970, 1973) to develop reticular-righting reflexes (cited in Valett, 1980).

Most neuropsychological education programmes have attempted to develop visual,auditory and related sensory abilities. Direct attempts have been made to remediate whatever specific processing duysfunctions may have been diagnosed. Some work, such as that of Frostig and Horne has focused on remediation of visual perception and assimilation with some attention to certain motor responses; Lowell and Stoner (1960) have worked in auditory training, with some focus on certain vocal response characteristics; Birch (1963) has attempted to intergrate non-symbolic material received simultaneously on another receptive channel (cited in Bateman, 1967).

All these studies have shown that it is possible to improve the relevant neuropsychological abilities through intensive training.

### **1.2.3.2. Strength-oriented approach :**

As already pointed out, this approach implies the attempt to improve reading performance of dyslexics through remedial programme developed on the neuropsychological strength of children.

Example of such strength-oriented approaches are alphabetic approach and whole-word approach recommended by Johnson and Myklebust in 1967.

The alphabetic or phonovisual approach emphasizes the teaching of sounds or phonograms in isolation and the blending of them into meaningful words; this approach depends heavily upon the child's ability to combine or blend sounds. It is well suited for use with children who have visual- channel deficits and auditory-channel strengths. It has been found (Johnson and Myklebust, 1967) that visual dyslexics respond best in reading when their instruction follows a phonetically oriented approach.

Whole-word approach has been recommended by Johnson and Myklebust (1967) for auditory-dyslexic children during the initial stages of reading instruction. This tack permits children who have strengths in visual channel but lack the auditory discrimination auditory memory and integration skills needed for phonetic analysis to develop a basic sight word vocabulary. It has been observed that some children are able to develop these auditory skills after learning a sight vocabulary.

The tactual-kinesthetic method has been recommended for visual auditory dyslexics as they experience impairment of perception, memory and integration in both the auditory and the visual channels.

But Fletcher (1967) has emphasized the need to combine methods so as to help the child to achieve mature reading.

### **1.2.3.3. Multisensory approach :**

Attempts have also been made to improve reading through remedial programmes which make use of multtisensory channels of dyslexics. A number of experimental studies have been conducted which support the utility of such an approach. Fundamental research in perception, such as that reported by Ittelson and Kilpatrick (1951) shows that what we perceive and understand is based on relevant and consistent multisensory



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experience and action. Spatche (1976) has reviewed numerous perceptual studies and concluded that reading is an intersensory process involving many visual, auditory, muscular and cross modality associations; therefore multimodal methods should be used in remedial instruction.

There are many multisensory reading methods and they are grouped into four major categories though there is considerable overlapping (Valett,1980). They are :

- a) Simultaneous association (Orton-Gillingham) - Through the use of simultaneous techniques, the child learns how a letter or word looks, how it sounds, how the speechorgans feel in pronouncing it, and how the hand feels in writing the grapheme or word.
- b) Psychoneurological impress-Intensive drills are used to "break-through" old behaviour which are detrimental to proficient learning and to make new impressions on the central nervous system.
- c) Kinesthetic methods.
- d) Perceptual-motor methods.

From the trend of research traced above to be effective regarding remediation of dyslexia, it is observed that all the approaches employed have been found to be effectrive, whether the focus is on the development of deficient abilities as in case of deficit-oriented approach or the other two wherein the focus is on teaching reading directly. As related to the latter two approaches, Chester (1974) has concluded that nearly all types of remedial reading programmes worked, while summarising four decades of work in the remedial reading of dyslexics (1933-1973). He has observed that numerous remedial reading techniques have been designed and tried out and nearly always the experimental group has done better.

#### **1.2.4. Attempts to Identify Dyslexics**

It has already been discussed under the section 1.1.4 that the viable approach to define a dyslexic is an exclusionary one by listing out the criteria that eliminate non-dyslexics. The same approach may be employed even to identify a dyslexic child, by excluding exogenous factors, sensory problems and mental-retradition that are not regarded as causes of dyslexia. But such an appraoch does not positively identify a child as dyslexia. It neglects the children who are having one or more other difficulties such as emotional maladjustment, or lack of motivation in addition to dyslexia. Therefore, there are ,of course, indirect attempts to identify dyslexia positively. The attempts to differentiate dyslexics from other types of readers on learning disabilities test battery, types of errors committed while reading, developmental history and eye movement can be included under this category of research.

##### **1.2.4.1. Learning disabilities test battery :**

The ten most frequently recommended tests and evaluations suggested for a learning-disabilities battery in authoritative publications of the past ten years (cited in Coles,1978) are the Illinois Tests of Psycholinguistic Abilities, the Bender Visual-Motor Gestalt Test, the Frostig Developmental Test of Visual Perception, the Wepman Auditory Discrimination Test, the Lincoln-Oseretsky Motor Development Scale, the Graham-Kendall Memory for Designs Test, the Purdue Perceptual-Motor Survey, the Wechsler Intelligence Scale for Children, a neurological evaluation by neurologist, and an electroencephalogram.

Retarded readers identified as dyslexics through exclusionary approach were compared with normal readers on various tests of this battery. Coles (1978) made a thorough review of such studies and noticed that all the tests of this battery failed to differentiate dyslexics from normal readers and non-dyslexic poor readers.

##### **1.2.4.2. Error analysis :**

Several investigators have attempted to test the hypothesis that dyslexics commit specific sorts of errors in reading, writing and spelling with rotations and reversals of letters (Fisher, F.William, Liberman, et al, 1978;



Collette, Martha, 1979; Taylor, Satz and Friel, 1979). These investigators have found that dyslexics were not differentiated from normal readers in the type of errors committed.

#### 1.2.4.3. Analysis of developmental history :

Several studies were conducted to find out whether dyslexia is related to parental age, deficiency in neuro-developmental skills, nervous habits such as nail biting,tics, enuresis, maturation delay and such other factors. Apart from these, attempts have been made to find out whether parents, siblings and close relatives of dyslexics also have learning disabilities. The general finding is that all the dyslexics do not have common history (Dow and Papp, 1943; Klasen 1972; Jayashekara and Street, 1978).

#### 1.2.4.4. Eye-movement pattern :

Clinical evidence suggests that 'patients afflicted with eye movement disorders' have problems in reading (Pirozzolo and Rayner, 1978; cited in Pavlidis,1981, p.116-117). Erratic eye movement in disabled readers were noticed in the first quarter of this century by Freman (1920) (cited in Pavlidis, 1981, p.117) who was the first to report that certain children with reading disability had irregular and wandering eye movements. Since then several investigators (Gray,1921; Mosse and Daniels, 1959; Zangwill and Blakemore,1972; Pavlidis, 1978; Elterman, et al, 1980) have studied the pattern of eye movements among dyslexics. Pavlidis (1981,p.152) has observed that dyslexics' erratic eye movements are present not only during reading but also in non-reading sequential tasks as in trying to follow sequentially illuminated light sources. From the impressive finding that sequential eye movement disability is unique to dyslexics Pavlidis (1981) has inferred that the 'lights test' may become an objective test for identification of dyslexia (p.154). Such a suggestion needs to be verified empirically.

### 1.3. CONTEXT AND NEED FOR THE STUDY

The review of the workdone on diagnosis and remediation of dyslexia reveals that continuous efforts have been made to understand the nature of dyslexia and also to overcome its effect on the reading achievement of dyslexics. Still there is much scope for research ,as,

- i) the etiological factors responsible for dyslexia have not been confirmed beyond some reasonable indications, (Hinshelwood, 1917;Orton,1928; Eustis,1947; Delacato,1963).
- ii) there is still much controversy about the neuropsychological dysfunction underlying dyslexia (Gunter,1971; Savin,1972; Naidoo, 1972; Vernon, 1977; Ellis and Miles, 1981),
- iii) lexical encoding deficiency cannot be the single most explanation for dyslexia (Baddley, 1971; Ellis, 1978, 1980; Ellis and Miles, 1981).
- iv) the attempts to identify dyslexia positively are not yet completely successful (Coles,1978; Collette, Martha,1979; Pavlidis, 1981),
- v) though almost all the remedial programmnes and procedures appear to be effective (Chester,1974; Valet,1980), they have not been tested in different language settings though the nature of language also determines the extent of influence dyslexia has on reading performance.

It is interesting to note that without adequate procedure for identification much research has been undertaken in diagnosis and without adequate diagnosis efforts at remediation have been judged effective. Though there is room for sususpecting the validity of the finding of those studies, it may not be the case as those studies might have included children selected through exclusionary approach following a set of criteria similar to the one discussed in the section 1.1. In fact the attempt to identify dyslexics positively will succeed only when it is possible to identify the key etiological factors or functional disabilities underlying dyslexia. The identification of dyslexics through error analysis may not become the universally successful procedure,since the type of errors committed by dyslexics vary with the nature of the language concerned. Therefore attempts



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to analyse the type of reading errors to be made in each language independently.

The reason for the apparent effectiveness of almost all the remedial programmes, though the attempts to diagnose dyslexics are not successful may be due to the attempts to treat almost the whole individual on the basis of the symptoms perceived, rather than dyslexia, as in the different approaches the attempt would be to develop the programmes on general principles of learning/teaching rather than specific principles for teaching dyslexics. The situation can be compared to a small episode in the Hindu epic 'Ramayanam', wherein, the character 'Hanuman' carried a whole mountain when he failed to identify a particular medicinal plant which was badly needed. This implies the amount of effort to be put forth to remediate dyslexics and it is not practicable in many social contexts.

The review has also revealed that diagnosis and remediation have been attempted through different approaches with different inclinations and specific objectives, thus contributing to the total picture and treatment of dyslexia. The knowledge about the correlates of neuropathology obtained through etiological diagnosis may not directly help to remove the effects, but still such a diagnosis is essential as the negligence of etiology may completely hamper educational therapy in the long run. Though there is such a realization about the significance of etiological factors, in the context of still limited knowledge about the physiological make up of human beings and the difficulties and obstacles in overcoming the neuropathology, the etiological diagnosis appears to be of less practical value. Therefore behavioural approach to diagnosis is to be considered practically adequate and useful. Each of the two approaches identified under the studies attempting to analyse the behavioural disabilities is by itself inadequate to explain all the behavioural symptoms of dyslexia, although they are complementary. Since there appears to be considerable consensus among the findings of research following the information processing model, and much contradiction among the findings of research following the neuropsychological model. Identification of the specific neuropsychological dysfunctions helps to make the remedial procedures, which appear to be cumbersome at present, simpler and more direct.

The deficit oriented approach to remediation has a lasting advantage as the necessary neuropsychological abilities are developed in the dyslexics. But such an approach is practically possible only in special schools or classes for dyslexics. In countries like India where there are no special schools or other organisational units and dyslexics have to be taught in normal schools, remedial programmes developed on strength - oriented approaches are more practicable. Since through multisensory approach, it appears possible to teach different types of dyslexics through common remedial programme, such an approach is of greater practical value.

Though there have been innumerable efforts to develop different remedial programmes for dyslexics abroad, because of the unique nature of Indian language there is a greater need to develop such programmes in different Indian languages. The ultimate aims of such studies should, however be, to throw light on the general nature of dyslexics irrespective of the language, specific features of dyslexics of Indian languages, and to remediate those dyslexics.

### **1.4. STATEMENT OF THE PROBLEM**

#### **1.4.1. Nature and Scope of the Study**

In the context of the status of research so far done and the requirements of the present educational setting of India, it was proposed in the present study to answer the following major questions :

- 1) Whether dyslexics have deficiency in certain specific neuropsychological processes essential to learn reading, more specifically, to recognize words.
- 2) Is it possible to improve Kannada words' recognition of different types of dyslexics through a common programme based on multi-sensory approach to remediation?

It was also proposed to answer the following additional questions.



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#### 3) What kinds of errors do dyslexics commit while reading Kannada?

The first requirement to answer those questions was to evolve a definition of dyslexics which is essential to identify a group of dyslexics among Kannada readers. On the basis of the existing definitions, descriptions, explanations for dyslexia discussed in the section 1.1. Supra, an operational definition of dyslexics including a set of criteria was evolved. Thus in the study dyslexics were conceived as children who met the following criteria :

- 1) Normal in sensory-visual and auditory-functioning; symbol tracking; eye-hand coordination.
- 2) Without any apparent emotional disturbance.
- 3) At or above 8 years of age.
- 4) Not been absent form school frequently.
- 5) At least 2 years retarded in word recognition.
- 6) Normal in auditory reception & comprehension.
- 7) Having adequate academic achievement motivation.
- 8) Has received extra coaoching or help at home at least since the beginning of Standards II and III in case of children studying in Standards III and IV respepectively.
- 9) Normal in intelligence.

Based on such a set of criteria a group of dyslexics were identified from among Kannada readers studying in Standards III and IV of elementary schools. The scope of the study was limited to the sample specified in Chapter-III.

The first question implied the need to select the most relevant neuropsychological processes essential to learn to recognize words. The study was restricted to the following neuropsychological processes essential to learn word recognition, although there are many other processes :

- 1) Visual discrimination.
- 2) Visual recognition.
- 3) Visual recall.
- 4) Visual sequential memory.
- 5) Auditory sequential memory.
- 6) Auditory discrimination.
- 7) Word analysis.
- 8) Word synthesis.
- 9) Visual-verbal association. (Faas,1976; Vernon, 1979; Valett, 1980).

In order to see whether dyslexics are deficient in any of the above neuropsychological processes it was essential to compare the performance of dyslexics in the above processes with that of normal readers. This implied a comparative study and in the study it was proposed to compare the performance of dyslexics in the above processes with both non-dyslexic poor readers and normal readers. Non-dyslexic poor readers were conceived as children who met all the criteria specified for dyslexics except variation in two of them viz., criteria '5' and '9'. Instead of them they met two other criteria as given below :

- 1) Receiving extra coaching or help at home not before the beginning of the respectrive academic years, i.e., not before the beginning of Standard III in case of children studying in Standard III and Standard IV in case of children studying in Standard IV.

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- 2) Eighteen months to six months reading retardation in case of children studying in Standard III and thirty months to eighteen months in case of children studying in Standard IV.

The additional question that was proposed to answer in the study was also implied the need to compare the types of errors committed by dyslexics while reading Kannada words. Such a comparison was restricted to reading only, although it could have been done for writing also.

The second main question of the study implied the need to develop a common remedial programme for different types of dyslexics based on multisensory approach and to experimentally evaluate its effect on Kannada word recognition was limited to word recognition only and did not aim at improving the related process, namely, writing.

### 1.4.2. Objectives of the Study

Keeping in mind the context, need, nature and scope of the study as discussed above, the following were specified as objectives for the study :

- 1) To identify dyslexics from among Kannada readers studying in Standards III and IV of elementary schools
- 2) To develop the tests required at different phases of the study, but were not available.
- 3) To find out in which of the following neuropsychological processes essential to learn to recognize words, dyslexics are deficient in comparison with non-dyslexic poor readers and normal readers-
  - a) Visual discrimination,
  - b) Visual recognition,
  - c) Visual recall,
  - d) Visual sequential memory, (Memory for visual shapes in sequence)
  - e) Auditory sequential memory, (Memory for auditorily presented digits in sequence)
  - f) Auditory discrimination,
  - g) Word analysis,
  - h) Word synthesis, and
  - i) Visual-verbal association.
- 4) To analyse the types of errors committed by the different groups of children while reading Kannada.
- 5) To plan out common remedial programme for different types of dyslexics.
- 6) To study the effectiveness of the above programme in improving the speed and accuracy of Kannada words recognition in case of dyslexics.

### 1.4.3. Definition of Key Terms

This caption is devoted to the definitions of the key terms used at various stages of the study as can be reflected in the criteria which define dyslexics, non-dyslexic poor readers and normal readers, objectives and hypotheses (Refer, Chapter-III) of the study.

(1) Dyslexics		Definitions are given in
(2) Non-dyslexic poor readers		this Chapter under the
(3) Normal readers		section 1.4.1.

- (4) Symbol Tracking/Visual Scanning :

It is the ability to follow objects and symbols in space. Chalfant and Scheffelin (1969) identified three kinds of scanning patterns : Zig-zag movements that occur when a child looks around the room, the visual



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pursuit or tracking of a moving object, and the systematic scanning required for reading. In the context of reading it is the ability to fixate on printed material, to hold it in focus and to coordinate ocular movements. During reading visual tracking ability is expressed in tasks like-determining picture story sequences in books and comics, finding letters in symbol sequence, following words and phrases, scanning and locating directed words, sentences and paragraphs.

In the present study symbol tracking was considered as the ability to copy a sentence having letters which are visually dissimilar. such a sentence was chosen in order to avoid the effect of any deficiency in visual discrimination ability.

### (5) Eye-hand Coordination :

Eye-hand coordination is the ability to coordinate vision with movement of the body or its parts. Eye-hand coordination is also called perceptual- motor match and visual-motor integration. Children first learn to match the movements of their eyes with the movements of their hands; this stage is followed by use of the eyes to direct the movements of the hands. The ability of eye-hand coordination is expressed in some of the reading and writing skills given below (Faas, 1976) :

- (a) Stopping and starting at a given point,
- (b) Colouring within the lines,
- (c) Drawing straight and curved lines horizontally, vertically and diagonally,
- (d) Tracing pictures, numerals or letters,
- (e) Writing numerals and letters which are consistent in size,
- (f) Writing on the line, and
- (g) Performing the eye-tracking movements involved in reading.

In the present study eye-hand coordination was conceived as the ability to copy a sentence which was used to test the ability of visual tracking.

### (6) Without Apparent Emotional Disturbance :

Those children who were not having observable behavioural symptoms like, depression, withdrawal, aggression, etc., were considered as without apparent emotional disturbance.

### (7) Retarded in word recognition

Children whose performance was below the expected level on Kannada Oral Reading Test for Primary School Children (Jaya Bai, 1958), which assesses the speed and accuracy of word recognition were considered as retarded in word recognition.

### (8) Auditory Reception :

Kirk and Kirk (1971) have considered auditory reception as the ability to gain meaning from auditory symbols. Thus, it is the ability to attend to some of the tasks like, answering 'Yes' or 'No' to a question containing two concepts, identifying objects from verbal descriptions, following verbal directions, attaching meaning to words, identifying and understanding environmental and speech sounds.

In the present study auditory reception was conceived as the ability to perform on the auditory reception test in Kannada, developed by the investigator, which includes simple questions eliciting the understanding of different concepts in the form of 'Yes' or 'No' responses.

### (9) Aural Comprehension/Listening Comprehension :

Aural comprehension is the ability to comprehend the text read by others. It is considered as a measure of reading potential, that is, reading comprehension potential, on the assumption that if an individual could

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decode and encode into speech, any reading material written at that difficulty level, he could also understand it (Della, 1968).

In the present study, aural comprehension was considered as the ability to perform on the aural comprehension test in Kannada developed by the investigator, accepting the above definition, which assesses the aural comprehension ability through question-answer technique.

#### (10) Academic Achievement Motivation :

It is a measure on achievement motivation inventory developed by the investigator. The definition of the term is given under the description of the test, in Chapter-III.

#### (11) Intelligence :

It is a measure on Raven's 'The Coloured Progressive Matrices'.

#### (12) Visual Discrimination :

Visual discrimination is the ability to recognize the similarities and differences between other items they compare. These items may be three-dimensional objects, pictures, geometric figures, letters, words or numerals.

The three types of visual discrimination tasks described by Chalfant and Scheffelin (1969) are (i) Prominent feature discrimination, (ii) Figure-ground discrimination and (iii) Visual closure.

Prominent feature discrimination is the ability to differentiate among colours, shapes, patterns, sizes, positions, brightness, texture and the horizontal and vertical directions of stripes or texture. Discrimination of different shapes, sizes and directions are involved in the process of reading and writing.

Figure-ground discrimination is the ability to focus upon the relevant aspects of the stimulus field while 'tuning out' the irrelevant background. In the context of reading this ability manifests itself in situations like, keeping place while reading, locating a word in the dictionary, an index or a sentence, and scanning for specific information in the text (Faas, 1976).

Visual closure is the perceptual ability to identify a common object from an incomplete visual presentation. Thus, visual closure is the ability to perform some of the activities like, assessing puzzles and objects; completing incomplete figures and dot pictures; identifying incomplete pictures, letters, numbers or words; completing words by closing space between letters, supplying the word that is missing when a blank appears in a sentence in place of an adequate speed of perception (Faas, 1976).

In the present study visual discrimination was considered as an ability to compare different shapes, letters, printed words, and to match them, as assessed on visual discrimination test developed by Devaki (1978).

#### (13) Visual Recognition :

It is the ability to recognize previously viewed visual stimuli. While reading this ability is expressed in tasks like identifying a particular letter or word which is included in a group of letters, numbers or symbols that is visible.

In the present study it was conceived as the ability to perform on the visual recognition test developed by the investigator, which includes various geometric and other meaningless shapes.

#### (14) Visual Recall/Revisualization :

Visual recall is the ability to retrieve a visual image of the stimuli- figures, pictures, words, letters, numbers or symbols. Johnson and Myklebust (1967) have defined visual recall, as a visual process involving visual memory and production of letters and words. Graphic production of the revisualized visual image serves as proof that revisualization has occurred.



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In the present study visual recall capacity was assessed through visual recall test developed by the investigator, which includes meaningless visual shapes. In this test visual recall ability was assessed through paired-association technique wherein the respondent was expected to immediately recall the counterpart of the pair, which was exposed earlier, when one of the shapes of the pair was presented.

### (15) Visual Sequential Memory :

Kirk (1972) has defined visual sequential memory as the ability to reproduce sequences of items from memory. Thus, visual sequential memory can be considered as the ability to perform some of the activities like reproducing a series of acts in the same order after seeing them demonstrated; reorganising a series of colours, blocks, pictures, or beads on a string after their order has been scrambled; organising a series of letters, numbers, words, phrases, or sentences into the same order as they were last seen; reordering a series of pictures, words; remembering the order of the letters in a word when trying to spell it (Fass. 1976).

In the present study, Kirk's (1972) definition of visual sequential memory was accepted. Currently the term VSM is referred to as memory for visual shapes in sequence. However, in the book both the terms are used with synonymous connotations. In this context it should be noted that in the task of visual sequential memory the ability to name is clearly an advantage if not a necessity. Thus, it may be wiser to consider that the sub test of ITPA-visual sequential memory-not only assesses memory for visual shapes in sequence but also involves some amount of verbal labelling.

### (16) Auditory Discrimination :

Auditory discrimination is the ability to distinguish one sound from another. It is the ability to undertake some of the tasks like determining whether non-language sounds are the same or different; distinguishing non-language sounds from language sounds. determining if language sounds are the same or different; determining if the initial, medial or final sounds of two words are the same or different; determining if blended sounds are the same or different; distinguishing between sounds which differ in pitch, volume and duration (Faas.1976).

### (17) Auditory Sequential Memory :

Auditory sequential memory is the ability to reproduce the sequence of auditory impression like, sequences of oral directions, events in a story; reproducing the order of letters in a word, words in a sentence; reproducing the tables, letters of an alphabet in a particular order; recalling the order of digits presented auditorily.

In the present study auditory sequential memory was conceived as the ability to recall the order of digits presented auditorily. (Memory for auditorily presented digits in sequence).

### (18) Word Analysis :

It is the ability to analyse sentence into its constituent words and words into component sounds. In the present study it was considered as the ability to analyse the words into component sounds (syllables) presented auditorily.

### (19) Word, Synthesis/Sound Blending :

Word synthesis is a form of auditory closure, that is, ability to identify an auditory stimulus when part of it is missing, in which isolated sounds are synthesised and integrated into words. This ability expresses itself while pronouncing new words.

In the context of the present study word synthesis was the ability to synthesize and integrate the isolated syllables presented aurally into new words.

### (20) Visual-Verbal Association :

It is the ability to establish link between visual and verbal stimuli. The visual stimuli may be objects, figures,

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numbers, letters, symbols, signs or meaningless shapes and verbal stimuli are the names-conventional or artificial-given to those visual stimuli.

In the present study visual-verbal association was conceived as the ability to associate letter sounds of Kannada alphabet with artificially contrived shapes.

#### (21) Multisensory Approach :

It is one of the approaches to improve the reading performance of dyslexics through many senses. In the present study, visual, auditory and muscular channels of dyslexics were made use of in improving their reading performance. In the remedial programme developed on the basis of this approach, there was adequate opportunity for the child to experience how a letter or word looks, how it sounds, how the speech organs feel in pronouncing it, and how the hand feels in writing the grapheme or word.

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## REVIEW OF RELATED STUDIES

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### 2.0. INTRODUCTION

The review of literature related to the research in diagnosis and remediation of dyslexia which is discussed in the Chapter-I under the caption 'status of Research in Diagnosis and Remediation of Dyslexia' gives an overall account of research in the field specified. Whereas this chapter is restricted to the review of those studies which attempted to achieve those objectives which were also at the focus of the present study. Such studies can be discussed under the following captions :

- (1) Studies related to the neuropsychological dysfunctions of dyslexics.
- (2) Studies related to the analysis of reading errors committed by dyslexics.
- (3) Studies related to the remediation of dyslexics involving direct teaching of reading.

### 2.1. STUDIES RELATED TO THE NEUROPSYCHOLOGICAL DYSFUNCTIONS OF DYSPLEXICS

Considerably a large number of studies attempted to verify whether dyslexia can be attributed to deficiency in any of the following neuropsychological processes :

- (a) Visual discrimination,
- (b) Visual recall and recognition,
- (c) Visual sequential memory,
- (d) Auditory discrimination,
- (e) Auditory sequential memory,
- (f) Word analysis and synthesis, and
- (g) Visual-verbal association.

The typical method followed in these studies were comparison of the performance of dyslexics with normal readers in tasks which called for the above processes.

The review of those studies indicates that there has been much contradiction in the findings of the studies related to each variable, especially, in studies related to the visual processing skills, namely, visual discrimination, recall, recognition and sequential memory functions. The reasons for such an inconsistency in findings may be due to the following reasons :

- (1) The assumption that 'these visual processes can be assessed in isolation', may itself be faulty.
- (2) The tests employed to measure each of the visual processing skills have not been able to measure them in isolation, and thus, questioning their validity itself.
- (3) Some investigators who studied visual processing skills and visual-verbal association of dyslexics have restricted their analysis and interpretation to the accuracy of responses given to particular tasks and the time taken for the same and some others have further analysed the underlying factors that determine the accuracy of responses. Thus, the extent of probe to identify the actual differentiating factors might have been the reason for the apparent contradiction of findings.
- (4) The samples employed in studies related to visual processing skills and auditory processing skills have been treated as a homogeneous group of dyslexics. It may be possible that such samples might include visual dyslexics, auditory dyslexics and /or visual-auditory dyslexics which would rise doubts about the findings of the studies themselves.



- (5) The lack of consensus in the findings of studies related to visual-verbal association may be due to the diversity in the procedures to assess the same ability.

Apart from the above reasons there could be other reasons related to measurement and methodological errors/problems unique to each study.

The detailed, review of studies given below make these issues clear.

### **2.1.1 Visual Discrimination**

Certain errors committed by dyslexics are considered to be due to deficiency in visual discrimination and there are several studies which have attempted to verify this hypothesis.

Studies reported by Stanley (1976) and O'Neill and Stanley (1976) were worked on the processing of digits and of straight lines by dslexics. In the first study the children had to identify digits formed of dots, tapping a key with the numeral on it. The dyslexics correctly identified more figures than the controls and were not slower at the task than the control group. However, analysis of error patterns showed that more than half of the dyslexics confused digits with curved features.

In one recent study (quoted in Goodacre, 1977) Stanley has suggested that dyslexics may have been responding in terms of a visual trace which led to the confusions on the curved figures. The above explanation needs further verification. But, anyhow, its generalisation value is questionable as it can be drawn from the study that there were some dyslexics who did not confuse digits with curved features. This finding suggests the heterogeneity among dyslexics as far as visual discrimination is concerned. Whereas the findings of the two experiments reported by O'Neill and Stanley (1976), that is, dyslexics needed longer stimulus exposure than their controls to detect differences in pairs of straight lines suggests that all dyslexics are having difficulty in visual discrimination.

Morley (1949) has found that learning and substitution of non- reversible symbols by dyslexics required considerably less time than learning of the reversible symbols. These results are interpreted as supporting the hypothesis that reversals in reading are due to problem in space perception. But, the problem of learning reversible symbols by dyslexics may not be due to space perception but may be due to the increased complexity of learning their names because of greater similarity in their visual features. Moreover, the study suffers from a limitation that it has not been possible to assess visual perception in isolation as the measures appear to get contaminated with association ability.

Similar limitation can be observed in the interpretation by Waites, Lucius (1980). In study with 198 dyslexic children he has found that 40 per cent were still unable, even at the age of 10, to write the alphabet without errors. On the basis of such a finding he has just inferred that dyslexic children have a primary difficulty in manipulating language symbols in space, without taking into consideration of the other factors like visual sequential memory, auditory sequential memory, association ability which might influence the learning of alphabet correctly.

The study reported by Coleman (1953) gives inconsistent results. The study is an investigation of the gross development of visual perception in a group of reading disabled cases. He has found that 20 out of 40 subjects were retarded in perceptual development to the extent of 10 or more months. This finding could not be extended to the rest of the group as in the same study, he has found that a minority of subjects showed considerable advance in perceptual development beyond their age. Hence, the author has suggested that it would be futile to ascribe functional significance to perceptual factors in these reading disabled cases and one must look for other factors.

Similar suggestion has been given by Gross, Karen and Rothenberg, Stephen (1979) as they pointed out that "visual perceptual disfunction may account for some form Stimuli of dyslexia, visual perceptual deficits must be ruled out as an explanation for poor performance by dyslexic children on tasks using visual before



'higher order' deficits in cognitive processing can be reasonably postulated".

Thus, the above studies suggest two ideas. Although it appears at the surface that dyslexics possess lower visual discrimination/visual perception ability as compared to normals (Stanley, 1976; O'Neill and Stanley, 1976; and Lucis, 1980), there have been dyslexics in the same studies (Coleman, 1953 and Stanley, 1976) who did not show such a trend. This suggests that dyslexics can be of different types. On the basis of such an observation some investigators (Coleman, 1953; Gross and others, 1979) have supported that some form of dyslexia can be accounted for visual perceptual dysfunction although they did not agree on it as a generalised factor for dyslexia.

Some investigators like, Fuller and Shaw (1963), Ellis and Miles (1978), Liberman, Shankweiler, Orlando, Harris and Berti (1971) disagree that visual perception difficulty is responsible for dyslexia and have tried to give alternate explanations.

On the basis of their study Fuller and Shaw (1963) have suggested that reading difficulties among non-brain damaged children, were not associated with difficulties in visual orientation as measured by perceptual tasks but were likely to be related to difficulties in symbol association.

Ellis and Miles (1978) have reported a series of experiments based on the view that there is a distinctive limitation in dyslexics which reduces their ability to process information. They have tried to determine the sources of this limitation by comparing dyslexics and normals on visual matching tasks where naming was or was not involved. They reported that dyslexics were slower when naming was involved. In matching shapes, even when this involved orientation differences, dyslexics were not inferior to normal readers.

Liberman, Shankweiler, Orlando, Harris and Berti (1971) have found that sequence reversals (e.g., was/saw) and Orientation errors (e.g., b/d) accounted for only a small proportion (25 per cent) of the errors in word lists containing words that could be easily confused (e.g., bad/dad; not/ton). Moreover, the sequencing and orientation errors recorded for the same group of children were not highly correlated with each other, contrary to what would be predicted by directional-confusion theories like Orton's. The authors concluded from their results that the positional and directional errors commonly observed in poor readers are linguistic intrusion (mislabelling) errors rather than perceptual inaccuracies.

Though there is apparent contradiction in the findings of the various studies quoted above, there is considerable agreement among the investigators in the inference they have drawn from those findings. Most of the investigators concluded that visual discrimination difficulty is not responsible for dyslexia in all the cases, and rather dyslexia may be attributed to factors like association or naming ability.

### **2.1.2 Visual Recall and Recognition**

Several investigators have claimed that not only spelling but also reading achievement is related to memory for visual shapes. Lunzer, Dolan and Wilkinson (1976) showed that the short-term visual memory of five-and one-half to six-year-old children for shapes and pictures correlated significantly with their performance on word-recognition tests one year later. It has also been found that visual memory for shapes was particularly deficient in poor readers (Trieschman, 1968; Naidoo, 1972). Recent studies by Audley (1976) have indicated that poor readers have no impairment in visual memory for single letter shapes. Reviewing such studies Vernon (1977) has inferred that for some disabled readers, the deficiency must be in the imagery of word structures and not in that of single letters.

The results of several studies by (Doehring, 1968; Lyle, 1968; Lyle and Goyen, 1968a, 1968b, 1975; Katz and Wicklund, 1971, 1972) have demonstrated difference between poor and average readers on measures of visual memory. But Vellutino (1977) has commented that these studies have yielded inconsistent results, finding differences between poor and average readers on some measure of visual memory and no differences on other measures assessing the same function. Further, he has pointed out that these studies frequently



compared groups on tasks employing printed letters and words and they did not typically control for the possible effects of deficiencies in verbal coding.

Vellutino (1977), has given examples of a study where previous experience with letters and words were controlled. In a study of comparably selected readers groups from grades two to six (Vellutino, Pruzek, Steger and Meshoulam, 1973; Vellutino; Steger, Kaman and Desetto, 1975) poor readers performed as well as others on tasks requiring immediate visual recall of varying length words printed in Hebrew, an unfamiliar orthography. However, none of the children in these studies performed as well as average children familiar with Hebrew's orthographic and linguistic characteristics.

Additional support for the contention that poor and average readers have comparable visual abilities is derived from several other studies wherein it was found that there were no differences between reader groups on measures of long-term memory employing novel visual stimuli (Vellutino, Steger, Desetto and Phillips, 1975; Vellutino, Harding, Phillips, 1975; Vellutino, Harding, Phillips and Steger, 1975; Vellutino, Steger, Harding and Phillips, 1975).

Joachim, Krapp-Raabe, Birgitta and Dieter (1976) have investigated the hypothesis that dyslexia is partially attributable to a deficit in memory capacity. Twenty three 11-year-old dyslexic children of average non-verbal intelligence, and a control group with just below average spelling ability (matched for age, sex, intelligence and socio-economic status) were administered several subtests of a standardized memory test. Results did not support the notion of a generalised memory deficit in dyslexic children. But both groups scored below average on a subtest requiring the learning of visual paired associates.

From the above studies it can be inferred that dyslexics are not inferior to average readers as far as visual recall-whether long-term or short-term-is concerned after exercising necessary control over effects of verbal coding. But in these studies, visual recognition as a differentiating factor between average readers and dyslexics, has not been studied specifically. However, in some studies (Joachim, Krapp-Raabe, Birgitta and Dieter, 1976) reference has been made of using various subtests to measure visual memory of which visual recognition may be one of the factors measured. From the point of view of diagnosing specific factors related to dyslexia, visual recognition needs to be studied separately.

### **2.1.3 Visual sequential Memory**

There are less number of studies which attempted to test the hypothesis that dyslexics are having deficiency in visual sequential memory.

Stanley and Hall (1973) have examined differences in the performance of dyslexic and normal children in the recall of letter arrays that were presented for varying durations. Thirty three dyslexic and 33 normal 8-12 year old served as subjects. Results showed significant differences in the level of performance rather than differences in the kind of visual information processing. Therefore, the authors have concluded that the results support the notion of a developmental lag in visual memory among dyslexics.

The studies carried out by Thomson and Wilsher (1978) (quoted in Goodacre, 1979); Gordon, Ida and Charles (1975) have also indicated that dyslexics were inferior to age matched control in visual sequential memory. Whereas, Hicks, Carolyn (1980) on the basis of his experiments has tried to give an alternative interpretation for the performance of dyslexics on visual sequential memory test (ITPA).

Four experiments with ninetyeight 8-9 year old normal and dyslexic readers examined the recall strategies employed in visual sequential memory test (ITPA). Results were as follows : The First experiment suggested that competent readers tended to use a verbal labelling strategy in the recall of visual stimuli, rather than visual memory per.se. Experiment-II suggested that the retention of the visual stimuli could be improved by the adoption of a verbal labelling strategy. Experiment-III suggested that when verbal labelling was suppressed, the performance of competent readers on the visual sequential memory task deteriorated to a level similar



to that of poor readers. Experiment-IV suggested that if retarded readers, were instructed to use a verbal labelling strategy, their retention of visual symbols improved significantly. Overall, results have suggested that good and poor readers might differ not with respect to visual memory but by their differential ability to employ a verbal labelling strategy in the retention of visual stimuli. However, a review of studies related to visual sequential memory test of ITPA, by Coles (1979) has revealed that the subtest visual sequential memory of ITPA did not differentiate poor readers from normal readers.

From the studies reviewed above it is observed that the number of studies related to identifying visual sequential memory as a factor responsible for dyslexia have been inadequate. Although deficiency in visual sequential memory among dyslexics has been observed by some investigators (Stanley and Hall, 1973; Stanley and others, 1975; Thomson and Wilsher, 1978) there has been no such difference as observed by others (Hicks, Carolyn, 1980). This lack of consensus suggests a need to explore this further. Further, some investigators have tried to probe into the variables underlying the performance on visual sequential memory on ITPA. But, even such studies are very few in number.

#### **2.1.4 Auditory Discrimination**

There are less number of studies which attempted to test the hypothesis that dyslexics problems of letter confusion is associated with deficiency in auditory discrimination.

Steinhagen, Klaus and Gutezeit, Gunter (1971) tested 25 Dyslexic and 25 normal third and fourth graders with the Seashore Measures of Musical Talents. Dyslexic children did poorer than the normals with respect to tonal memory but did not differ on pitch loudness, rhythm, tone, length or timbre, But, in the report itself there is some contradiction, as it is reported that in dyslexic children correlations were found between score on timbre and kind of dyslexic error. And further the authors have suggested that acoustic discrimination training be included in the treatment of dyslexia.

Jason and Jeffrey (1980) also investigated the possibility that phonological confusions may underlie some difficulties in processing written language, using four speech perception tasks. Twelve dyslexic and four normal 8-12 year old identified and discriminated synthetic speech syllables that varied either in voice-onset time or direction of format transitions. Both normal and dyslexic subjects perceived these sounds categorically. The authors have suggested that linguistic disturbances at other stages of the grapheme-to-meaning transformation underlie misreading.

Even the study by Johnson (1982) supports the above finding. He has studied the ability of none, twelve and fourteen year old dyslexics to recall auditorily presented rhyming and non-rhyming letter strings. These children showed a normal phonemic confusability effect, although their overall recall was much poorer than that of their chronological age controls. The author has argued that though earlier studies concluded that poor readers show a weak phonemic confusability effect, this findings does not appear to be generalizable to older poor readers.

The study by Lingren (1969) (quoted in Coles, 1978) shows that eight of the 20 disabled readers, but none of the 20 normal readers, were below the norms on the Wepman Auditory Discrimination Test. This indicates that in individual cases of reading disability there may be difficulty in auditory discrimination. But the study by Flynn and Byrne (1970) (quoted in Coles, 1978) suggested some degree of environmental influence on one's auditory discrimination ability. Findings that cast doubt about the inability of dyslexics to perceive the sound properly have been reported by Larsen, Rogers and Sowell (1976) and Goetz (1971) (quoted in Coles, 1978) who failed to notice any difference between dyslexics and normals in auditory discrimination test scores and reading achievement respectively.

It may be observed in the studies reviewed above that although earlier studies might have shown phonemic confusability effect be present among poor readers (Johnson, 1982) most of the studies conducted



of late have failed to demonstrate any such deficiency in them (Jason and Jeffrey, 1980; Johnson, 1982). But, it is interesting to note in some studies (Lingren, 1969) that only some dyslexics do have problem in auditory discrimination. This suggests that there could be different types of dyslexics classified on this variable. Some investigators like (Flynn and Byrne, 1970) have suspected environmental influence on one's auditory discrimination. The above observations need further exploration in different cultural contexts.

#### **2.1.5 Auditory Sequential Memory**

Verification of the hypothesis that dyslexics are having primary impairment in auditory sequential memory has been the focus of some of the studies.

Gordon, Ida and Charles (1975), have found that dyslexics were inferior to controls on auditory sequential memory. Belmont and Birch (1966) have also observed the same. The work by Tallal (1976) has shown that dyslexics suffered from a primary impairment in auditory temporal processing.

A study by Golden and Steiner (1969) has revealed that among second- grade children good readers were significantly superior to poor readers on auditory sequential memory subtests of the ITPA. Many other studies, such as those by Bryden (1972), Ealck (1973), Spring (1976) and Badian (1977) have also pointed out the existence of significant auditory memory deficiencies in dyslexics.

Thus, it can be seen that the findings of all the studies quoted above agree with each other as far as the deficiency of dyslexics in auditory sequential memory is concerned.

#### **2.1.6 Word Synthesis and Analysis**

Hammil and Larsen (1974) have found that in the primary grades sound- blending skills had positive correlation with word recognition and it was even more significant in grades seven through twelves. sound blending (word synthesis) in first-grade was also found to predict silent reading ability in the third-grade.

Golden and Steiner (1969) have found that among second-grade children good readers were significantly superior to poor readers on sound blending.

Zigmond (1966) has conducted a study of sensory processing in non- dyslexic and dyslexic children. He has found that the auditory functions that most often differentiated the groups were auditory blending and oral spelling (which requires phonemic analysis).

In a study savin (1972) (quoted in Vernon, 1977) has found that children failed to learn to read in the first grade were particularly poor at analysing word sounds into phonemes.

Newcomer and Hammill (quoted in Coles, 1978) after reviewing several studies have noticed that when mental ability was controlled the Sound Blending Subtest of ITPA did not differentiate normal readers from the disabled.

Since there are very limited number of studies, there is a need for further research before arriving at any conclusion that dyslexics are inferior to normal readers in word analysis and synthesis. Moreover, it appears that the amount of ability needed to perform such tasks varies with the nature of the script, i.e., highly phonetic or less phonetic. so the hypothesis has to be verified in different languages and conclusion has to be postponed till then.

#### **2.1.7 Visual-verbal Association**

several studies, directly or indirectly, support the hypothesis that the dyslexics main problem lies in establishing association between visual and verbal stimuli which is very much essential to learn the names of letters. But there is a lot of scope for confusion as the methodology of various experiments conducted in such studies have differed considerably suggesting that they might be measuring entirely different abilities. A review of some studies conducted in this line may help in giving an idea about the different testing procedures adopted to assess the same ability, that is, visual-verbal association/integration and the inferences drawn



from such studies. Apart from this the depth to which the results are analysed also have lead to apparent contradictions.

Birch and Belmont (1964, 1965) have attempted to test the visual- auditory matching of tapped-out patterns. In this test rhythmic patterns are tapped out which the subjects have to match with visual dot configurations; thus auditory-temporal patterns have to be matched with visual-spatial ones.

Bakker and Schroots (1981) have observed that Birch and Belmont as well as other investigators (Muehl and Kremenak, 1966; Sterrit and Rudnick, 1966; Van de Voort, Senf and Benton, 1972) have shown that intersensory integration measured this way not only differentiates normal and specific reading disturbed children, but also correlates with reading ability in general. Bakker and Schroots (1981) have attributed this finding to the fact that reading requires the visual-spatial and auditory-temporal patterns. Printed letters and words are ordered in space from left to right while speech sounds are ordered in time. By considering such experiments they raised a question whether reading disabled children are having difficulty in auditory-visual or in temporal-spatial or both forms in bothforms of integration? Marion Blank and her associates (Blank and Bridger, 1966; Blank, Weider and Bridger, 1968) set up a task requiring temporal-spatial but not auditory-visual integration. They observed that disabled readers in the first and fourth grades who had difficulty in intersensory-matching and temporal- ordering tasks also had problems in using a verbal-coding system to help remember presented stimuli. This was in contrast to other first and fourth grade children, who were apparently more effective in utilising verbal mnemonics to aid recall. The authors suggested that reading disability may result from deficiencies in verbal concepts rather than dysfunction in "cross-modal transfer" (matching auditory and visual equivalents).

But such a suggestion raises one more question what made the dyslexics efficient in verbal concepts? Learning of verbal concepts (concrete concepts) also requires visual-verbal association ability. In the studies by Birch and Belmont (1964,1965), Blank and her associates (1966, 1968), it appears that difficulty in verbal concepts may be responsible for difficulty in intersensory-matching and temporal ordering tasks. Such an implication could be derived when sensory integration was assessed through perceptual matching. But, if sensory integration were to have measured through associative learning and deficiency being observed, it might have been possible to explain deficiency in verbal concepts in terms of deficiency in association ability/sensory integration.

In two separate investigations (Zigmond, 1966; Vande Voort, Senf and Benton,1972) it was found that average readers were better on matching identical stimuli within as well as between modalities. This suggests that in these studies also integration was assessed through perceptual matching. Vellutino (1977) has commented that "the tasks employed in all these studies relied heavily upon attention and memory factors. Therefore, such results are not necessarily indicative of dysfunction in intersensory integration". Further, he has continued that "it is difficult to be certain that differences between reader groups are not attributable to encoding and/or rehearsal problems or other factors influencing a subject's short-term memory".

In contrast to the above finding (Zigmond, 1966 and Vande, et al, 1972) there are results of several studies that consistently found no differences between poor and average readers on measures of their ability to associate (pair) non-verbal stimuli from different sensory modalities (Steger, Vellutino and Meshoulam, 1972; Vellutino, Steger, and Pruzek,1973; Vellutino (1977) has observed that cross-modal transfer tasks employed in these investigations involved associative learning (long-term memory) rather than perceptual matching and thus controlled for the compounding effects of attention and short-term memory,implying thereby that the results of the studies quoted above that dyslexics do not have difficulty in associative learning have greater validity.

The above finding that dyslexics do not have problem in associative learning and the suggestion given by Blank and her associates (1966 and 1968) and Vellutino (1977), that is dyslexics' problem lie in using



verbal concepts appears quite contradictory to each other. For learning verbal concepts (concrete concepts) associative ability is essential and use of verbal concepts facilitates associative learning. This suggests different possibilities that dyslexics problem may lie in use of verbal concepts rather than their learning (i.e., problem only in retrieval) or in learning of verbal concepts (i.e., problem in visual verbal association) or in both of them. If this argument is valid then dyslexics may or may not have problem in visual-verbal association. Hence, one cannot come to a conclusion from the findings of the studies quoted above (Blank, et al, 1966 and 1968; Zigmond, 1966; Vande, et al, 1972) that dyslexics are not deficient in visual-verbal associations. This only suggests that studies need to explore the possibilities of deficiencies in dyslexics in the use of verbal concepts (i.e., difficulty in naming), in visual-verbal association or in both. there have been studies in this direction which support that dyslexics have problem in both 'naming' as well as in 'visual-verbal association'. Such studies are reviewed below.

The possibility that reading disability may be associated with deficiencies in naming and labelling has been the focus of several investigators (Denckla, 1972a, 1972b). In two of the most recent studies, Denckla and Rudel (1976a, 1976b) compared poor and normal readers (ages seven to twelve) on "rapid automatic naming" tasks and found that the groups differed on both accuracy and latency measures. Poor readers generally made more errors and took longer than average readers to generate the names of common objects, colours, letters, words and numerals presented visually. the authors suggested that dyslexics may be characterised by basic word- retrieval problems. This finding is supported by several other investigators (Eaklin and Douglas, 1971; Spring and Capps, 1974; Perfetti and Hogaboam, 1975; Spring, 1976).

The concept of lexical encoding is now introduced to explain all the difficulties faced by dyslexic children. A deficiency at the level of lexical encoding implies some degree of failure in the activation of entries in the lexicon. Miles and Ellis (1981) have argued that such failure is central to dyslexia. Then the tasks which involve verbalisation are to be the ones which dyslexic subjects (unless they work out appropriate compensatory strategies) would find most difficult. Experimental and clinical evidences are there to prove such an argument. But the question is, whether there are evidences to show that there is a proper entry in the lexicon? This implies that dyslexics may have problem in registration also or registration alone. The experiment reported by Done and Miles (1978), supports such a possibility. In a paired-associative learning task, Done and Miles (1978) observed, dyslexic children needed more trials than age-matched controls to learn 'names' (three-letter nonsense words) for meaningless shapes. Ellis and Miles (1981) have considered that this experiment has involved a replication of the stimulation where a child initially learns the names for letters and figures. They have considered that since lexical encoding is required if these meaningless shapes are to be given names, dyslexic children need more 'trials' before they make the necessary associations. But, such a reasoning does not seem to be appropriate. Because the problem related to taking more trials is not of 'giving out names' or in other words retrieval, but of learning the 'names' themselves which involves association of visual and verbal stimuli while learning. Thus, the findings of Done and Miles (1978) quoted above only implies that the dyslexics have problem in establishing association between visual and verbal stimuli.

Vellutino, Stegar, Harding and Phillips (1975) have also observed that at ten years, learning the trigrams-three letter words-attached as names to pictures of animal was slower in poor readers.

To conclude, it is found that there have been studies which point out that dyslexics are deficient in intersensory integration/visual-verbal association. But the studies have differed in their methodology employed to measure such a deficiency as well as in the interpretations made for out-comes of the studies. Some studies (Birch and Belmont, 1964, 1965; Zigmond, 1966; Vande Voort, et al, 1972), have employed perceptual matching procedure whereas others (Stegar, et al, 1972; Vellutino, et al, 1973, 1975) have employed associative learning. Vellutino (1977) has criticised the former approach and supported the latter



on the grounds of validity. There has been a greater consensus in the findings of the first group of studies that dyslexics are deficient in intersensory integration. This is attributed by those authors to the deficiency in then use of verbal concepts. As regards the second group of studies, there has not been an agreement on the findings. Some have shown the deficiency in visual-verbal association in dyslexics (Vellutino, Stegar, Harding and Phillips, 1975) and others have not demonstrated such a deficiency. Such a contradiction is justifiable if one analysis other problem of dyslexics as being difficult in registration, retrieval or both. There have been studies which point out that dyslexics are deficient in registration or associative learning. There are studies which point out that they are deficient in 'naming' (Denckla, 1972a and 1972b; Spring and Capps, 1974; Spring, 1976) which the investigators have attributed to the problem of retrieval. But, it may be argued that such a deficiency in 'naming' may also be due to the basic problem in associative learning. Hence, it needs to be further explored to find out if the dyslexics are deficient in associative learning.

## **2.2. STUDIES RELATED TO THE ANALYSIS OF READING ERRORS COMMITTED BY DYSLEXICS**

Several attempts have been made to find out the types of errors committed by dyslexics and to find out whether they are specific to dyslexia.

The patterns of errors in reading isolated words was studied in two groups of children with respect to reversals of letter sequence and letter orientation (William, Liberman and Shankweiler, 1978). The 'Institute' group consisted of 13 children of 8-10 years old who had been diagnosed as 'dyslexic' according to medical and psychoeducational criteria. The 'School' group included all the children in a second-grade elementary school, class who fell into the lowest third on a standard test of reading achievement. Although the Institute subjects were somewhat poorer in word recognition than the school subjects selected purely on psychometric grounds, the groups did not differ significantly in the incidence of reversal errors. The performance of the two groups differed in relation to directional bias in letter reversals and in the presence or absence of a significant correlation between letter reversing and word reversing tendencies. The bulk of reading errors made by both groups reflected their common difficulties with linguistic characteristics of words rather than with their properties of visual patterns.

The results of the study by Collette (1979) indicated that dyslexics did not differ from the poor readers in the type of errors committed. Twentysix eighth and ninth grade dyslexics with poor perceptual/attentional ability were matched with 19, reading retarded subjects with age equivalent perceptual/attentional test scores for age, IQ, and degree of reading retardation. They were compared both with each other and with 96 adequate readers, for reversals, rotations, insertions, substitutions, omissions, poor handwriting and visual ability on the Gary Oral Reading Tests, the spelling subtest of the Wide Range Achievement Test, a writing task, and the Star- tracing mirror test. On 46 of 49 variables, the dyslexics and retarded readers performed comparably. Together they made more classic errors and had lower achievement scores than the adequate readers on 44 of 49 variables. Classic errors clustered with poor reading but not diagnosed dyslexia.

Even the results of the study by Taylor, Satz and Friel (1979) did not support the hypotheses that dyslexics are more prone to make reversals in letter sequence or to confuse letters which differ primarily in orientation.

Shankweiler, Liberman and Isabella (1978) question on the basis of the findings of their own study whether dyslexics can be differentiated from other poor readers on the basis of a high rate of reversal errors. In their study although some dyslexics showed orientational and directional biases that were absent in most poor readers, neither group typically displayed a higher proportion of reversals than of other errors. The authors have commented on the results that the difficulties manifested in the common error pattern were chiefly outside the domain of visual perception. They were language- related and were not specific to the visual perception of language. The difficulties of poor readers appeared to reflect the inaccessibility of the phonetic segmentation of spoken language, inability to adopt an efficient coding strategy for operations involving short term memory, and failure to grasp the complex nature of English spelling. The authors have



suggested that since the difficulties of learning to read interact with the structural peculiarities of particular language and the way those structure are manifested in the writing system, important work remains to be done in cross- language comparisons of children's reading errors.

Although, studies reveal that dyslexics do not commit unique errors, attempts have been made to classify dyslexics on the basis of error analysis.

Boder (1973) has presented an approach wherein direct diagnosis through analysis of reading and spelling performance, is the focus for identifying subtypes of dyslexia for remedial and prognostic implications. The sub- groups are-

- (a) Dysphonetic,
- (b) Dyseidetic and
- (c) Mixed.

Children were identified by the use of the investigator's and Cohorts' diagnostic Screening Procedure for developmental dyslexia.

Similar attempts have been made by Bravo Voldivieso, Luis (1980). They studied 110 dyslexic children (aged 11 years and older) through psychometric and experimental tests. Results were correlated at three reading levels; letters and words, sentence ordering and reading comprehension. Weak positive correlations were found, and only a few of them were significant. Weak correlations were also found between specific errors and sentence arrangement. No correlation was found between specific errors and reading comprehension. From the results the authors inferred that there are different levels of various types of psychopathology within the dyslexic phenomenon whose only common denominator is reading process. But, however, they warn, this sole criterion should not be viewed as a sufficient basis to justify grouping dyslexics into the same clinical entity.

Aaron (1978) conducted a study to test the hypothesis that the dyslexic child, being normal in intelligence, is most likely to be deficient either in analytic - sequential processing of letter or a holistic perception of the salient features of the entire word while being normal in the other. Twentyeight reading-disabled children, classified on the basis of the nature of errors made in a dictation task, were divided into two groups: analytic-sequential-deficient and holistic deficient. Further testing showed that the first group was poor in processing a sequence of digits but normal on hostilitic memory tasks. The opposite pattern of performance was shown by the second group. A control group of 14 normal readers did not show such an imbalance.

From the above review of studies related to analysis of errors committed by dyslexics, it appears that dyslexics do not differ from other types of readers in the kinds of reading errors committed (Collette, 1979; Taylor, and Satz, 1979). Although some investigators have tried to classify dyslexics into different groups on the basis of errors (Boder, 1973; Aaron, 1978; Bravo, Voldivieso, Lucius, (1980) this does not imply that errors can form a criterion for identifying dyslexics. Such errors need to be further analysed and probed into in terms of the underlying neuropsychological functions which should ultimately form the basis for identification/or classification of dyslexics. As suggested by Shankweiler, et al (1978), such errors are related to the nature of language learnt. Hence, one needs to study the kinds of errors committed by dyslexics in other languages also. This would help in cross-language comparisons and to derive the common as well as specific reading behavioural symptoms related to dyslexia.

### **2.3. STUDIES RELATED TO THE REMEDIATION OF DYSLEXICS INVOLVING DIRECT TEACHING OF READING**

Though dysexics are having deficiencies in neuropsychological processes, the development of which is very much essential for the dyslexics to learn reading, there are attempts to develop reading skills among



dyslexics without attempting to develop the neuropsychological processes in which the dyslexics are deficient. In those studies various methods have been employed.

Richardson, Ellis and Collier, Lucy (1971) have studied the acquisition of decoding skills (sound-symbol correspondence, visual analysis and blending) with 12 children who scored below average on a battery of psychomotor tests. After screening, all subjects were tested on the Wepman Auditory Discrimination Test, Birch Perceptual Motor Sequencing Test, Birch Audio-Visual Tapping Patterns Test, and the Bender Gestalt. A group of 12 'no treatment' control subjects were found to be superior to experimental subjects in reading simple sight words on a laboratory pretest. Each experimental subject required an average of four and a half hour of tutorial time, distributed across 143 sessions, in learning the program context. Post-test results showed experimental subjects to be superior to controls on all measures of decoding and demonstrated that experimental subjects could apply decoding skills to unfamiliar content. The major conclusion drawn by the authors was that the so-called dyslexic children could learn basic reading skills. The authors attributed the success to the highly-structured, programmed approach.

A kinesthetic technique and the Fernald tracing method as described by Belts (1946) have been employed at the Temple University Reading Clinic with the aim of developing initial reading skills for certain types of children. In mild cases of dyslexia the kinesthetic approach was used; for extreme types, the Fernald technique. Steps in the kinaesthetic method included identification of unknown words in silent reading, motivation, pronouncing the unknown word, writing the word without copy, reviewing the meaning of the word, finding the word in another sentence, and writing the word again without copy. The tracing technique involves visual, auditory, tactile, and kinesthetic models of learning. The authors have suggested that the type of remedial procedure employed was based upon the nature of the problem, or case typing.

Emperatriz and Frederick (1965) have found that the combination or multiple-approach method of teaching reading yielded better results in teaching Pilipino in grades one and two than the cartilla or direct-phonics-drill method.

Hornsby and Miles (1980) have also observed the effectiveness of a dyslexia-centered approach in improving both reading and spelling of dyslexics.

Stauffer (1951) has given the illustration of a basic remedial programme to an eight year old boys with above-normal intelligence who had not yet learned to read. The programme included utilisation of concepts and oral language experience as a starting point, teaching words by the Kinesthetic-tactile technique, systematic re-use of words learned and basal readers.

Gunter and Elizabeth (1975); Gutezeit and Meier (1977) have tested the effectiveness of tachistoscope in reducing reading and spelling errors. Results of the studies indicated that tachistoscopic technique is effective in increasing the spelling accuracy and speed and accuracy of reading.

Kline and Kline (1975) have compared 92 dyslexic children who received private tutoring in the Orton-Gillingham tutoring programme with 29 dyslexic children who did not receive the tutoring. Using operational definitions of levels of improvement, it was found that the tutored group improved more than the untutored. An additional 95 dyslexics, 48 tutored and 47 untutored by the Orton-Gillingham programme, gave similar findings. Length of tutoring was a factor in the improvement level. It is concluded by the authors that some dyslexic children can improve markedly in a short time, but most require two years of tutoring and some require three years.

Staurt (1963) has reported extensive research finding supporting simultaneous association (Orton-Gillingham) method. A major study involving this method was conducted by Wilson, Harris and Harris (1976). This programme involved 380 elementary school students from twenty one schools divided into four experimental groups. The students were diagnosed as having significant auditory perceptual deficiencies



according to the Lindamood Auditory Conceptualization Test. A number of different remedial programmes were used including the Gillingham, Auditory Discrimination in Depth (ADD), Sullivan programmed Reading, and some combinations of these. Post-test scores on the Woodcock Reading Mastery Tests for Word Identification and Word Attack showed that the Gillingham method produced gains in reading. However, even more effective results were achieved when this method was combined with the ADD programme.

In a study various treatment approaches to dyslexia, Johnson (1969) has advocated the use of intrasensory compensatory techniques for visual and auditory dyslexia; visual dyslexics profited from colour cues, increased letter size, verbalization, and tactile guides; auditory dyslexics gained most from rhyming-blending-sequencing tasks with eyes closed, learning sight words, biaural amplifiers, and the combined use of Kinesthetic approaches.

Tarnopol and Tarnopol (1976) have reported that the Orton-Gillingham method is among the most frequently used in remedial programme throughout the world. But, this method has been found not adequate by itself. Its effectiveness can be further increased by supplementing with other methods/ techniques (Johnson, 1969; Wilson, Harris and Harris, 1976).

From the above review it can be observed that direct methods of teaching reading to dyslexics without attempting to develop underlying disabilities are of different types. Mainly they are Kinesthetic methods, tachistoscopic technique and Orton-Gillingham method of which Orton-Gillingham method has been the most frequently used one. In some studies the approaches have not been clearly specified, whatever might be the method, it is interesting to note that all the methods, were effective in improving the reading. The effectiveness as well as the wide use of these methods by practitioners may be attributed to the sound principles of teaching dyslexics on which they are based. such principles are listed below :

As far as possible remedial programme should

- a) employ highly structured and programmed approach (Richardson, Ellis and Collier, 1971),
- b) follow multisensory and multiple approaches (Emperatriz and Frederick, 1965),
- c) be based upon the nature of the problem, or case typing (Belts, 1946),
- (d) use concepts and oral language experience if the dyslexic learners (Stouffer, 1951),
- (e) incorporate intrasensory compensatory techniques, especially for visual and auditory dyslexics.

These principles, although not exhaustive provide guidelines for planning remedial instructional programme for dyslexics. In other words, any remedial programme for dyslexics based in such principles can be hypothesised to be effective, although basing it on wider range of tested principles would make it more effective.

## **2.5. REVIEW OF STUDIES AS A BASIS FOR FORMULATING HYPOTHESIS**

As has been discussed in Chapter-I, it is more appropriate to tackle the problem of dyslexia by analysing the neuropsychological dysfunctions of dyslexics rather than analysing the etiological factors involved in dyslexia on the grounds that the former approach can provide practical hints for remediation directly. This approach also has the potentialities to explain why dyslexics fail to learn to read to the same extent as normal readers. The studies reviewed above show that most of neuropsychological dysfunctions related to reading process have been explored which can be classified as visual processing skills-visual discrimination, visual recall, recognition and sequential memory; auditory processing skills-auditory discrimination, auditory sequential memory, word analysis and synthesis; and integrating skill-visual-verbal association.

As regards visual discrimination and visual sequential memory there has been no consensus in findings that they are differentiating factors between dyslexics and normals. The authors have mainly attributed the deficiency of dyslexics in these variables to deficiency in naming ability. Hence, as regards these variables only



null hypotheses could be formulated. Similar observation of no consensus in findings has been observed with respect to auditory discrimination as a differentiating factor. Hence even with this variable a null hypothesis was formulated in the present study. The failure in arriving at consensus in findings related to the above variables suggests that there could be dyslexics of different types. Such an attempt at classifying dyslexics depending on the nature of the neuropsychological dysfunctions present in them has been attempted in the study. As regards auditory sequential memory, although there has been a consensus that dyslexics are deficient in that ability, the number of studies has not been adequate. Hence, a null hypothesis has been formulated with respect to this variable.

As far as visual recall is concerned there is much consensus among the investigators that dyslexics are not inferior to average readers in this ability. Therefore, a null hypothesis has been formulated with respect to this variable. Another observation that can be made from above review is visual recognition has not been studied as a variable separately contributing to dyslexia. In the present study apart from visual recall, visual recognition has been studied separately as to what extent it can be a differentiating factor between dyslexics and normals. On the basis of lack of adequate evidences a null hypothesis was formulated even with regard to this variable.

When integrative functions related to reading process were studied among dyslexics there appears to be a ray of hope of identifying the most differentiating factor among them. But, as regards visual-verbal association, as a differentiating factor, there has been contradiction in the findings which is attributed to the methodology adopted to study the above variable. There has been a consensus that dyslexics are deficient in visual-verbal association in all the studies that have employed associative learning approach to measure the variable. Some investigators have argued about the greater validity of such an approach as compared to perceptual matching approach. But, such studies are inadequate. In spite of that, in the present study, wherein associative learning approach has been employed, a positive hypothesis has been formulated that dyslexics are more deficient in visual-verbal association as compared to normals. This is because there are indirect evidences to support it. The studies which attempted to find out whether dyslexics are having difficulty in 'naming ability' have supported that dyslexics are deficient in it. But, this deficiency in 'naming ability' assume that learning has already taken place and the problem is just of retrieval. This suggests that more basic to this problem in 'naming' can be the problem in learning itself, i.e., in making visual-verbal association ability might have expressed itself as a problem in naming ability. Hence, all the studies which suggest the deficiency in naming among dyslexics indirectly support the hypothesis formulated in the study. Another justification for making a positive hypothesis with regard to this variable can be sought in clinical studies where it has been observed that one of the major types of difficulties faced by dyslexics during reading and writing is 'correlating difficulties' (Ingram, 1967).

Learning to read a word/reading a word involves not only visual-verbal association but also word analysis and synthesis abilities. As regards the latter two variables although the studies are inadequate in number, all those studies point out that dyslexics are deficient in both the abilities. There are other supporting factors for the above finding. It has been observed clinically that dyslexics have 'speech-sound difficulties' while reading and writing (Ingram, 1967). On these grounds of justification, it has been hypothesised in the study that dyslexics are deficient in word synthesis and word analysis abilities.

Studies probing into types of errors committed by dyslexics point out consistently that it is not possible to differentiate dyslexics on the basis of errors they commit. But, such studies have been mainly with respect to English language and it may not be possible to generalise across other languages as the nature of language is also an important factor related to the reading errors committed. Taking the trend of findings and lack of support for errors committed by dyslexics in Kannada language as differentiating factor a null hypothesis has been made in the present study with respect to the errors committed by dyslexics. In the present study an

*Review of Related Studies*

attempt has also been made to explain the different types of errors committed by dyslexics in terms of their neuropsychological dysfunctions as has been observed in the study.

As regards remediation of dyslexics, the present study employed the method of teaching reading directly for reasons mentioned in Chapter-I. The studies that are reviewed related to remediation of dyslexia through direct methods of teaching reading have validated not only certain approaches of teaching reading directly to remediate dyslexics but also indirectly, the principles that underlie their effectiveness. Some of these principles have provided partly a basis for the remedial programme employed in the present study with a view to make it an effective one. Because of such underlying principles and other inputs which have justification for making the programme effective (Refer Chapter-Vii) a positive hypothesis has been formulated as regards the effectiveness of the remedial programme.



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## METHODOLOGY

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### 3.0. INTRODUCTION

In the previous chapter, a critical review of research related to the objectives of the study has been given. Based on such a review, a justification has also been made for the hypotheses formulated in the study.

This chapter is devoted to the methodology employed in order to achieve the objectives and to verify the hypotheses of the study. Such a methodology has been classified according to the objectives of the study given in Chapter-I. It includes details regarding the hypotheses, the sample, variables studied, procedure employed for collection of data, and analysis of the data. For some of the objectives related to identification of dyslexics and remediation of dyslexia, the methodology included here gives only an overview as separate chapters have been set apart for them which include greater details. This chapter also includes the details regarding the tools employed in the study which are classified as those that were developed by the investigator and those that were developed by other authors.

### 3.1. HYPOTHESES

In the present study it was proposed to verify the following hypotheses :

- 1) There is no difference between dyslexics, non-dyslexic poor readers and normal readers in :
  - a) Visual discrimination,
  - b) Visual recognition,
  - c) Visual recall,
  - d) Visual sequential memory (Memory for visual shapes in sequence)
  - e) Auditory discrimination, and
  - f) Auditory sequential memory (Memory for auditorily presented digits in sequence)
- 2) Dyslexics are poorer than
  - a) Non-dyslexic poor readers and
  - b) Normal readers with respect to
    - i) Word analysis,
    - ii) Word synthesis, and
    - iii) Visual verbal association.
- (3) There is no difference between non-dyslexic poor readers and normal readers in :
  - a) Word analysis,
  - b) Word synthesis, and
  - (c) Visual-verbal association.
- 4) There is no qualitative difference in the types of reading errors in Kannada committed by dyslexics as compared to the other two groups.
- 5) Speed and accuracy of word recognition of dyslexics tend to improve through the remedial programme employed in the study.

### 3.2. SAMPLE

In order to achieve the objectives and verify the hypothesis of the study it was essential to identify matched group of dyslexics, non-dyslexic poor readers and normal readers. Considering the criteria employed for the different types of readers (Refer, chapter-I and section 1.4.) it was thought that there is no necessity to have a satisfied random samples of schools or of children. Hence, for this purpose eleven schools-both Government and Private- in and around Mysore City, were selected depending upon the feasibility to administer tests. The table below gives an idea about those schools.

TABLE 3.1 : DISTRIBUTION OF SCHOOLS

Sl. No.	Place	Number of Schools		
		Govt.	Private	Total
1.	Mysore City ...	3	4	7
2.	Chamaraja Nagar ... (a Suburb)	2	1	3
3.	Somavara Pete ... (rural)	1	-	1
	Total ...	6	5	11

All the poor readers studying in the grades III and IV having Kannada as their first language at schools were selected based on teachers' opinion. An equal number of normal readers were also selected as per their teachers' opinion. The total number of children came upto 550.

Out of those 550 children only 14 could be identified as dyslexics after employing all the criteria that describe them (wide, Chapter-I and section 1.4.). Equal number of non-dyslexic poor readers and normal readers matched on the required variables were also selected from among the same group of 550 children for purposes of comparison.

The details about the procedure followed to identify and select matched groups of dyslexics, non-dyslexic poor readers and normal readers are given in chapter-IV.

### 3.3. PROCEDURE FOR COLLECTION AND ANALYSIS OF DATA

This section is devoted to the description/overview of the method of collection of data and techniques of analysis of the data to achieve objectives of the study. Under each objective, in general, the description/overview of method of collection of data includes the description/overview of the variables selected/kinds of data required, tools\* and techniques employed to collect the required data, and the sample on which the data were collected. Such a description/overview does not include all the above aspects, in the same order, under each of the objectives of the study.

#### 3.3.1. Identification of dyslexics

It was attempted to identify dyslexics through exclusionary process. The justification for employing such a process has been given in Chapter -I and sections 1.3.

The exclusionary process presupposes a set of criteria employed to eliminate non-dyslexics. The table below gives the set of criteria that were kept in mind while identifying dyslexics and the various tools and techniques employed for measuring each of those criteria.

\* The descriptions of the various tools employed to collect data for achieving different purposes of the study are given in the section 3.4. of this Chapter.



TABLE 3.2 : CRITERIA AND TOOLS/TECHNIQUES EMPLOYED FOR IDENTIFICATION OF DYSLEXICS

Sl. No.	Criteria	Tools/Techniques	Author
1.	Normal in sensory-visual or auditory functioning, visual tracking, eye-hand coordination	Teacher's opinion, self-reporting, copying a sentence	
2.	Without any serious emotional disturbance	Teacher's opinion	
3.	At or above 8 years of age	School records	---
4.	Not been absent from school frequently	school records and Teacher's report	---
5.	At least two years related in reading	Kannada oral reading test	Jaya Bai (1958)
6.	Normal in auditory reception	Auditory reception test in Kannada	Investigator
7.	Normal comprehension	Aural comprehension	Investigator
8.	Has adequate academic achievement motivation	Academic achievement motivation inventory	Investigator
9.	Has received extra coaching/help at home	Self-report	---
10.	Normal in intelligence	Coloured progressive matrices	Raven

By employing the above criteria, dyslexics were identified from the sample described in section 3.2. of this chapter. The various steps followed to identify dyslexics are described in Chapter-IV.

### 3.3.2. Comparison of the Neuropsychological Processes of dyslexics, Non- dyslexic poor Readers and Normal Readers.

#### Collection of Data :

In order to meet the objective No. 3 of the study, a number of tests were individually administered to all the three groups of children, that is, 14 dyslexics, 14 nondyslexics and 14 normal readers. The table below gives various variables on which the three groups were compared and the various tools employed to measure each of those variables.

#### Analysis of the Data :

The data obtained by administering all the tests mentioned above, were subjected to statistical analysis. One-way Analysis of Variance was employed to verify the hypotheses '1-3'. Wherever 'F' ratio was found to be significant 't' ratios were computed. Chi-squares were also computed to examine whether or not dyslexia is related to those variables using contingency tables.

Whenever it was found that there was dependence of the three groups of readers on the different levels on each variable-below average, average and above average, it was further examined at which level it is most likely that a particular type of reader exists.

### 3.3.3. Comparison of the Errors Committed by all the Three Groups while reading Kannada

#### Collection of the Data :

It was attempted to analyse the errors committed by dyslexics during Kannada words' recognition and to compare those errors with those committed by non-dyslexic poor readers and normal and normal readers.

### Methodology

To get the data about the different kinds of errors committed by all the three groups while recognising the words, Kannada Word Recognition Test developed by the investigator was administered individually to 14 dyslexics identified in the study and to groups of non-dyslexic poor readers and normal readers of the same size. The data related to the performance of different types of readers on this test was in the form of actual response given while recognising each word on the test.

#### Analysis of the Data :

In order to verify the hypothesis '4' of the study the data were analysed only qualitatively, as it was considered inappropriate to subject them to any statistical analysis. The responses were analysed in terms of different types of errors.

**TABLE 3.3 : VARIABLES ON WHICH THE  
THREE GROUPS WERE COMPARED AND TOOLS  
EMPLOYED TO MEASURE EACH OF THOSE VARIABLES**

Sl. No.	Variables	Tools	Authors
1.	Visual discrimination	Visual discrimination test	Devaki (1978)
2.	Visual recognition	Visual recognition test	Cattell adopted by the investigator
3.	Visual recall	Visual recall test	Investigator
4.	Visual sequential memory	Visual sequential memory sub-test of ITPA	Kirk, Mccarthy, et al, 1968
5.	Auditory discrimination	Auditory discrimination test	Kumudavalli (1973)
6.	Auditory sequential memory	Auditory sequential memory sub-test of ITPA	Kirk, Mccarthy, et al, 1968
7.	Word analysis	Word analysis test in Kannada	Investigator
8.	Word synthesis	Word synthesis test in Kannada	Investigator
9.	Visual-verbal association	Visual-verbal association tests I and II	Investigator

### 3.3.4. Development of Common Remedial Programme for Different Types of Dyslexics

#### 3.3.4.1. Preparation of the Remedial Programme :

To meet the objective No. 5 of the study, a common remedial programme was prepared for different types of dyslexics on sound principles for remediation of dyslexics through multisensory approach (vide, Chapter-VIII and section 7.1.1). This programme included a number of lessons written in Kannada to meet two broad objectives.

(a) To teach all the letters, 'kagunitha', and other accessory forms of Kannada alphabet.

(b) To give practice in word analysis and synthesis.

The main features and the outline of the procedure of administration of the programme are described in detail in Chapter-VII and section 7.1.2.



## Methodology

### 3.3.4.2. Evaluation of the remedial Programme :

Collection of the Data :

#### Sample :-

In order to meet the objective No.6 and to verify the hypothesis '5' of the study the remedial programme prepared in the previous step was tried out experimentally. In the course of the experiment the remedial programme was tried out on only six dyslexics because (a) treatment had to be given individually and (b) dyslexics were studying in different schools which were far away from each other. But still the sample was made as representative as possible in terms of different combinations of neuro-psychological strengths and weaknesses of dyslexics (for details of the sample selection vide Chapter-VII and section 7.2.1).

#### Variables and Tools :

Though the main focus of this part of the study was to find out the effectiveness of the remedial programme in improving the speed and accuracy of word recognition in case of dyslexics, incidentally, it was also attempted to see its effectiveness in improving the speed and accuracy of letter recognition, level of Kannada reading comprehension, word analysis and synthesis abilities. Thus, in the experiment, the remedial programme was the independent variable and speed and accuracy of letter recognition, word recognition, level of reading comprehension, word analysis and synthesis abilities were the dependent variables.

The table below gives the different tools employed for measuring each variable.

Table 3.4 : VARIABLES AND TOOLS EMPLOYED TO EVALUATE THE  
REMEDIAL PROGRAMME

Sl. No.	Variables	Tools	Authors
1.	Speed and accuracy of word recognition	Kannada Oral reading Test	Jaya Bai
2.	Accuracy of word recognition	Kannada word Recognition Test	Investigator
3.	Speed and accuracy of letter recognition	Kannada Letter Recognition Test	Investigator
4.	Level of reading Comprehension	Reading Comprehension Test in Kannada	Investigator
5.	Word Analysis	Word Analysis Test in Kannada	Investigator
6.	Word synthesis	Word Synthesis Test in Kannada	Investigator

#### Design of the Experiment :

Because of the inter individual differences among dyslexics and difficulty in getting controls a single case pre-test-post-test design was thought to be appropriate in the context of the present experimental study. Although the same remedial programme was administered to each type of dyslexic (N=1), it was intended to find out its effectiveness with respect to each individual case. The design of the experiment can be represented as follows :

Table 3.5. : DESIGN OF THE EXPERIMENT

Pre-test	Measurement of speed and accuracy of word recognition, letter recognition, level of reading comprehension, word analysis and synthesis abilities.
Treatment	Administration of the remedial programme.
Post-test	Measurement of speed and accuracy of word recognition, letter recognition, level of reading comprehension, word analysis and synthesis abilities.

The details about the experimentation are given in Chapter-VII and Section 7.2.1.



Analysis of the Data :

To find out the effectiveness of the independent variables, that is, the remedial programme on the different dependent variables specified in case of each dyslexic, the data were analysed qualitatively. Statistical analysis could not be done as the experiment was conducted on single cases of different types of dyslexics.

**3.4. DESCRIPTION OF THE TOOLS EMPLOYED**

The various tools employed in the study for collecting data related to the objectives and hypotheses of the study have been enlisted in Tables 3.2 - 3.4 of this Chapter. This section is devoted to give details of the procedure employed for the development of each of the tools developed by the investigator and to give description of the tools developed by other investigators.

**3.4.1. Tools Developed by the Investigator**

**3.4.1.1. Auditory Reception Test in Kannada :**

This graded test in Kannada was developed as a tool to eliminate children of grades III and IV who are very poor in auditory reception. But, this test would serve the general purpose of assessing auditory reception capacity of Primary School children of age groups 6-10.

One hundred simple questions, requiring 'Yes/No' response were written which would elicit the understanding of different concepts which children of various age levels from 6.0 through 9.0 could have easily picked up from day-to-day life. They were so chosen as to suit the children of different age levels almost proportionately. These items included some-both original and modified-items of Auditory Reception Test of ITPA (Kirk, et al, 1968) and also about 60 new items of a similar nature. These items were tried out individually on 350 children selected almost equally from among the first four Primary grade levels. The sample was so selected that it represented almost proportionately different socioeconomic status and age levels, types of school attended, and locality.

While administering the test, the questions included in the test were read by the administrator, one after another. The child had to respond in terms of 'Yes' or 'No' to each question. During try-out the test was administered orally as a group test seeking written responses (✓ or 'X'). But it ought to be administered individually. One point (score) was given for each correct response.

Item analysis was done for each grade separately, that is, indices of discrimination and difficulty were calculated for each of the four grades. All those items which had discriminative index of at least 0.2 were pooled together. Since this had to be graded test, for each item one should expect a greater proportion of respondents to succeed as we move from grade I to grade IV, further the item could be such that it discriminated relatively poorly, between high and low achievers at grades I and IV as compared to those at grades II and III, in view of the proportion of children answering it correctly at each level. Thus, 24 items were selected for the final form satisfying both the criteria mentioned above. To illustrate, one of the items included in the test had following indices of discrimination and difficulty for different grades.

Grades	I	II	III	IV
Discrimination indices	0.3	0.46	0.63	0.29
Difficulty indicates	66.0	75.0	83.5	88.5

The following were the norms developed for each age group separately by computing the mean score for the same sample employed for standardization of the test.

Table 3.6 : MEANS FOR DIFFERENT AGE GROUPS AND GRADES ON AUDITORY RECEPTION TEST (N=350)

Grade	I	II	III	IV
Mean age	6.6	7.6	8.6	9.6
Mean score	15	16	19	21



#### *Methodology*

The final form of the test includes 24 items. It is an individually administered test. One score is given for each correct response, thus, the maximum possible score is 24.

When a stereotyped response - 'Yes ' or 'No' - given for all items, the assessment of auditory reception can be considered as invalid, which suggests (a) readministration of the test or (b) further probe.

#### **3.4.1.2. Academic Achievement Motivation Inventory :**

The test was constructed to find out whether children of Primary Schools studying in grade III and IV have adequate academic achievement motivation.

Academic achievement motivation refers to the extent to which the learner consciously and deliberately persists interest in spite of personal and environmental limitations, and derives satisfaction either in achieving academic expertise for its own sake or as a means to achieve some other goal; and feels dissatisfied or discomforted when such limitations prevent him on reaching his goal.

Twelve statements were written to represent the construct for academic achievement motivation as conceived above. These statements were descriptions of different situations/or expected tasks eliciting how one would behave therein. The following were the various situations included :

- (1) Doing home assignments regularly,
- (2) Attending school regularly,
- (3) Unfavourable circumstances for studies at home,
- (4) Personal limitations for studies, and
- (5) Difficulties encountered while doing self study.

Three alternative responses implying motivation-intrinsic (3) extrinsic (2) and none of the two (1) were provided for each statement of which one was to be selected by the respondent, the numbers indicated in the brackets against each alternative response being the weightage assigned to it. These statements along with the operational definition for academic achievement motivation were given to a small group of knowledgeable professionals in this field for purposes of establishing face validity. All the items were retained along with the same weightage assigned for various possible responses since they were judged to be adequate to measure the construct among the Primary School Children.

The total score on this inventory was computed for each child by cumulating the scores/ratings that he obtained on all the 12 items. The maximum score one could get was 36 and the minimum score was 12.

The performance on this inventory, of children, studying in grades III and IV of Primary Schools who were considered as academically interested and disinterested by their teachers, was compared and it was found that there was significant difference between the means ( $t=11.04$ ,  $df=22$ , significant at 0.01 level). This established empirical/criterion validity.

On this inventory it is possible to make a rough classification of children as having adequate academic achievement motivation or not. For this purpose, the cut off score of 18 may be used which is the mid point of the average score (24) and the lowest (12) one can get on this inventory.

#### **3.4.1.3. Visual Recognition Test :**

The test was developed as a tool to assess the visual recognition of children of age groups 6-10 studying in grades I to IV of Primary Schools.

All the items of 'Retentivity Test' (Cattell, 1953) were used by the investigator in developing the 'Visual Recognition Test'. The original test could not be used as such, as it was developed as a tool to assess the retentivity of visual imagery after one hour and it was standardized on children of age groups 10-14.



### Methodology

The original test was administered individually to a group of selected 120 children studying in different grades from I through IV of four local schools almost equally representing age groups from 6 through 10 years. The sample selection was so made as to include equal proportions of good and poor readers as judged by teachers in each of these age groups. All the 10 visual features of the test which included both geometric and meaningless visual patterns printed on a card were exposed to the child for observation for one minute. Immediately after this, another card having the same visual patterns randomly mixed up with 10 more visual patterns acting as distracters was shown to the child asking him to point out the previously observed visual patterns. Responses were recorded.

As in the original test, the score on the test was computed by subtracting number of wrong responses from right responses. Thus, the score one could get on this test varied from -10 to + 10. But scores less than '0' were considered as '0'. The following were the norms developed in the form of mean scores for different age groups of the same sample on which standardization of the test was done.

Table 3.7 : MEANS FOR DIFFERENT AGE GROUPS AND GRADES ON VISUAL RECOGNITION TEST (N=120)

Grade	I	II	III	IV
Mean age in years	6.6	7.6	8.6	9.6
Mean scores	2	2	3	3

The above table reveals that there is not much difference between the above age groups in visual recognition. In the original test the expected mean retentivity score for all the age groups from 10-14 is '-5' only.

#### 3.4.1.4. Visual Recall Test :

The purpose of this test is to assess the visual recall of children of age groups 6-10 studying in grades I to IV of Primary Schools.

Initially, a number of pairs of meaningless visual shapes/figures were exposed to a group of primary school children to find out whether they could be copied easily by them. From among them, 16 pairs were selected and arranged in 5 sets (3 pairs each in first four sets and 4 pairs in the 5th set), and each set being written on a separate card. The selection of pairs of visual features for each set and the sequencing of the sets were so made as to gradually increase the complexity of the sets. This could be done by

- (1) gradually reducing the interpair similarity between the pairs of different sets, till they become completely different from each other, thus, the similarity between the symbols of pairs of set II and less than that of set I and more than that of set III, and
- (2) gradually increasing the interpair similarity of different sets; thus, the interpair similarity of set II was more than that of set I and less than that of set III.

These can be illustrated with the following examples :

Set I    A   B                      Set II    P    Q  
          C   D                                      R    S

The similarity between A and B and, C and D was more than that between P and Q; and, R and S. The similarity between AB and CD was less than that between PQ and RS.

The test was tried out on a stratified random proportionate sample of 175 children studying in grades I through IV, stratified on the basis of grade level, type of school, sex and also on whether they were good, average, or poor readers as per their teacher's opinion. While administering the test, paired-association technique was employed wherein the respondent was expected to immediately recall the counterpart of the pair when one of the symbols of the pair was presented. Each set of symbol written on a card was exposed



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to the child for about a period of 45 seconds and covered. The first symbol of each pair in a particular set written on a separate card was shown and the child was expected to copy the shape shown and write its counterpart. There was no time limit for recall. Similar procedure was employed for other sets also. For the first four sets the order of presentation of pairs of visual features for recall was 2, 1, 3 and for the last set it was 2, 1,3 and 4, the number indicating the serial number of the pair in the set. This was done to randomise the order of presentation at the time of recall such that the influence of factors like sequential memory could be minimised.

Scoring involved giving one score for each correct response. When the response was slightly deviated from the expected original feature 50 per cent of the credit, that is, half score was given.

Discrimination indices in the form of 't'-ratios between top 27 per cent and bottom 27 per cent of respondents were computed for each pair in each set. It was found that all the items (pairs) had high discriminative indices (greater than 0.48 except the I item (pair) of the set I, that is 0.19). Difficulty indices, in terms of percentage of children passing each item were computed. The average difficulty level increased gradually through the different sets as implied by the respective average difficulty indices of each set given below :

Sets	Difficulty indices
I	81.00
II	52.66
III	40.66
IV	22.00
V	20.25

Hence all the 5 sets of pairs of visual symbols were retained in the same order. Thus, the maximum score that can be obtained on the final form of the test is 16.

The test as a whole could differentiate significantly poor and good readers classified according to their teacher's opinion.

Norms in the form of mean scores have been developed for the same standardization sample (N=175) for each age group and grade separately and the same are given below :

Table 3.8 : MEANS FOR DIFFERENT AGE GROUPS AND GRADES ON VISUAL RECALL TEST (N=175)

Grade	I	II	III	IV
Mean age in years	6.6	7.6	8.6	9.6
Mean scores	5	8	8	10

#### 3.4.1.5. Word Synthesis Test in Kannada :

The test was constructed in Kannada to measure the ability of children of different grades of Primary School I through IV to synthesise word\* when the isolated sounds constituting the word are presented auditorily.

\*

A number of word (30) which had number of sounds varying from 2 to 7 were selected from Primary School text books. Those words were tried out on a small sample of children (N=32) including equal number of good and poor readers, selected on the basis of their teachers' opinion, and studying in different grades I through IV of two Primary Schools. During the administration of the test, the examiner presented successive sounds of each word at the rate of one per second with a distinct pause between the sounds. The child

\* 'Kannada' like most of the other Indian languages is highly phonetic in nature, that means, each sound is denoted by a distinct symbol. Therefore, the number of sounds in a word corresponds to the number of symbols/letters that the word is having.

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was asked to verbalise the whole word. No repetition of the word was made. The responses were noted down. One score was given for every correctly formed word. Among the 30 words which were thus tried out those items/words which could be correctly formed by 20-80 per cent of children were selected. Thus, in the final form of the test there are 24 words. These words include the number of sounds ranging from 2-6. The number of sounds gradually increased through these 24 words. The maximum score one can get on this test is 24.

#### 3.4.1.6. Word Analysis Test in Kannada :

The test was constructed in Kannada to measure the ability of children of different grades of Primary School I through IV to analyse the words presented auditorily into their constituent sounds.

Initially a number of words (42) each including number of sounds varying from 2-11 were selected from Primary School textbooks. Those words were tried out on the same sample which was used for developing word synthesis test. During the administration, the examiner presented the words auditorily one at a time and the child was asked to analyse it into component sounds. When the child failed to respond correctly or remained silent, the examiner proceeded to the next word.

One score was given for every correctly analysed word.

Among the 42 words, those which could be answered by 20-80 per cent of children were selected for the final form. Thus, in the final form of the test there are 33 words of 3-10 sounds, and thus the maximum score one can get on this test is 33.

#### 3.4.1.7. Visual-Verbal Association Test-I :

The test was constructed to assess the ability to associate visual and verbal stimuli, among Primary School children of age group 6-10.

To start with, a number of strokes generally used while writing various Indian languages were thought off. From these, various simple shapes/ figures (N = 43) were contrived. As far as possible, these did not resemble the letter strokes of any particular language. Each of these were given letter sound of Kannada alphabet randomly. Two, three and four lettered words in Kannada which could be easily assumed to have been familiar to Primary School children were made out of these letters. These words were arranged in different sets as follows :

Set	Number of words	Number of letters
I	1	2 = 2
II	2	2 + 2 = 4
III	2	3 + 3 = 6
IV	2	3 + 4 = 7
V	3	2 + 4 + 5 = 11
VI	3	3 + 4 + 6 = 13

The difficulty level increased through the sets I to VI only with respect to the number of words and number of letters in each word. The letters included in each set were such that many two lettered words other than the ones included in any set could be formulated from the same letters. These were used for testing purposes, each set was written legibly on separate cards.

The test was tried out on a stratified random proportionate sample of 102 children studying in grades I through VI, stratified on the basis of grade level, age (6-10 years), types of school, sex and also on whether they were good, average or poor readers as per teachers' opinion. All the six sets were presented to each child one by one in the same order, that is, I through VI. The general procedure followed for presenting the above sets of words was as follows :



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The examiner presented the card having a particular set of words. He pointed to each letter of the first word and spoke out the sound to be associated with it. The child was made to repeat the sound by observing all the letters within the word. If the child failed to form the word the examiner helped him. Similar procedure was followed to teach the letters and corresponding sounds of the next word. After all the words within that particular set were taught this way the entire procedure was repeated 3-4 times to teach, until the child was able to recall the sounds of the letters when they were pointed out randomly.

The child was instructed that he had to learn the names of all the letters separately and the examiner would ask him to recall the names of the letters in any order and not in the same sequence. The child was given the following intervals of time, depending on the set, to observe the letters keenly and memorise their names. Time interval given for each set was as follows :

Sets		Intervals (in seconds)
I	...	30
II	...	45
III	...	60
IV	...	60
V	...	90
VI	...	105

The association ability was tested by asking the child to recall the names of both the letters in two lettered words presented, which were formed out of same letters included in a particular set of words but in different combinations. Assessment of the association ability was done at the end of each set. By this way, learning of all the letters were tested and only two letters (one in IV and the other in V set) had to be tested twice and scored because of the difficulty in formulating a two lettered word for testing. There were two, three lettered words in V set and one in VI set, while testing.

One score was given for each correctly identified letter and the total score was computed for each child.

Discriminative indices were computed for each letter. All the items/letters which had discriminative indices more than 0.2 and difficulty indices ranging from 10-90 were considered. Since the discriminative indices of the items of the set I were '0' that set was retained for giving practice to children. The set VI which had some letters of low discriminating value, i.e., less than 0.2 and with average difficulty index less than 20 was rejected.

Thus, the final form of the test includes all the first five sets of which the set I containing one word of letters is kept for practice. The remaining sets including items of high discriminative indices (more than 0.42 except one item with discriminative index of 0.29) are kept for testing purpose. The average difficulty level of the tests gradually increased from set II through V as implied by the respective average indices of each set as given below :

Sets		Difficulty indices
II	....	69.21
III	....	62.21
IV	....	48.31
V	....	29.81

The maximum score one could get on this test is 30.

The performance on this test was rescored for the final form of the test for the standardization sample and analysed. The results were as follows :

Goodness of fit test indicated that visual-verbal association ability was normally distributed ( $X^2 = 3.48$ , not significant at 0.01 or 0.05 level significance) for the standardization sample.

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A high association was found between visual-verbal association ability measured on this test and reading performance as per teacher's opinion ( $X^2 = 32.15$ ).

Mean for whole sample (N=102) was 15.78 and SD = 6.04.

#### 3.4.1.8. Visual-Verbal Association Test - II :

The purpose of this test is same as that of visual-verbal association Test- I

To start with, a number of strokes generally used while writing various Indian languages were thought of. From these, various simple shapes/figures (N=27) were contrived. As far as possible, these did not resemble the letter strokes of any particular language. Each of these was given letter sounds of Kannada alphabet randomly. For some of the similar visual features formulated, similar sounds were given as found in Kannada and other Indian languages. Each letter was written on a separate card and these cards were arranged into different sets as follows :

Sets	Number of letters
I	2
II	3
III	4
IV	5
V	6
VI	7

The difficulty increased from sets I through VI with respect to (1) number of letters included, 2) similarity in sounds and in visual features.

This preliminary form was tried out on a small group of 35 children belonging to two age groups, namely, 8-9 and 9-10. The sample was drawn in such a way as to represent equal proportions of children of grades III and IV studying in three Primary Schools, both the sexes, and with different levels of reading performance (average, above average or below average) as per their teachers' opinion.

After the initial rapport the child was given the following instructions orally :

"You will be shown certain shapes/letters and their names will be uttered to you one by one. You have to observe the shape and listen to the corresponding sound simultaneously and repeat it. You should try to remember and learn the shape and its sound".

Then, the cards bearing the different letters were presented one by one following the prescribed order of letters within set and between sets. The general procedure followed for teaching each letter and its sound is as follows :

#### I Practice Session :-

First, the card with a visual feature was shown to the child and its name is uttered simultaneously. Then, he was asked to repeat the sound by observing the visual feature. After making sure that he has learnt the sound the card was placed in front of him for 15 secs. to associate the sound with the visual feature. In the same way the other letters in a particular test were introduced.

#### I Testing Session :-

After completing the set the association ability was tested by presenting the same cards in the set one by one, but in a different order and asking the child to recall their names. The responses were noted down.

#### II Practice Session :-

Another practice session was given to learn the letters in the same set in the same way as the I practice session, but the order of presentation of the cards being changed.



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II Testing Session :-

The child was tested for the association ability once again in a way similar to that of I testing session. The responses were noted below.

Thus, practice-testing sessions were given alternately, everytime changing the order of presentation of letters to be learnt or tested. The number of such sessions varied for different sets. The details regarding the same are given below :

Table 3.9. : THE ORDER OF PRESENTATION OF DIFFERENT LETTERS WITHIN EACH SET DURING VARIOUS PRACTICE AND TESTING SESSIONS

Sets	Practice	Session	Testing	Session				
I	1	II	I	II				
	1a	1b	1b	1a				
	1b	1a	1a	1b				
II	2a	2c	2c	2a				
	2b	2b	2b	2b				
	2c	2a	2a	2c				
III	3a	3d	3b	2d	2b	2a		
	3b	3c	3d	2c	2d	2b		
	3c	3b	3a	2b	2a	2c		
	3d	3a	3c	2a	2c	2d		
IV	4a	4e	4b	4e	4b	4a		
	4b	4d	4d	4d	4d	4b		
	4c	4c	4a	4c	4a	4c		
	4d	4b	4c	4b	4c	4d		
	4e	4a	4e	4a	4e	4e		
V	5a	5f	5b	5a	5f	5b	5a	5a
	5b	5e	5d	5b	5e	5d	5c	5b
	5c	5d	5f	5c	5d	5f	5e	5c
	5d	5c	5a	5d	5c	5a	5b	5d
	5e	5b	5c	5e	5b	5c	5d	5e
	5f	5a	5e	5f	5a	5e	5f	5f
VI	6a	6g	6b	6a	6g	6b	6a	6a
	6b	6f	6d	6c	6f	6d	6c	6b
	6c	6e	6f	6e	6e	6f	6e	6c
	6d	6d	6a	6g	6d	6a	6g	6d
	6e	6c	6c	6b	6c	6c	6b	6e
	6f	6b	6e	6d	6b	6e	6d	6f
	6g	6a	6g	6f	6a	6g	6f	6g

**NOTE :-**

- (i) Letters 'a' to 'g' represent the different letters included within the set.
- (ii) Numerical 1 to 6 represent the serial number of the set.

The raw score for each set was first computed by using the formula -

$R - \frac{W}{(N-1)}$  Where, R = Number of correct responses. W = Number of wrong responses. N = Total number of letters in the set.

The sum of the raw scores of all the 6 sets was the final raw score on the entire test indicating child's visual-verbal association ability.

Although the standardization sample was small, item analysis was attempted. The sets which had items with discriminative indices more than 0.2 and difficulty indices ranging from 20-80, that is, sets I through V, were retained : whereas the set VI which had items with discriminative indices less than 0.2 and average difficulty index less than 20 was rejected. Although this test needs standardization on a larger sample, it was considered adequate for the purposes of the study.

The average difficulty levels of the selected sets increased gradually from I through V as implied by the respective average difficulty indices of each set that are given below :

Sets	I	II	III	IV	V
Difficulty indices	78.25	67.36	56.77	50.22	28.10

The final form of the test includes sets I through V, with 20 shapes/ letters altogether.

**Differentiating and Similar features of Visual-Verbal Association Test - I and Test - II :-**

**Similar Features :**

- i) Both have common purposes of assessing visual-verbal association ability of primary school children of age group 6-10 in case of Test-I and 8-10 in case of Test - II
- ii) Both are individually administered.
- iii) The method of testing the ability is similar which requires the learner to recall the sound of each letter. In this way the disadvantage for those who are poor in visual memory for shapes was overcome.

**Differentiating Features :**

The approach employed by the learner while learning individual letters is different. In Test - I, the letters to be learnt within a set are presented one at a time. Although learning each letter within a word involves associating the sound with the corresponding visual feature, each letter is learnt in the context of a word. Such an approach makes the test suitable to children who are poor in auditory memory for meaningless sounds of single letters also.

In Test - II, the letters to be learnt within a set were presented and learnt one at a time. The learning of each letter does not take place in the context of a word.

The apparently visible disadvantage for those who are poor in auditory memory for meaningless sounds of single letters was overcome by exposing one letter at a time with its corresponding sound for learning.

**3.4.1.9. Reading Comprehension Test in Kannada :**

This test was developed to measure Reading Comprehension in Kannada among Children studying in grades I through IV.

Comprehension in general and reading comprehension in particular can be considered as knowing the "lexical meaning" and "structural meaning" of the text. It can also be construed in terms of different component



skills of comprehension. Barrett has listed the following comprehension skills as constituting comprehension :

- 1) Literal Comprehension - to identify ideas and information that are explicitly stated in the selection.
- 2) Reorganization - to analyse, synthesise, and /br organize ideas of information explicitly stated in the selection.
- 3) Inferential Comprehension - to use the ideas and information explicitly stated in the selection for making conjectures and hypotheses on the basis of one's intuition, and personal experiences.
- 4) Evaluation - to make an evaluative judgment by comparing ideas presented in the selection with external or internal criteria.
- 5) Application - involves all the previously cited cognitive dimensions of reading, for it deals with the psychological and aesthetic impact of the section on the reader.

This test restricts its scope of assessment of reading comprehension to the following component skills/areas of comprehension - literal, reorganizati0on and inferential.

A number of passages in Kannada from popular children's literature suited to children studying in grades I through IV were selected. Each passage had all the possible questions pertaining to the literal, reorganization and inferential skills of comprehension. The passages were arranged in an order of difficulty in terms of easy access to reorgnize the words, knowing the meaning of words in the context, sentence structure, level of comprehension. It was assumed that

- a) as the degree of implicitness increase, and
- b) if there is scope for more number of inferential comprehension questions the level of comprehension increases.

The passages were tried out initially on a small sample of children studying in all the grades from I through IV of Primary Schools. Eight passages were selected on the basis of pre tryout such that two passages were suited for each of the four grades in terms of easy access to recognize the words, knowing their meaning in the context, sentence structure and the number of questions related to each of the three comprehension skills included in the text.

Final tryout of these passages was done on a representative sample of 120 children selected from three Government and two Private Schools studying in grades I through IV based on the assumption that children attending these schools vary with respect to the educational standard of their parents, the help they get by their parents to improve their reading performances as well as the type of methodology of teaching to which they are exposed to at schools. These children also satisfied another condition related to their performance on Kannada oral reading test (Jaya Bai, 1958). Based on the performance on this test, children were classified into different grades on speed and accuracy of word recognition. A child was classified as above average, average or below average if his reading grade was higher than, same as or lower than the grade in which he was studying respectively. Fifty percent of the sample from each type of school constituted average readers and the remaining 50 percent was equally drawn from among above average and below average readers excluding zero graders (readers less than 5 words/minute on Kannada oral reading test). The gradewise distribution of these 120 children is given below :

Grades	I	II	III	IV
Number of Children	25	25	30	40

Reading comprehension test was administered individually to these children.

#### Administration Procedure :-

In the beginning of the test, two passages were given for training purpose, wherein, the examiner helped



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the child in giving the correct answer. This was thought essential because -

- 1) it was assumed that children are not generally trained in schools to comprehend the text through self reading, and
- 2) it was observed during tryout that some children, especially of grades I and II failed to depend on the passage while giving answers to questions. They were used to give answer erratically.

The training helped them to get an idea as to how to search for answers from the passages. The child was asked to read the passage loudly. It was instructed to the examinee that he had to read the passage correctly and try to understand while reading so that he could answer the questions asked by the examiner immediately after his reading of a particular passage. The test was administered individually. One booklet having the passages was given to the child to read and the examiner kept one for herself to observe how the child read. As the child read the passage, the examiner provided the correct word when the examinee failed to recognize it correctly. But, before doing so, the examiner asked the child to observe the word carefully. After the child had read each passage, the questions pertaining to that passage were asked by the examiner one after the other. The expected answer to particular questions varied from one to four sentences in length. The oral responses to questions were considered as correct if the content was the same as that given in the 'key', irrespective of the sentence structure of the response. When the child failed to respond, the question was repeated once more and proceeded further whether the child responded or not after stating the question for the second time.

The examinee was allowed to look into the passage while answering, because the purpose was not to assess the memory of the content. But the examinee was not allowed to read out sentences directly from the passage as answers to particular questions. When the examinee gave incomplete answer, the examiner sought further information by asking the questions suggested in the 'key' itself. The responses to the questions and the number of errors committed while reading were noted down.

Testing was ceased in the following situations :

- i) When the child committed 18 mistakes in any passage, even after allowing him to re-read the mis-read words, somewhere in the middle itself. This prevented in becoming the test of reading comprehension a test of aural comprehension. When the child completed the passage committing only 18 mistakes, questions pertaining to that passage were asked, but, the child was not permitted to take the next passage. Self-corrections, mis-pronunciations and mis-articulations were not considered as mistakes. The examinee could read by making use of word-attacking skills. When the examinee recognized all the letters individually but failed to form a word out of them it was considered as an error.
- ii) When the examinee failed to answer at least one question of a particular passage although he committed less than 18 errors during reading. This procedure was based on the assumption that every passage contained at least one question which could be answered by the children below the grade to which that particular passage was meant.

Usually 45 minutes were required to administer the whole test when the child's speed of reading was on par with grade norm given for word recognition test. When the child was reading slowly, the test was administered in two sittings to avoid fatigue factor. Thus, the child was allowed to read at his own pace.

One score was given for every correctly answered question. Total score was the sum of scores obtained on all the passages.

Percentage of children of all the four grades (I through IV) passed in each question of every question of every passage was calculated separately (Difficulty indices). Items for which there was a gradual increase in the frequency of children passed in different grades were selected. The remaining questions were rejected.



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Thus, the test was made a graded one which suggests it is a valid test. The validity of the test was established earlier also at the time of selection of the passages on the basis of pre-tryout and experts opinion. Thus, in the final form of the test the number of questions pertaining to each passage measuring the three areas of comprehension - literal, reorganization and inferential are as follows :

Passages	Literal Comprehension	Reorganisation	Inferential Comprehension	Total
I	3	2	0	5
II	2	2	0	4
III	1	3	2	6
IV	1	2	3	6
V	0	2	4	6
VI	0	2	4	6
VII	0	3	6	9
VIII	0	2	6	8
Total	7	18	25	50

Thus the maximum score one can get on this test is 50.

The selected items/ questions were rescored and grade norms in the form of arithmetic means were developed on the same sample. The table below gives the same.

**TABLE 3.10 : MEANS FOR DIFFERENT GRADES  
ON READING COMPREHENSION TEST (N = 20)**

Grades	....	I	II	III	IV
Mean scores	....	9	15	24	28

#### 3.4.1.10. Aural Comprehension Test in Kannada :

This test was developed to measure aural comprehension in Kannada among children studying in grades I through IV.

Unlike in case of reading comprehension test, in aural comprehension test, the passages were read by the administrator and the children had to answer the questions pertaining to each passage by listening to it.

This test restricts its scope of assessment of aural comprehension to the following component skills/ areas of comprehension - literal, reorganization and inferential as in the case of reading comprehension test.

The rationale for the selection of eight passages and sampling on which the standardization of the test was done was similar to that of development of reading comprehension test. The standardization of the test was done on the same sample on which the reading comprehension test was standardized. But, the sample include 'zero' graders also, that is, those who read less than 5 words/minute on Kannada oral reading test (Jaya Bai, 1958). Thus, there were altogether 140 children. The gradewise distribution of these 140 children is given below :

Grades	....	I	II	III	IV
Number of Children	....	30	30	35	45

Aural comprehension test was administered individually to these children.

#### Administration Procedures :-

In the beginning of the test, two passages were given for training purpose. The justification for having those passages is similar to that in case of reading comprehension test.

Unlike the reading comprehension test, while administering this test, the examiner read the passage and the examinee was instructed to listen to it carefully and to try to understand it, so that he could answer the

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questions asked by the examiner immediately after reading each passage by him. In order to standardize the administration procedure, a tape recorder ought to have been used. But, it was not used to avoid the novelty effect and it was assumed that if the examiner could read with an optimum speed suited to the grade level with clarity it would not vitiate the reliability of assessment. After reading each passage once, the examiner read out the questions too, not for assessment purpose but to orient the examinee to concentrate on the main ideas and details. This procedure was followed because unlike the reading comprehension test here there was no provision for the child to refer back to the passage to find out the answer to the particular question. Only after the second oral reading of each passage by the examiner the child had to answer the questions of that particular passage. The responses were noted down. The responses were considered as correct if the content was same as that given in the 'key'. Testing was stopped when the child failed to answer at least one question of the particular passage.

Testing required a period of about 45 minutes. The test was administered in a single sitting. But, depending upon the cooperation of the child, it was administered in two sittings also.

One score was given for each correctly answered question. Total score was the simple summation of the scores on all the passages.

Selection of items was done by following the same procedure as that in case of reading comprehension test. Thus, in the final form of the test the number of questions pertaining to each passage measuring the three areas of comprehension - literal, reorganization and inferential are as follows :

Passages	Literal Comprehension	Reorganization	Inferential Comprehension	Total
I	4	1	0	5
II	1	1	2	4
III	2	1	3	6
IV	1	3	4	8
V	0	2	3	5
VI	0	4	4	7
VII	0	3	4	7
VIII	0	3	4	7
Total	8	18	23	49

Thus the maximum score one can get on this test is 49.

The selected items/questions were rescored and grade norms in the form of arithmetic means were developed on the same sample.

**TABLE 3.11 : MEANS FOR DIFFERENT GRADES  
ON AURAL COMPREHENSION TEST (N = 140)**

Grades	....	I	II	III	IV
Mean Scores	....	14	14	20	25

#### 3.4.1.11. Kannada Word Recognition Test:

This test was constructed to assess and accuracy of Kannada word recognition among grades III and IV.

This test includes 100 words consisting of almost all the letters of Kannada alphabet and sample of 'kagunitha' (consonant + different sounds including vowels and diphthongs denoted by specific symbols). Each consonant combines with each of the 16 sounds leading into 16 'kagunithas' derived from it. The way each such consonant combines with each of the 16 sounds and represented graphically is similar for all the remaining consonants. Since a total of 35 consonants will lead into 35 X 16 'kagunithas', only a sample of 'kagunithas' were selected such that all the 16 sound combinations with one or the other consonant



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were represented at least once. While writing the words out of the selected letters and 'kagunithas', double consonant sounds (for example, 'spa') were avoided such that the average reader of grade III could easily read all the words when sufficient time was given. But, sounds like 'kka, ppa' were included. Since word recognition demands sound blending/word synthesis, ability along with identification of letters, the difficulty for word recognition was increased only in terms of number of letters out of which the words were formed. Thus, the words formed out of selected symbols included 2-7 letters. The words were arranged in an increasing order of number of letters in words.

The list of 100 words was given to a few Primary School teachers to see whether average readers of grade III could read them without much difficulty. There was almost no modification made and the entire list of 100 words was kept for the final form.

This is an individually administered unaimed test. There is no insistence on any particular procedure to be followed while reading the word. The child could perceive the whole word or make use of word attacking skills to recognize word. One score is given for every correct response.

#### **3.4.1.12. Kannada Letter Recognition Test :**

This test was constructed to assess the accuracy of Kannada letter recognition (grapheme-phoneme correspondence). It was intended to use this test especially among dyslexics.

Since this was a letter recognition test in Kannada, there had to be representation of Kannada letters in such a way that all the visual and auditory differences were considered. In other words, the list of letters to be written had to include all the letters of the alphabet only a sample of 'kagunitha' such that all the vowel combinations with one or the other consonant were represented at least once. Apart from this criterion, since it was intended to assess the confusion, if any, between letters with similar visual - auditory and visual - auditory features while recognising the letters, another criterion was kept in mind while selecting letters. That is, the representation of letters that were included in the list was made with respect to similarity in visual features, sounds or both among the letters.

Keeping the above criteria in mind 100 symbols including Kannada letters and 'kagunithas' were listed and were checked by a group of experts for meeting such criteria.

Thus, the final form included 100 symbols. They were arranged in 11 rows of eight letters and three more rows of four letters each.

It is an individually administered, untimed test. One score is given for each correct response.

#### **3.4.2. Tools Developed by other Authors**

##### **3.4.2.1. Kannada Oral Reading Test :**

The test was developed by Jaya Bai (1958) to assess the speed and accuracy of oral reading for the seven grades of Primary Schools from grade II through VIII.

The preliminary test consisted of 320 Kannada words and was administered to a group of children of both the sexes. During pre-tryout stage the subjects took their own time to read those words. After pre-tryout 150 words were selected for the final tryout. For the final tryout, the selected 150 words were administered to 416 girl students of the seven grades II through VIII of the Primary School. The sample was randomly drawn from seven Primary Schools situated in different areas of Mysore City.

In the final form, 150 words are arranged in the order of difficulty. These words are printed in 22 lines each consisting of seven words except the last line which consists of only three words. Space has been left between two words to distinguish them from the continuous matter. The subject has to read the words horizontally and soon after he finishes the last word in the previous line, he has to proceed to the first word of the next line.



It is an individually administered one minute scale. The number of correctly read words within a minute has to be noted down. One score is given for every correctly read word.

The reliability coefficient of the test found by the test-retest and odd-even split-half methods were 0.98 and 0.81 respectively.

Validity of the test was determined by calculating the coefficient of correlation between the test scores and examination marks in Kannada, and also between the test scores and the teacher's estimates which were 0.36 and 0.57 respectively.

Taken the test as a whole, it was found that the test was at 53 per cent of difficulty. This level of difficulty was a little below the accepted level (50 per cent). Though, it suggests that the test was a little easier, since the difference was not much, the author has considered that the test was more or less of 50 percent difficulty level. Norms were developed in the form of mean scores for each grade. The table below gives mean scores for each grade.

**TABLE 3.12 : MEANS FOR DIFFERENT AGE GROUPS AND GRADES ON KANNADA ORAL READING TEST (N=416)**

Grades	Mean age in years	Mean scores
II	7.3	22.7
III	8.3	36.9
IV	9.2	43.2
V	10.3	56.4
VI	11.1	65.5
VII	12.0	72.8
VIII	13.1	83.4

#### 3.4.2.2. The Coloured Progressive Matrices :

This test was developed by Raven (1965). The coloured matrices are designed for use with young children and old people, for anthropological studies, and for clinical work. They can be used satisfactorily with people who, for any reason, cannot understand or speak the regional language, with people suffering from, physical disabilities, aphasia, cerebral palsy, or deafness, as well as with people who are intellectually subnormal or have deteriorated. It has been also found that many dyslexic subjects, both children and adults, have had remarkable success in the Advanced Matrices Test (Raven, 1965). Miles and Wheeler (1974) have considered this test as the most 'dyslexia-free' of any intelligence test available because it is a test which calls for recognition of abstract relationships, but the amount which the person has to 'hold in mind' at once is strictly limited ; he must recognize relationships as he scans the patterns horizontally and he must recognize relationships as he scans the patterns vertically, but he need not scan them both at once, and the number of defining properties of the correct design for completing the matrix is well within the limits of the 'load' which he can carry. But, the author has pointed out that it is not a test of 'general intelligence' and therefore he has recommended the use of a vocabulary test in conjunction with it.

The three sets A, Ab, B each with twelve problems constituting, the coloured matrices are arranged to assess the chief cognitive processes of each children under 11 years of age are usually capable.

The test was administered individually by following the instructions given in the manual. The responses were recorded by the investigator and scoring was done as per the instructions given in the manual.

The author has given the following classifications of persons based on the performance on this test.

#### Grade -

I or 'intellectually superior', if his score lies at or above the 95th percentile for people of his age group.



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- II 'definitely above the average in intellectual capacity', if his score lies at or above the 75th percentile,
- III+, if his score is greater than the median or 50th percentile,
- III-, if his score is less than the median,
- IV 'definitely below average in intellectual capacity'; if his score lies at or below the 25th percentile.
- IV-, if his score lies at or below the 10th percentile , and
- V 'intellectually defective', if his score lies at or below the 5th percentile for his age group.

Instead of following the above classification rigidly, a slight modification was done in the present study. In the study children whose percentile points fell in between 25th and 10th percentiles were also considered as children with average intelligence. This is because some of the good readers included in the study also scored below 25th percentile, indicating thereby though the test is considered as culture fair, some factors might affect the performance of Indian school children on this test. Since what inhibiting factors are not known a relaxation was made for such children considering them as having average mental ability and all the three groups of children of the study were matched accordingly.

### 3.4.2.3. Visual Discrimination Test :

This test was developed by Devaki, in 1978. It measures child's ability to compare different shapes, letters, printed words, and to match them.

The test items were chosen by analysing the Kannada script and selecting the distinctive features of the Kannada alphabet taking into consideration of the features such as, shape of the letters, length of the lines and combination of lines and curves. The sets of letters and words chosen were those that could be confused visually. Each letter was compared with every other letter to find out similarities and differences among them. The items used for gross discrimination were those which differed from each other in terms of more features. The items used for fine discrimination were those which had more features in common and were different from each other only slightly. From the above analysis, major features which seem to be relevant were obtained. All the features that seem to be relevant have been included in this test.

The test was standardized on a sample of 100 children drawn randomly from the school going population of Mysore City. The children selected were in the age range of 3 to 6.6 years studying in lower kindergarten, upper kindergarten and first standard in seven different schools, in different areas of Mysore City.

All the children were divided on the basis of age into four groups. The interval covered in three of the groups was 12 months and in one group, the interval was six months. The age groups and the number of children in each age group are given below.

Group	Age in years	Number of Children
1	3.0 - 3.11	25
2	4.0 - 4.11	30
3	5.0 - 5.11	30
4.	6.0 - 6.6	15

The test includes thirty items. Each stimulus card consists of five to six pictures of different shapes, letters and words. The test is an individually administered one. During administration the children are asked to point out the two pictures which are similar. Each correct item is given score one and an incorrect one, 'zero'.

The test-retest reliability coefficient for the test with a time gap of 10 to 21 days was found to be 0.90. The mean score and standard deviations for different age groups obtained for the test are given below.



TABLE 3.13 : MEANS AND STANDARD DEVIATIONS FOR DIFFERENT AGE GROUPS ON VISUAL DISCRIMINATION TEST (N=100)

Age groups	Mean	Standard deviation
3.0 - 4.0	15.50	4.60
4.0 - 5.0	19.80	4.79
5.0 - 6.0	21.99	3.87
6.0 - 6.6	24.70	2.50

Since the test was developed for children of below 6.6 years of age the test was administered by the investigator to a group of 20 children studying in grade IV to see whether the test was very easy for them or not. It was found that 90 per cent of them committed at least one mistake. Therefore, this test was selected. Apart from this reason, since the items included in this test were written in such a way as to resemble and represent Kannada alphabet, and no other test was available, it was thought to be the appropriate test for the purpose. Since the purpose of the study was to see whether dyslexics' problem could be attributed to their difficulty in discriminating the letters visually, a test like this seemed to be quite appropriate for such an analysis. Moreover since the test was standardized as part of Reading Readiness Test, it was thought that through this test it was possible to find out whether dyslexics of the study were having readiness for reading as far as visual discrimination is concerned.

#### 3.4.2.4. Auditory Discrimination Test :

This test was developed by Kumudavalli, in 1973 and restandardized by Devaki, in 1978. It measures child's ability to discriminate between pairs of phonemes differing in one or two distinctive features in Kannada language.

The selection of such pairs of distinctive phonemic features depended on;

- a) Familiarity of the words to young children, and
- b) Picturability of both the members of the pair.

Thus, pairs of phonemes differing in one or two distinctive features were chosen and a list of 17 minimal pairs was made out of them.

Each word pair forms the stimulus pair which needs to be listened to requiring response in terms of identification of the same words expressed pictorially. Each such word pairs is represented by four pairs of pictures. For any word pair, say for example a-b, the response alternatives in the form of corresponding picture pairs are a-a, a-b, b-a and b-b. This arrangement of picture pairs is the same for all the items. The picture pairs of each set pasted on a sheet of thick paper.

To start with, the subjects are shown all the pictures and asked to name them orally so as to get themselves familiarised with the words that represent them. When the children do not name the pictures, the experimenter has to tell its name and if the picture is ambiguous, the examiner has to explain it.

The children are tested individually. The child is instructed to listen to the word pairs carefully when uttered by the examiner and point out the corresponding picture combinations given on the card. Then the examiner presents each card containing four picture combinations and utters the corresponding stimulus word pair. The task should be demonstrated to the children and trials are to be given. After ensuring that the children have understood the instructions, stimulus word pairs are uttered randomly one after the other, each time presenting the child with the corresponding card containing picture combinations for giving out the response. Each response has to be noted down as correct or wrong on a record form. This test also,



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tests the ability of the children to pay attention; to follow directions and to examine the pictures carefully. Therefore, the child has to be occasionally reminded to listen carefully and to respond carefully.

Each correct response receives one score and incorrect response '0'.

The test was standardized by Devaki, (1978) on the same sample including children of age group 3 - 6.6, on which standardization of Visual Discrimination Test was also done. Reliability of the Auditory Discrimination Test was established in the same way as in case of Visual Discrimination Test. The test-retest reliability coefficient obtained with a time gap of 10-21 days was 0.89. Thus, the test was found to be highly reliable.

The mean scores and standard deviations for different age groups were calculated and the same are given below :

**TABLE 3.14 : MEANS AND STANDARD DEVIATIONS FOR DIFFERENT AGE GROUPS ON AUDITORY DISCRIMINATION TEST (N=100)**

Age group	Mean	S.D.
3.0 - 4.0	37.17	7.50
4.0 - 5.0	43.26	8.30
5.0 - 6.0	49.23	7.74
6.0 - 6.6	53.18	8.43

Since the test was developed for children of below 6.6 years of age, the test was administered by the investigator to a group of 20 children studying in grade IV to see whether the test was very easy for them or not. It was found that such children also committed mistakes. Therefore, this test was selected. Apart from this, since the purpose of the present study was to see whether dyslexics' reading difficulty can be attributed to their inability to discriminate Kannada sounds, a test like this seemed to be more appropriate as it is developed on the basis of the analysis of features which are distinctive in Kannada language.

#### 3.4.2.5. Visual Sequential Memory Test :

It is a sub-test of Illinois Test of Psycholinguistic Abilities developed by Kirk, McCarthy et Al (1968) for children of age group 2.4 to 10.3.

This test assesses the child's ability to reproduce sequences of non-meaningful figures from memory. The sequences increase in length from 2-8 figures. Two trials for each sequence are permissible if needed. The child is shown each sequence of figures for five seconds and then is asked to put corresponding chips of figures in the same order. If subject passes the first trial, no second trial is administered ; however, subject is always given a second trial if he fails the first trial. The orientation of individual chips is disregarded in scoring.

The test was administered individually to the children of the present study. The administration recording and scoring were done according to the instructions given in the Examiner's Manual of the test.

Psycholinguistic Age Norms are given for different ages from 2.4 through 10.3. But in the present study raw scores were retained as such for the purpose of analysis.

As discussed already in the chapter 1 and section 1.4.3. the test not only assess memory for visual shapes in sequence but also some amount of verbal labelling implicitly.

#### 3.4.2.6. Auditory Sequential Memory Test :

It is sub-test of Illinois Tests of Psycholinguistic Abilities developed by Kirk, McCarthy et Al (1968) for children for the age group 2.4 to 10.3

This test assess the child's ability to reproduce from memory sequences of digits increasing in length from 2-8 digits. The digits are presented at the rate of two per second and child is allowed a second trial of each sequence if he fails on the first presentation. He receives more credit for success on the first than on the second trial.

Instructions given in the Examiner's Manual of the test was strictly followed in the administration of the test, recording and scoring of the responses.

Psycholinguistic age norms are given for different ages from 2.4 - 10.3. But in the present study raw scores were retained as such for the purpose of analysis.





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## IDENTIFICATION AND SELECTION OF DIFFERENT GROUPS OF READERS

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### 4.0. INTRODUCTION

The three groups of reader - dyslexics, non-dyslexic poor readers and normal readers - were identified and selected for the purposes of meeting the objectives and verifying the hypotheses of the study, from the sample described in the Chapter - III and section 3.2. The details about the procedure followed to identify matched groups of dyslexics, non-dyslexic poor readers and normal readers are described below.

### 4.1. IDENTIFICATION OF DYSLEXICS.

The identification of dyslexics was done by using a set of criteria which are listed below :

1. Normal in sensory-visual or auditory-functioning, symbol tracking and eye-hand coordination.
2. Without any apparent emotional disturbance.
3. At or above eight years of age.
4. Not been absent from school frequently.
5. At least two years retarded in word recognition.
6. Normal in auditory reception and comprehension.
7. Having adequate achievement motivation.
8. Has been receiving extra coaching or help at home at least since the beginning of grades II and III in case of children of grades III and IV respectively.
9. Normal in intelligence.

The various steps followed to identify dyslexics keeping in mind the above criteria are described below.

#### Step - 1 - Meeting the Criteria '1-4' :

A list of children studying in grades III and IV of those schools selected for identification of dyslexics, and are poor in Kannada reading was made based on their teachers' opinion. Among those poor readers, those who were having sensory problems, apparent emotional disturbance; behaviour problems including truancy and below eight years of age were eliminated on the basis of the data collected through school records and teacher's report. The remaining children were tested for symbol tracking and eye-hand coordination so as to eliminate their influence on the objective assessment of variables like visual discrimination with which they are related. These abilities were assessed having letters by asking the children to copy a sentence having letters which were dissimilar visually and were observed for the difficulties faced by them in relation to the two variables.

#### Step - 2 - Meeting the Criterion '5' :

Teacher's opinion about the reading achievement of children selected in step 1 was cross validated by asking them to read a passage selected from their textbooks. Those who were slow but accurate were eliminated. In order to meet the criterion '5' of the study, Kannada Oral Reading Test (Jaya Bai, 1958) which measures the rate and accuracy of Kannada word recognition was administered to these children. Since the norms used for classification of children into grades from II through VIII were available in the form of mean scores like 22.7, 36.9, etc. (vide Chapter - III and section 3.4.2.1) which were just points, it was thought appropriate to have range of scores around these points for each grade, to ensure greater reliability. Thus,



20-29 ; 30-39 and 40-49 words/minute were the ranges expected for grades II, III and IV respectively. Since there was no norm in the form of mean performance of grade I, 10-19 words/minute was considered as the range for the same. Since the children to be selected in this step had to be at least two years retarded in reading, children who read less than 10 words/minute among both grades III and IV were retained for further testing. In other words, children who were at least two years retarded in case of grade III but three years in case of grade IV were retained. Such a difference was maintained with the assumption that as the discrepancy between expected and actual performance becomes wider the probability of dyslexia is also more among poor readers. Such an idea has also been supported by Pavlidis (1980) who has used the following as one of the criterion for identification of dyslexics: the children must be at least two years retarded in reading if more than 10 years of age; and 18 months retarded if less than 10 years of age, suggesting thereby higher the age group, wider should be the discrepancy.

**Step - 3 - Meeting the Criterion '6' :**

In order to choose children with normal auditory reception from among children who were retained in the previous step, auditory reception test in Kannada developed by the investigator was administered. Those who showed single type of response (either Yes or No) to all the statements consistently in two consecutive trials with a time gap of one week, were eliminated. This was done on the presumption that such a response might be due to factors like lack of ability to follow directions and /or lack of attention among those children. But, the influence of lack of attention on the response does not appear to exist as similar responses were observed in both the trials and adequate care was taken to motivate them while administering the test. If such stereotyped responses were due to the other factor namely, lack of ability to follow direction, then the assessment of their auditory reception would lack validity. Hence such children were eliminated.

Of the remaining children, all those who could not answer at least 50 per cent of the questions, that is, obtaining a score of at least 12 were further eliminated. This is because, such children were much below the mean score of children of grade I (i.e., 15) and that it was possible to obtain at least 12 on the test by mere guessing (24 being the maximum score with a possibility of only two alternatives for a response). Thus, the cut off score on this test was kept as low as possible since the purpose was to make gross elimination of children with very low auditory reception or in other words to include children with the minimum auditory reception and since final elimination and selection was intended to be made based on the performance on auditory comprehension test at a later stage.

The Aural Comprehension Test developed by the investigator was administered to those children who were normal in auditory reception in order to further select children with normal aural comprehension. Employing the norms developed for the test, the above children were screened as follows. Accordingly, those children who scored more than  $M - \frac{1}{2}SD$  ( $M = 20$ ,  $SD = 16$ ), that is, a score of 12 in case of grade III and more than  $M - 1SD$  ( $M = 25$ ,  $SD = 11$ ), that is, a score of 14 in the case of grade IV on this test were selected. The formula used to decide on the cut off points to include children with normal performance on this test was different for grades III and grade IV since for the former grade, the was so high ( $M - 1SD$ ) would turn out to be far less than mean for grade I children.

**Step - 4 - Meeting the Criterion '7' :**

The poor readers who were selected as normal in aural comprehension in the previous step were further screened for criterion '7' namely, 'having adequate academic achievement motivation'. The 'Academic Achievement Motivation Inventory' developed by the investigator was administered to such children to measure their academic achievement motivation. Those children who scored less than 18 on it were considered as children with low motivation and were eliminated (vide Chapter III and section 3.4.1.2).



**Step 5 - Meeting the Criterion '8' :**

From among those children selected at step 4, those who were receiving extra coaching or help at home since the beginning of their previous academic year (i.e., since the beginning of grade II in case of grade III children and grade III in case of grade IV children) were listed out. Although these children were already identified as retarded in reading (i.e., reading less than 10 words/minute on Kannada Oral Reading Test (Jaya Bai) (Refer, step 2) in order to confirm whether they still could read less than 10 words/minute only in spite of extra coaching or additional help at home. Kannada Oral Reading Test (Jaya Bai) was administered to them once again, that is, in December 1982 and their performance on it was compared with earlier performance on the same test administered in August 1982. Those children who did not show any improvement in word recognition, that is, still reading less than 10 words/minute were retained for further screening.

**Step - 6 - Meeting the Criterion '9' :**

The children selected in the previous step met all the criteria to be considered as dyslexic except the criterion related to intelligence. In order to screen children with subnormal intelligence, the Raven's Coloured Progressive Matrices was administered. Children who fell at and above 10th percentile were considered as normal in intelligence and were retained. Justification for considering 10th percentile as the cut off point instead of 25th percentile is given in Chapter - III and section 3.4.2.2.

Raven (1965) has considered his test as inadequate to test the general mental ability and has suggested the use of a vocabulary test along with it. Since the use of a vocabulary test is not suited for dyslexics from the point of view of their inadequacy to develop vocabulary through reading, an aural comprehension test would adequately supplement the Raven's test of intelligence. But this has already been used for screening at step 4.

The children who were selected at this step, met all the criteria to be considered as dyslexics.

The table below shows the number of children excluded for not meeting various criteria, in the course of identification of dyslexics.

TABLE 4.1 : NUMBER OF POOR READERS (N=246) ELIMINATED AND RETAINED AT VARIOUS STEPS IN THE PROCESS OF IDENTIFICATION OF DYSLEXICS

Steps	Reasons	Number eliminated	Number retained
1	Sensory defect	1	
	Speech defect	3	
	Epileptic	1	
	Apparent emotional problem	3	
	Truancy	26	
	Under age	1	
	Total	35	211
2	Slow but accurate	17	
	Read 10 words/minute and more than that	68	
	Total	85	126
3	Very poor in auditory reception	19	107
4	Inadequate aural comprehension	54	53
5	Inadequate academic achievement motivation	4	49
6	Not receiving additional help at home	25	24
7	Showed improvement in word recognition during second testing, i.e., read 10 w.p.m. and more than that	7	17
8	Subnormal in intelligence	3	14
	Total	232	14



From the above table, it is clear that in the process of identification of dyslexics 232 children were eliminated at different steps, and only 14 could be retained finally. Those 14 considered as dyslexics as they met all the criteria specified.

#### **4.2. IDENTIFICATION OF NON-DYSLEXIC POOR READERS**

The criteria used for the identification of non-dyslexic poor readers were the same as that used for dyslexics except criteria '5' and '9' which were respectively modified as follows :

- i) One and a half years to six months of reading retardation in case of grade III children and two and a half to one and a half years in case of grade IV children.
- ii) Had not been receiving extra coaching prior to the beginning of the academic year of the grade in which they were studying, i.e., beginning of grade III in case of children of grade III beginning of grade IV in case of children of grade IV.

The steps followed to identify non-dyslexic poor readers are described below :

##### **Step - 1 - Meeting the Criteria '1-4' :**

The same set of 246 children out of which dyslexics were identified formed the sample for selection of non-dyslexic poor readers. All the children were screened for the first four criteria in the same way as that followed in the Step 1 for identifying dyslexics.

##### **Step - 2 - Meeting the Criteria '5' :**

To those children who were screened in step 1, Kannada Oral Reading Test (Jaya Bai) was administered. Only those who could read 10 to 24 words/minute on this test were retained for further screening. At step 5, while applying criterion 8, criterion 5 was rigidly followed.

##### **Step - 3 - Meeting the criteria '6 and 7' :**

The children selected from step 2 were screened for the criteria 6 and 7 in the same way as that followed in the identification of dyslexics.

##### **Step - 4 - Meeting the Criteria '5' (rigidly) and '8' :**

From among the children selected in Step 3 those who had not been receiving additional help prior to the beginning of the academic year of the grade in which they were studying were retained. This included both groups of children who were receiving and were not receiving any additional help at home since the beginning of the academic year of the grade in which they were studying. To find out whether those children who were receiving help have improved or not in word recognition after a few months of additional help, they were retested on Kannada Oral Reading Test (Jaya Bai) once again in December 1982. Their performance on this test was compared with their performance on previous testing using the same test in August 1982. These children showed some improvement suggesting that their reading retardation could be due to poor educational environment. Among those children who could read 15 to 24 words/minute in the second testing (i.e., in December, 1982) were retained. This would correspond to the extent of reading retardation in terms of grade as specified in the criterion '5'.

Among those children who were not receiving any help at home, those who could read 15 to 24 words/minute when tested in December 1982 were also retained. They constituted a very small group.

##### **Step - 5 - Meeting the Criterion '9' :**

The children selected from the step 4 were screened for the criterion '9', i.e., normal intelligence, in the same way as that employed for identifying dyslexics. Those children who fell at and above 10th percentile were retained.

The children screened as above were considered as non-dyslexic poor readers, as they met all the



criteria for considering them as non-dyslexic poor readers. There were 43 non-dyslexic poor readers.

#### **4.3. IDENTIFICATION OF NORMAL READERS**

The criteria used for identification of normal readers were the same as that used for dyslexics and non-dyslexic poor readers except with respect to the two criteria, viz., '5' and '9'. They were modified respectively as follows :

- i) Reading performance is on par with expected performance for their respective grades.
- ii) May or may not be receiving additional help at home.

The steps followed to identify normal readers are described below :

##### **Step - 1 - Meeting the Criteria '1-4' :**

From among the same set of 11 schools from which dyslexics and non-dyslexic poor readers were identified, a list was made of children studying in grades III and IV who were considered as normal in Kannada reading by their teachers. The total number of such children was 304. These children were screened for the criteria 1-4 in the same as that followed in the identification of dyslexics and non-dyslexic poor readers. Those who met all the 4 criteria were retained and the remaining were eliminated.

##### **Step - 2 - Meeting the Criterion '5' :**

To those children who were selected in the step 1, Kannada Oral Reading Test (Jaya Bai) was administered. As per the criterion, those who could read 30-39 words/minute in case of grade III children and 40-49 words/minute in case of grade IV children ought to have been selected. But those children who could read 25-49 words/minute on this test were retained for further screening and the remaining children were eliminated. At step 4 while applying criterion 9, criterion 5 was rigidly followed.

##### **Step - 3 - Meeting the Criteria '6' and '7' :**

The children selected from the step 2 were screened for the criteria 6, and 7 in the way similar to that followed in the identification of the other two groups.

##### **Step - 4 - Meeting the Criteria '5' (Rigidly) and '8' :**

To those children selected at step 3, Kannada Oral Reading Test (Jaya Bai) was readministered in December 1982 (first administration was made in August 1982). From among those who could read 30-39 words/minute in case of children of grade III and 40-49 words/minute in case of grade IV children were retained as they were the ranges expected for respective grades. Most of the children selected were receiving the help at home since grades I or II whereas the remaining children were not receiving any additional help at all. Applying criterion 9, no elimination of children was made.

##### **Step - 5 - Meeting the Criterion '9' :**

The children selected at step 4 were screened for the criterion of normal intelligence in a way similar to that followed while identifying the remaining two groups. Those children who fell at and above 10th percentile were retained. These children thus selected were considered as normal readers as they met all the criteria to consider them so. There were 76 normal readers.

Thus, all three groups of children - dyslexics, non-dyslexic poor readers and normal readers - were identified by employing the same set of criteria except the variation in two of the criteria related to the extent of reading retardation and the extent of additional help received at home.

#### **4.4. SELECTION OF DYSLEXICS, NON-DYSLEXIC POOR READERS AND NORMAL READERS.**

All the 14 dyslexics identified by employing various criteria were retained for the purpose of meeting the objectives of the study.

*Identification of Group Readers*

From among the 43 non-dyslexic poor readers and 76 normal readers identified by employing the various criteria, a group of 14 non-dyslexic poor readers and 14 normal readers who were matched with dyslexics on age, sex, grade at which studying, type of school attending, grades on coloured progressive matrices (Raven) and on aural comprehension score were selected for the purpose of meeting the objectives of the study.

The table below gives the details about the three groups with references to the variables on which all the three were matched.

**Table 4.2 : DESCRIPTION OF ALL THE THREE GROUPS OF CHILDREN -  
DYSLEXICS, NON-DYSLEXIC POOR READERS AND NORMAL READERS**

Variables	Dyslexics	Non-dyslexics poor readers	Normal Readers
Number of boys	7	7	7
Number of girls	7	7	7
Number of children studying in grade III	5	5	5
Number of children studying in grade IV	9	9	9
Number of children fallen to -			
II	0	1	1
III	8	10	9
IV	6	4	3
grades on Raven's coloured Progressive Matrices			
Average age in years	9.4	9.3	9.4
Mean score on Aural Comprehension Test	17.2	17.0	17.5

The table above clearly shows that all the three groups were matched on various related variables.



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## ANALYSIS OF THE DATA ABOUT THE NEUROPSYCHOLOGICAL PROCESSES OF ALL THE THREE GROUPS OF READERS

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### 5.0 INTRODUCTION

The data about the neuropsychological processes obtained by administering a series of tests to all the three groups of readers - dyslexics, non-dyslexic poor readers and normal readers - were analysed through Analysis of Variance and Chi-square Test and are discussed below.

### 5.1. RESULTS OF ANALYSIS OF VARIANCE

In order to achieve the objective, namely, to find out in which of the following neuropsychological processes underlying reading skills, dyslexics are deficient in comparison with non-dyslexic poor readers and normal readers :

- a) Visual discrimination,
- b) Visual recognition,
- c) Visual recall,
- d) Visual sequential memory (memory for shapes in sequence),
- e) Auditory discrimination,
- f) Auditory sequential memory (Memory for auditorily presented digits),
- g) Visual - verbal association,
- h) Word analysis,
- i) Word synthesis,

matched groups of Dyslexics, non-dyslexic Poor Readers and Normal Readers were compared for their mean performance on the above variable. Hypotheses were formulated relating to each of the above variable and verified by employing ANOVA technique. The details regarding such an analysis are given table 5.1 and 5.2.

From the 'F' values given in the table 5.1 it is clear that all the three groups differed from each other only in the five variables - Auditory sequential memory, visual verbal Association presented in isolation and in the context of word, word analysis and synthesis. When the F-value was found to be significant at a confidence level of at least  $p > 0.5$  level t-tests were carried out so as to make groups - Dyslexics and Normal readers, Normal readers and Nondyslexic poor readers; Nondyslexic poor readers and Dyslexis - indicated the variables in which they differed significantly. From the 't' values it can be inferred that

- 1 ) Dyslexics differed significantly from normal readers in
  - a) Auditory sequential memory
  - b) Visual verbal association when presented in the context of a word
  - c) Visual verbal association when presented in isolation
  - d) Word analysis and
  - e) Word synthesis

Table 5.1. Means and standard deviations for the scores of the 3 groups on the 10 different tasks  
(N=14 for each group)

	Visual discrimination	Visual recognition	Visual recall
Dyslexics	28.85 ( $\pm$ 7.18)	4.36 ( $\pm$ 2.31)	5.32 ( $\pm$ 3.42)
Non-dyslexic poor readers	29.07 ( $\pm$ 1.07)	3.07 ( $\pm$ 2.41)	6.28 ( $\pm$ 2.80)
Normal readers	28.85 ( $\pm$ 1.17)	3.28 ( $\pm$ 1.99)	5.71 ( $\pm$ 1.84)
F	0.18 (ns.)	1.08 (ns.)	0.46 (ns.)
	Memory for shapes in sequence	Auditory discrimination	Memory for auditorily presented digits
Dyslexics	19.64 ( $\pm$ 3.92)	63.00( $\pm$ 3.64)	18.78( $\pm$ 1.48)
Non-dyslexic poor readers	20.42 ( $\pm$ 8.84)	63.93 ( $\pm$ 2.65)	18.07( $\pm$ 2.35)
Normal readers	19.35 ( $\pm$ 4.48)	63.43 ( $\pm$ 4.64)	21.64 ( $\pm$ 5.27)
F	0.22 (ns.)	1.84 (ns.)	9.67 **
	Word analysis	Word synthesis	Visual-verbal association I
Dyslexics	21.35 ( $\pm$ 6.78)	14.86 ( $\pm$ 3.24)	16.71 ( $\pm$ 3.65)
Non-dyslexic poor readers	27.00 ( $\pm$ 4.15)	15.28 ( $\pm$ 3.33 )	19.57 ( $\pm$ 4.39)
Normal readers	29.64 ( $\pm$ 3.22)	18.07 ( $\pm$ 3.41)	19.92 ( $\pm$ 4.23)
F	10.90 **	16.72 **	4.2 *
			Visual-verbal association II
			6.70 ( $\pm$ 2.65)
			11.23 ( $\pm$ 2.75)
			10.08 ( $\pm$ 1.59)
			12.75 **

\*\* = p is greater than 0.01

\* = p is greater than 0.05



- 2) Nondyslexic poor readers differed significantly from normal readers in
  - a) Auditory sequential memory and
  - b) Word synthesis
- 3) Dyslexis differed significantly from Nondyslexic poor readers in
  - a) Visual verbal association when presented in isolation
  - b) Visual verbal association when presented in the context a word, and
  - c) Word analysis.

Table 5.2 t-values and confidence levels when the groups are compared in pairs

	Dyslexics and Normal readers	Dyslexics and Non dyslexic poor readers	Normal readers and Non-dyslexic poor readers
Memory for auditorily presented digits	3.68**	1.44(ns)	2.24*
Word analysis	3.67**	2.50 +	1.68 (ns)
Word synthesis	4.12***	0.54(ns)	3.58**
Visual - verbal association I	3.21**	2.86**	0.35 (ns)
Visual - verbal	2.87**	3.97***	1.01 (ns)

- \*\*\* = p is greater the 0.001  
 \*\* = p is greater the 0.01  
 + = p is greater the 0.02  
 \* = p is greater the 0.05

## 5.2. RESULTS OF CHI-SQUARE TEST

Analysis of variance technique helped in verifying whether there existed any significant difference between means of the three groups of readers with respect to each of the criterion variables related to reading process. But in order to test the dependence of each variable with respect to each group and further to find out at which level of each variable the probability of belonging to a particular group of readers is the greatest, Chi-square test was employed.

The raw scores of children of all the three groups, on different variables were converted into T scores separately. The mean and standard deviation of T scores were made use of in determining the cut off points. Thus a score lying between  $(M + \frac{1}{2}SD)$  and  $(M - \frac{1}{2}SD)$  indicated an average performance, a score less than  $(M - \frac{1}{2}SD)$  a below average performance and a score greater than  $(M + \frac{1}{2}SD)$  an above average performance. An  $\frac{1}{2}SD$  instead of one SD was taken into consideration because of the large size of SD. Thus, all the children of the three groups were classified as average, below average on each of the variables.

In order to see whether there is any relationship between different levels of performance on each variable and the different groups of readers namely, dyslexic, non-dyslexic poor readers and normal readers Chi-square technique was employed. The table below indicates the Chi-square thus obtained.

TABLE : 5.3

Chi-square values indicating the level of relationship between  
different criterion variables and the groups of readers

(df = 4 for each contingency table)

Criterion Variables	Chi-square value	Probability (P)
Visual Discrimination	0.19	less than 0.95 level
Visual Recognition	2.79	lies between 0.70 and 0.50 levels
Visual Recall	1.56	lies between 0.90 and 0.80 levels
Memory for shapes in sequence	0.31	less than 0.95 level
Auditory Discrimination	1.74	between 0.80 and 0.70
Memory for auditorily presented digits	9.43	lies at 0.05 level
Word Analysis	7.74	lies at 0.10 level
Word synthesis	7.28	lies between 0.20 and 0.10 levels
Visual verbal Association - I	4.41	lies between 0.50 and 0.30 levels
Visual verbal Association - II	18.73	lies beyond 0.01 level

From the table it can be understood that only in the case of Memory for auditorily presented digits and visual verbal association - II (in isolation) the obtained chi-square value is significant at 0.05 and 0.01 levels respectively. This indicates that dyslexia is not independent of these two variables. In order to determine at which particular level of the variable memory for auditory presented digits and visual verbal association in isolation, and in which group of readers the dependence is maximum, the following tables which includes chi-square values for each cell are helpful.

Table 5.4 Chi-square values  $\frac{(f_o - f_e)^2}{f_e}$  for each cell of the Contingency Table  
for Auditory sequential Memory of Different Groups of Readers.

	Dyslexics	Non-dyslexic poor readers	Normal readers
Below average	3.54	0.52	0.52
Average	0.0024	0.33	0.13
Above average	1.13	0.13	3.13

From the above table, it can be understood that the contribution to chi-square value by dyslexics who are below average in auditory sequential memory is the maximum and the next in order is by normal readers who are above average in auditory sequential memory. This means that the probability for a child who is below average in auditory sequential memory to be a dyslexic is maximum. In the same way higher the level of auditory sequential memory for a child there are greater chances for him to be free from dyslexia.

Table 5.5 : Chi-square values  $\frac{(f_o - f_e)^2}{f_e}$  for Each Cell of the Contingency  
Table for Visual Verbal Association (in isolation) of Different Groups of Readers.

	Dyslexics	Non-dyslexic poor readers	Normal readers
Below average	6.4004	0.3676	2.7283
Average	1.1163	1.1163	3.2624
Above average	1.2500	2.4500	0.0500

In the above table, it is revealed that the contribution to chi-square value by dyslexics who are below average in visual verbal association (in isolation) is the maximum. That means the probability for a child who is poor in visual verbal association to be a dyslexic is maximum. In other words relatively more number of dyslexics are poor in visual verbal association when stimuli are exposed in isolation.



### **5.3 DISCUSSION OF THE RESULTS**

One of the major objectives of the study was to find out in which of the following neuropsychological processes underlying reading skills, dyslexics are deficient in comparison with non-dyslexic poor readers and normal readers.

- a) Visual Discrimination (VD)
- b) Visual Recognition (VRn)
- c) Visual Recall (VRI)
- d) Visual Sequential Memory (VSM)
- e) Auditory Discrimination (AD)
- f) Auditory Sequential Memory (ASM)
- g) Word Analysis (WA)
- h) Word Synthesis (WS)
- i) Visual Verbal Association (VVA)

Hypotheses were formulated regarding the presence or absence of significant difference among dyslexics, non-dyslexic poor readers and normal readers in the above variables. These hypotheses were verified employing analysis of variance and Chi-square test and the obtained results are discussed below.

#### **5.3.1. Visual Discrimination of All the Three Groups of Readers**

In the present study, it was found that the three groups of readers - dyslexics, non-dyslexic poor readers and normal readers - did not differ significantly in their mean performance on visual discrimination. This finding is supported by a large number of studies (Fuller and Shaw, 1963; Ellis and Miles 1978; Liberman, Shankweiler et al, 1971) in which the comparisons have been made between dyslexics and normal readers. But there has been no study where in non-dyslexic poor readers have been compared with dyslexics. Sufficient justification has been given in the light of empirical evidence in Chapter - II for making a hypothesis of a no difference in visual discrimination between the three groups and such a hypothesis is again retained. A considerable number of studies (to quote some, Fuller and Shaw, 1963; O'Neill and Stanley, 1976; Waites, 1980) have attempted to find out whether or not the certain reading errors like positional and directional committed by dyslexics are due to deficiency in visual discrimination. Apart from the contradictory findings of those studies they also suffer from methodological drawbacks. Investigators like, Liberman, Shankweiler, Orlando, Harris and Berti (1971) have tried to explain the contradictory results in terms of the limitations of the tools employed to assess visual discrimination in those studies. According to them the observed difference in visual discrimination between dyslexics and normal readers is not due to any difference in visual discrimination as such rather it can be attributed to mislabelling. Such a suggestion is supported by Fuller and Shaw (1963). Thus there is more support for the finding of the present study.

Though there is no mean difference among the three groups of readers as far as visual discrimination is concerned it was found in the study that dyslexics took more time (average time 5.64 minutes) as compared to non-dyslexic poor readers (average time 4.71 minutes) and normal readers (average time 4.35 minutes) to reach the same level of efficiency. This observation is contradicted by the findings of studies by O'Neill and Stanley (1976) who found that dyslexics were not slower at the task than the control group. The possible reason for dyslexics to take more time to complete visual discrimination test as observed in the present study



may be due to the inclusion of certain items in the test which were words. It appears that such items were more advantageous for normal readers as they could name them and match the words quickly. But such a facilitating factor was present to a limited extent in non-dyslexic poor readers and to a still lesser extent in dyslexics. Since this test was not a timed test such a factor does not affect the validity of the test because sufficient time was allowed to the subject to perceive similarities and differences between any two visual features. This suggests that the performance on a reading task although apparently appears to get affected by deficiency in visual discrimination, there can be other factors like, time, which would be a more dominant determining factor.

The above finding of the study that visual discrimination does not differentiate dyslexics, non-dyslexic poor readers and normal readers is supported by further analysis made in the study employing Chi-square test. It is observed that there is no relationship between different levels of visual discrimination and dyslexia. In other words it is equally likely that a child may be a dyslexic, non-dyslexic poor reader and normal reader whatever may be his level of visual discrimination. Contradicting with this observation Coleman (1953) found that "twenty of the forty subjects were retarded ten or more months in perceptual development". Further, it has been suggested by Gross, et al (1979) that "visual perceptual dysfunction may account for some form of dyslexia". But the finding of the study that there were normal readers who were also deficient in visual discrimination casts doubt on the above suggestion indicating that a child can be normal reader in spite of his deficiency in a visual discrimination. This implies that there may be other factor/factors which affects reading performance to a greater extent than the deficiency in visual discrimination. If a child is adequate in those factor/factors the influence of deficiency in visual discrimination on reading performance may be reduced. However, such a hypothesis has to be verified keeping the other variables constant.

### **5.3.2. Visual Recognition of All the Three Groups of Readers**

Tiedmann, Krapp-Raabe, and Rager (1976) have investigated the hypothesis that dyslexia is partially attributable to a deficient memory capacity. Results did not support the notion of a generalised memory deficit in dyslexic children. But, from this study it is not clear what memory functions were tested. It is interesting to note from the review of literature there is no single investigator who has hypothesised that visual recognition is a problem to dyslexics. Since visual recognition is also a variable related to reading, this needs to be studied separately along with visual recall. Anyhow in the present study it was hypothesised that 'there is no significant mean difference among the three groups of readers in visual recognition'.

This hypothesis has been retained implying thereby visual recognition ability does not discriminate the three groups of readers. The finding is further supported by the results of Chi-square test wherein it is revealed that there is equal probability for a child to be dyslexic or not irrespective of his level of his visual recognition. However, more studies need to be conducted in this direction to verify the above hypothesis.

### **5.3.3. Visual Recall of All the Three Groups of Readers**

Several investigators tried to verify the hypothesis that dyslexics are deficient at visual memory for shapes. There appears to be contradiction in the findings of those studies. But there is greater agreement towards the conclusion that dyslexics are not inferior to normal readers in visual recall ability and in most of the cases any finding which contradicts with the above conclusion has been attributed to methodological deficiencies like employing printed letters and words, such tasks do not control the possible effects of verbal coding and previous experience with letters and words.

The present study has avoided such methodological deficiencies by using meaningless shapes and by assessing visual recall ability through learning of visual paired associates.



In the study it has been revealed that there is no significant difference between the three groups of readers, namely, dyslexics, non-dyslexic poor readers and normal readers in visual recall ability. While examining this finding in the light of previous studies employing similar assessment procedure for visual recall requiring the learning of visual paired associates, it is surprising to note that there is only one such study by Tiedmann, Krapp-Raabe and Rager (1976). They found that 11-year old dyslexic children scored below average in visual recall on a test requiring the learning of visual paired associates. In the light of inadequate number of similar studies, it is difficult to suggest any trend in findings and to say whether the findings of the present study follows the trend or not. But it may be suggested that more such studies are required not only to discuss the findings of the study but also since such studies are meaningful from the point of view of the similarity of the task employed in visual paired associate technique while testing and the reading task where the child needs to recall the whole word.

There have been studies related to ability to recall words by disabled readers. Vernon (1977) has hypothesised that for some disabled readers, the deficiency must be in the imagery of words structures not in that of single letters. It is implied from this that the disabled readers have problem in recall of visual features, then the findings of the present study do not support the hypothesis. Because, it is observed that it is equally probable for a child to be a dyslexic or not irrespective of his level of performance in visual recall. There are other studies which also do not support the above hypothesis (Vernon, 1977) and support the findings of the present study. Vellutino, Pruzek, Stegar and Meshoulam (1973); Vellutino, Stegar, Kaman and Desetto (1975) found that poor readers performed on par with normal readers on tasks requiring immediate visual recall of varying-length words printed in Hebrew, an unfamiliar orthography.

Thus, there appears to be a greater support than otherwise for the findings of the study that dyslexics are no less than non-dyslexic poor readers and normal readers in visual recall. Still, more studies on these lines need to further verify this hypothesis.

#### **5.3.4. Visual Sequential Memory of All the Three Groups of Readers.**

In the present study which has employed the sub-test of ITPA to assess visual sequential memory it is revealed that there is no significant difference in visual sequential memory between dyslexics and other two groups of readers. Further, it is found that there is equal probability for a child to be dyslexic or not irrespective of his level on visual sequential memory. While examining this finding in the light of earlier studies it is observed that there are only a few studies which have tried to find out whether dyslexics have deficiency in visual sequential memory or not. The findings of the present study receives support by Coles (1978) who has revealed that the performance on visual sequential memory, sub-test of ITPA did not differentiate poor readers from normal readers.

There are studies which do not support the hypothesis retained by the present study. Thomson and Wilsher (1978), Stanley, Gordon; Kaplan, Ida and Poole, Charles (1975) have revealed that dyslexics are inferior to age matched controls in visual sequential memory. Hicks, Carolyn (1980) on the basis of his experiments has tried to give an alternative interpretation for the poor performance of dyslexics on visual sequential memory sub-test of ITPA. The overall results of such experiments suggested that good and poor readers may differ not with respect to visual sequential memory but by their differential ability to employ a verbal labelling strategy in the retention of visual stimuli.

It is too early to examine the validity of the explanation given by them as the hypothesis that dyslexics are deficient in visual sequential memory needs to be verified by more studies. Moreover, it is wrong on their part to assume the existence of such a deficiency in dyslexics as there are studies including the present study which contradicts with such an assumption.



### **5.3.5. Auditory Discrimination of All the Three Groups of Readers.**

Some of the investigators while examining the problem of letter confusion among dyslexics tried to find out whether dyslexics are deficient in auditory discrimination or not. The findings of majority of those studies (Jason and Jeffrey, 1980; Johnston, 1982, Lingren, 1969) have revealed that auditory discrimination problem lies only in individual cases and not invariably in all the dyslexics. In the present study it is revealed that there is no difference among the three groups of readers in auditory discrimination. Further, it is revealed that there is equal probability for a child to be dyslexics or not irrespective of his level of auditory discrimination. Thus, although the general trend of findings that auditory discrimination problem lies only in individual cases is supported by the present study, it may be noted that such a statement can be made even for normal and non-dyslexic poor readers. This further suggests that dyslexics' problem of letter confusion cannot be attributed completely to deficiency in auditory discrimination as there may be individuals who are normal readers in spite of deficiency in auditory discrimination. And more than that since auditory discrimination affects speech development also, normal speech development among most of the dyslexics also is an indication of lack of deficiency in auditory discrimination among all dyslexics.

### **5.3.6. Auditory Sequential Memory of All the Three Groups of Readers.**

In the present study, it was revealed that there was a significant difference between the groups of readers, namely, dyslexics, non-dyslexic poor readers and normal readers in auditory sequential memory. Comparing two groups at a time, dyslexics and non-dyslexic poor readers differed significantly from normal readers but did not differ from each other in auditory sequential memory.

The results related to the superiority of normal readers in auditory sequential memory when compared to dyslexics has been supported by the earlier studies (Bryden, 1972; Ealck, 1973; Gordon, Ida and Charles, 1975; Spring, 1976; and Badian, 1977). Almost there has been no contradiction regarding this finding. The results of Chi-square test supplements this finding as it is found that a child who is below average in auditory sequential memory has got greater chances of being a normal or non-dyslexic poor reader. But considering the results related to non-dyslexic poor readers, it apparently implies that auditory sequential memory cannot be a differentiating factor between dyslexics and non-dyslexic poor readers. Such an inference does not appear to be valid if one examines the frequencies of different types of readers at different levels of auditory sequential memory. It is observed that none of the non-dyslexic poor readers and normal readers are below average in auditory sequential memory. Instead it can be inferred that auditory sequential memory exists on a continuum from dyslexics through non-dyslexic poor readers to normal readers. This can be observed in the mean scores on the variable for the three groups in order, namely, dyslexics, non-dyslexic poor readers and normal readers.

### **5.3.7. Visual Verbal Association of All the Three Groups of Readers.**

Several studies have attempted to verify the hypothesis that the dyslexics' main problem lies in establishing association between visual and verbal stimuli which is very much essential to learn the names of letters. Some studies (Birch and Belmont, 1964, 1965; Zigmond, 1966; Vande Voort, et al, 1972) have employed perceptual matching procedure whereas others (Stegar, et al, 1972; Vellutino, et al, 1973, 1975) have employed associative learning. In the present study, in order to verify the same hypothesis, the second approach, namely, associative learning which was considered as more valid (Vellutino, 1977) in assessing visual verbal association ability was employed. It has been revealed in the present study that dyslexics are differed from both non-dyslexic poor readers and normal readers but there is no significant differences between the later two groups. This finding is supported by the findings of some of the studies (Vellutino, stegar, Harding and Phillips, 1975; Done and Miles, 1978. Vellutino, 1987). Further, there are studies which



point out that dyslexics are deficient in 'naming' (Denckla, 1972a and 1972b; Spring and Capps, 1974; Spring, 1976) which the investigators have attributed to the problem of retrieval. But it may be argued that such a deficiency in 'naming' may also be due to the basic problem in associative learning. Thus, there is more support to the hypothesis that dyslexics are inferior to normal readers in visual verbal association although some studies (Stegar, Vellutino, et al, 1972; Vellutino, Stegar, et al, 1973 and Vellutino, Harding, et al, 1975) have pointed out that dyslexics are not inferior to normal readers in the variable.

The additional observation in the study is that, the results of Chi-square for the data obtained by the two tests, namely, verbal association Test-I, in which the stimuli were presented in a word context and visual verbal association Test-II, in which the stimuli were presented in isolation, are different. The difference observed is, in the former case though relatively more number of dyslexics are poor in the variable compared to the other two groups, such an observation fail to reach the accepted level of significance. Whereas in the latter case the same observation is statistically significant. From the observation, it appears that relatively more number of dyslexics, compared to the other groups are having problem in establishing association between visual and verbal stimuli when they are presented in isolation. Whereas in the situation wherein the stimuli are presented in a word context, the ratio between the number of children of different groups who are below average in VVA-I are less compared to that of VVA-II. Since the approach employed, that is, associative learning, to assess visual verbal association in the study is almost parallel to situation of learning to read from the above observation it can be inferred that teaching reading in whole word context is a better approach compared to the other one.

Anyhow, since the finding of some studies contradict with the finding of the present study and the observed deficiency in visual verbal association among dyslexics has been explained in terms of deficiency in lexical encoding by some of the investigators (Ellis and Miles, 1981) there is a need for more number of studies to verify the hypothesis that dyslexics' basic problem lies in visual verbal association.

#### **5.3.8. Word Analysis and Synthesis of All the Three Groups of Readers.**

In the present study, it is revealed that dyslexics are significantly differed from the other two groups in word analysis. And further, it is found that relatively more number of dyslexics are poor in word analysis compared to the other two groups. The finding that dyslexics are having difficulty in word analysis has been supported by Zigmond (1966) who found that dyslexics differed from non-dyslexics in spelling (which requires phonemic analysis).

In the study it is also revealed that dyslexics are differed from normal readers in word synthesis whereas there is no such difference between dyslexics and non-dyslexic poor readers. But, non-dyslexic poor readers are differed from normal readers. The finding that dyslexics are inferior to normal readers has been supported by Golden and Steiner (1969), Zigmond (1966) who also found that good readers were superior to dyslexics in sound blending. But, Newcomer and Hammill (quoted in, Coles, 1978) after reviewing several studies have noticed that when mental ability was controlled the sound blending sub-test of ITPA did not differentiate normal readers from disabled.

Anyhow, in the present study the mental ability was controlled and still significant difference is observed. Thus, it appears that Newcomer and Hammill's (Coles, 1978) observation suspects the validity of sound blending sub-test of ITPA rather than the existence of deficiency in sound blending among dyslexics. But, since non-dyslexic poor readers are differed from normal readers and not from dyslexics, word synthesis can become a differentiating factor between dyslexics and normal readers but not between dyslexics and non-dyslexic poor readers.

Since, this is the only available study which attempted to find out whether dyslexics among Kannada readers differ from other two groups of readers in word analysis and word synthesis any conclusion cannot



be drawn. And more than that as there is no agreement about the performance of dyslexics among English readers it is not possible to compare the performance of dyslexics among Kannada readers with that of English readers. So, there is need for further verification of the hypothesis related to word analysis and word synthesis.

#### **5.4. NEUROPSYCHOLOGICAL FACTORS DIFFERENTIATING DYSLEXICS FROM OTHER TWO GROUPS OF READERS.**

Summarily, the present study has revealed that out of the ten selected variables related to reading, dyslexics differed significantly from normal readers only in four variables, namely, (a) Auditory sequential memory, (b) Word analysis, (c) word synthesis, and (d) Visual verbal association. Such an observation finds great support by previous research work. Still no tentative generalisations can be made as there are only a limited number of studies and methodological variation and deficiencies have given room for different interpretation. Further, none of the previous studies tried to compare dyslexics with non-dyslexic poor readers also. Inclusion of such a group helps to identify finer discriminating factors related to dyslexia. In other words, it is not enough if we identify the factors which differentiate dyslexics from normal readers. In the present study, it has been found that dyslexics differed from non-dyslexic poor readers only in visual verbal association and in word analysis. Whereas in other two variables - auditory sequential memory and word synthesis - which differentiated dyslexics from normal readers non-dyslexic poor readers differed from normal readers also. Thus, it can be inferred that dyslexics are differentiated from non-dyslexic poor readers as well as normal readers in visual verbal association and in word analysis abilities.

The above observation made in the study suggest the independent existence of three groups of readers and also support the validity of the criteria used to identify dyslexics. But, since these criteria neglect children with other deficiencies along with dyslexia and since they do not help in early identification before schooling an alternate set of criteria has to be given. From the findings of the present study it can be proposed that level of performance of visual verbal association tasks and on word analysis test help in identifying dyslexic from any given population and at an earlier age. But, word analysis may vary with the nature of the language concerned, that is, to what extent script of it is phonetic. So, visual verbal association ability forms the single differentiating factor. Such an inference has to be verified with controlled experiments such as longitudinal studies starting from pre-school ages onwards. If the results are positive then dyslexic can be defined as one with deficiency in visual verbal association ability. It does not mean he is having deficiency only in visual verbal association ability. It only suggests that it is the primary determining factor and he may be deficient in one or more additional abilities also. In the present study, it can be seen that majority of the dyslexics are deficient in word analysis, word synthesis and auditory sequential memory. In individual cases they may be deficient in visual and auditory discrimination; and visual memory functions - recall and recognition also.

The criteria for identifying non-dyslexic poor readers was set arbitrarily. On the basis of the assumption that the reading retardation of non-dyslexic poor readers is mainly due to lack of adequate educational experience, it was hypothesised in the study that there is no significant difference between non-dyslexic poor readers and normal readers in any of the variables selected for the study. But, the present study showed that non-dyslexic poor readers differed from normal readers in auditory sequential memory and word synthesis ability. That means non-dyslexic poor readers are also relatively deficient compared to normal readers in those two abilities. Thus, non-dyslexic poor readers are not normal at least in these two variables. It suggests that the poor performance of non-dyslexic poor readers cannot be attributed to educational factors only. They are having in built deficiencies which hinder normal learning of reading.

Though, dyslexics and non-dyslexic poor readers do not differ from each other as far as auditory sequential memory and word synthesis are concerned, dyslexics are significantly more deficient in visual



verbal association ability than non-dyslexic poor readers. This suggests that visual verbal association ability is the major determining factor in learning reading. It is observed in the present study that the level of auditory sequential memory of non-dyslexic poor readers is lower than normal readers but higher than that of dyslexics although the difference are not significant. This suggests that auditory sequential memory facilitates the learning of reading, but the deficiency in itself does not seriously affect the learning of reading. The improvement of non-dyslexic poor readers within a short period of extra coaching and no improvement of dyslexic over a long period of extra coaching also supports this inference. More than that the fact that a few normal readers of this study were not receiving any help outside the school also supports the idea that the poor performance of non-dyslexic poor readers is due to inadequacy in auditory sequential memory and word synthesis irrespective of the extent of extra coaching. This finding is very important as it throws some light on the reason for contradiction in the findings of research related to deficiency of dyslexics in the various variables chosen for the study. As each and every variable is related to reading performance, deficiency in any of the variables affects learning of reading. Therefore, even after controlling the factors like intelligence, emotional status, education background, and motivation, there is considerable diversity among the group of poor readers. Thus, it is not possible to say that all the poor readers who satisfy the criteria related to the factors mentioned above, are dyslexics. Apart from reading retardation, even if the symptoms like difficulty in learning the multiplication tables, and names of months are the criteria for identification of dyslexics, still it is not possible to screen dyslexics, as non-dyslexic poor readers may also be deficient in these tasks, because of the deficiency in auditory sequential memory. This indicates more and more unique symptoms of dyslexics are to be explored and the factor/factors underlying majority of those symptoms is/are to be considered as the major differentiating factors. At the present status of research in the area of diagnosis of dyslexia, lexical encoding deficiency is considered as the major differentiating factor. But, the present study shows that visual verbal association ability is the predominant factor. At this context whether deficiency in association ability underlies deficiency in lexical encoding or vice versa need to be determined.

Anyhow, from the findings of the present study the dyslexics can be defined as those who are invariably deficient in visual verbal association ability. Therefore, the non-dyslexic poor readers of the present study though are having deficiency in some of the variables are still non-dyslexics. Since the size of the sample is limited and the studies including non-dyslexic poor readers are also limited replication of the studies is very much essential before concluding.

## **5.5. CLASSIFICATION OF DYSLEXICS**

After considering dyslexics as those who are invariably deficient in visual verbal association, it was attempted to classify dyslexics into different categories. From the analysis and discussion of results given in the previous section, it was revealed that dyslexics could be found at different levels - average, below average and above average - in different variables that are related to reading process. In other words, a dyslexic child could be below average in one or more variables, above average or average in other variable/s. Thus, it was possible to get different types of dyslexics with deficiency in varied combinations of variables. But usually, three types of dyslexics have been identified by earlier investigators. They are (i) visual dyslexics who are deficient only in visual processing skills, namely, visual discrimination, visual recall, visual recognition and/or visual sequential memory functions; (ii) auditory dyslexics having deficiency only in auditory processing skills, namely, auditory discrimination, auditory sequential memory, word analysis and/or synthesis ; and (iii) auditory visual dyslexics having deficiency in both types of skills mentioned above.

In the present study also similar attempt was made to classify dyslexics. In order to make three groups as average, below average and above average in each variable, raw scores of all the visual, auditory and visual verbal association skills obtained by each child were converted into T scores. Such scores for all auditory skills were added and their mean was computed for each child. Similarly, the mean scores for all



visual skills and mean scores for both the association skills (word context and in isolation) were computed for each child. These three mean scores were considered as raw scores for auditory, visual and association skills for each child. The mean and SD of such raw scores of all the 42 children were computed separately for auditory, visual and association skills. In order to classify children as below average, average or above average in each type of skills,  $(M + \frac{1}{2}SD)$  and  $(M - \frac{1}{2}SD)$  were considered as cut off points. That is a score lying between  $(M + \frac{1}{2}SD)$  and  $(M - \frac{1}{2}SD)$  was considered as an indicative of average performance, a score above  $(M + \frac{1}{2}SD)$  as below average performance and a score below  $(M - \frac{1}{2}SD)$  as above average performance. Instead of One SD, an half SD was taken into consideration because of the large size of SD.

Since association skills were considered to be the primary determining factors, first it was attempted to see how many dyslexics were below average in association skills. It has been found that out of 14 dyslexics 13 dyslexics were below average; one was above average; and none was average in visual verbal association skills taken together. Thus, out of 14, only 13 children who were deficient in association skills were considered as dyslexics. The remaining one who was above average in association skills was probably wrongly identified as a dyslexic.

Those 13 dyslexics were further classified according to their deficiencies in different types of skills. Thus, there were 2 ( 15.38%) dyslexics who were deficit in visual skills; 5 (38.45%) in auditory skills; 2 (15.38%) in both visual and auditory skills; and 4 (30.76%) who were deficient only in association skills.

Thus, it can be seen that the number of auditory dyslexics who were deficit in auditory skills and relatively more compared to the remaining types of dyslexics.

In addition to the classification proposed by previous investigators like, Johnson and Myklebust (1967) and Boder (1971), the present study revealed one more type of dyslexics, that is, with deficiency in association skills only. Boder reported in 1971 (Quoted in, Faas, 1976) that her study of the reading and spelling patterns of 107 dyslexic children revealed that 63 per cent were auditory dyslexics, 9 per cent visual dyslexics and 22 per cent visual auditory dyslexics. In the present study the percentage of auditory dyslexics appears to be more. But such a comparison of findings may not be appropriate, as the number of dyslexics identified in the study is small and moreover, the basis of classification of dyslexics into different types is also different. Anyway, it could be possible to classify all the 13 dyslexics into 4 categories as follows :

- (i) Deficient in visual processing skills and association skills (2/13).
- (ii) Deficient in auditory processing skills and association skills (5/13).
- (iii) Deficient in all the three processing skills. (2/13).
- (iv) Deficient in association skills only )4/13).

Following a similar procedure employed for classifying dyslexics, an attempt was made to classify non-dyslexic poor readers and normal readers on the basis of their performance on all the three types of processing skills - visual, auditory and association skills. The following observations were made.

The 14 non-dyslexic poor readers included in the study could be classified into the following categories:

- (i) Deficient in auditory processing skills only (5/14).
- (ii) Deficient in visual processing skills only (1/14).
- (iii) Deficient in visual processing skills and association skills (1/14). He can be considered as visual dyslexic.
- (iv) Not deficient in any of the skills (7/14).



The 14 normal readers included in the study could be classified into the following categories :

- (i) Deficient in visual processing skills and association skills (1/14). Though appears as visual dyslexics cannot be considered as so because of average performance in reading.
- (ii) Deficient in visual processing skills only (3/14).
- (iii) Not deficient in any of the skills (9/14).

It can be observed from the above classification of dyslexics, non-dyslexic poor readers and normal readers that 92.31 per cent of dyslexics were deficient in association skills whereas 84.62 per cent of normal readers and 92.31 per cent of non-dyslexic poor readers were adequate in it. The number of children with deficiency in auditory processing skills is equal in case of dyslexics and non-dyslexic poor readers, whereas none of the normal readers is poor in auditory processing skills. The number of children with deficiency in visual processing skills were more among normal readers as compared to the remaining two groups. The number of children who were not deficient in any of the skills is more among normal readers (69.21%) compared to that of non-dyslexic poor readers (50%).

Since more number of normal readers were deficient in visual processing skills, it suggests that such skills may not affect reading performance to a greater extent. This may be due to the fact that tracing or kinesthetic experience is also generally provided in schools while teaching reading. Therefore, children need not completely depend on visual skills. Usually, normal children are expected to be normal in visual processing skills also. These normal readers on the contrary were deficient in visual processing skills, but normal in auditory processing skills. This indicates that these normal readers were relatively more verbal oriented. But, when one considers auditory processing skills, both the categories of poor readers (dyslexics and non-dyslexics) were more deficient in them as compared to normal readers. This suggests that when compared to visual processing skills, auditory processing skills affect reading performance to a greater extent in the present day school context. This has to be interpreted in the light of methodology employed to teach reading in present day schools. But, when one considers association skills, since dyslexics were found to be at the lowest ebb, the utility, of these skills appears to be the highest as far as reading performance (in the present day school context) is concerned.

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## ANALYSIS OF THE ERRORS COMMITTED BY ALL THREE GROUPS OF READERS WHILE READING KANNADA

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### 6.0. INTRODUCTION

One of the additional objectives of the present study was to analyse the types of errors committed by all the three groups of readers while reading Kannada and to find out the possibility for identifying dyslexics in particular on the basis of such errors. Various attempts have been made to find out whether dyslexics can be differentiated from other types of readers and to find out the possibility to classify dyslexics on the basis of different types of errors. Such attempts are very useful to classroom teachers in identifying and classifying dyslexics easily without administering any neuropsychological tests and to provide differential treatment suited to each type of dyslexic. Although, majority of the studies reviewed in Chapter - II and section 2.2 did not support hypothesis that dyslexics can be differentiated from other types of readers on the basis of reading errors, such hypothesis is yet to be verified in Kannada language. (For accounts of reading difficulties in different orthographic systems see Aaron & Joshi, 1989.) In the present study the identification and classification of errors while reading Kannada by different types of readers was made on the basis of the performance on the Kannada word recognition test developed by the investigators (Discussed in Chapter-III and section 3.3.3). Such an attempt was not extended to errors committed while reading sentences as it was observed that dyslexics included in the present study could not read at that level. This chapter is devoted to the analysis of the reading errors committed by all the three groups and the discussion of the findings.

### 6.1. OBSERVATIONS RELATED TO READING ERRORS COMMITTED BY ALL THE THREE GROUPS OF READERS

The focus of the error analysis in the present study was limited to meet the following specific objectives :

- i) To find out the general tendency of reading - whole word perception or letter by letter reading - among the three groups of readers,
- ii) To find out whether or not all the three groups of readers commit similar types of errors to the same extent,
- iii) To find out the possible reasons for committing different types of errors by all the three groups of readers, and
- iv) To find out whether or not the same set of cues mislead the different groups to commit errors while reading.

#### 6.1.1. General Tendency of Reading

While observing the way, the different types of readers read words, it was found that generally, the dyslexics made use of word attacking skills in identifying the words, that is, they tried to identify each and every letter in isolation and then synthesis them into words. Non-dyslexic poor readers attempted both the methods - whole word perception and use of word attacking skills.

Usually, normal readers attempted whole word perception. Although this was the general tendency, there were variations in the approach followed by different groups of readers with respect to individual words. The approach employed while reading a word determines the type and quantity of errors committed by the reader. Because of these two reasons the data could not be analysed statistically and only qualitative analysis was attempted.



### 6.1.2. Types of Reading Errors

This section is devoted to the analysis of errors committed by the three groups of readers and to make a comparison of the frequencies and the nature of such errors and to find out the possible reasons have influenced the three groups of readers to commit such errors. And also to see whether same set of cues mislead all the three groups to commit mistakes while reading.

It was possible to observe the following types of errors among the different groups of readers:

- i) Word substitution error,
- ii) Letter substitution errors,
- iii) 'Kagunitha' substitution,
- iv) Blending errors, and
- v) Reversal errors.

Each type of errors is discussed below.

#### 6.1.2.1. Word Substitution Errors:

When a different word is substituted in the place of stimulus word it is considered as a word substitution error. Readers commit word substitution errors only when they attempt to perceive the whole word. Thus, the more frequently the reader employs whole word approach there is a great likelihood for him to commit more number of word substitution errors. The examples for word substitution errors are given in the Appendix VI. The frequencies of word substitution errors committed by different types of readers are given below:

Groups of Readers	Dyslexics	Non-dyslexic poor readers	Normal readers
Frequency of errors	70	124	57
Number of children	14	14	14

From the above frequencies of errors, it can be seen that normal readers have committed lesser number of errors although they had greater chances for committing word substitution errors as they generally make use of whole word perception to read words. This suggests that they can read more accurately. Though dyslexics had least chances for committing word substitution errors are lesser and greater for non-dyslexic poor readers compared to normal readers and dyslexics respectively. Thus, the frequency of word substitution errors committed by non-dyslexic poor readers suggests that non-dyslexic poor readers could not perceive the whole words accurately.

Word substitution errors can be attributed either to impulsively or to an inability to identify a word correctly. So, in order to identify the specific reason, whenever such errors were noticed, the children were asked to reread those words carefully. It has been observed that second reading helped many children to identify the words correctly. The number of correctly identified words in the second reading which were misread in the first reading are given below.

Groups of readers	Dyslexics	Non-dyslexic poor readers	Normal readers
Number of words correctly read in second reading	23	59	41
Number of errors in first reading	70	124	57
Proportion	0.33	0.48	0.74

From the above data, it is clear that the second reading helped normal readers to perceive the words



correctly to the maximum extent and dyslexics to a minimum extent. The ratio of improvement is approximately 1/3 in case of dyslexics, 1/2 in case of non-dyslexic poor readers and 3/4 in case of normal readers. This indicates that if normal readers are attentive while reading they will commit lesser number of errors. Whereas, in case of non-dyslexic poor readers and dyslexics readers, in spite of attentivity the chances for committing errors are more indicating that the errors committed by them are mostly due to inability to recognize correctly rather than due to inattentivity.

The error committed while recognising the words during second reading also can be attributed to letter or kagunitha identification difficulties or blending difficulties. The illustrative examples pointing to such possibilities are given in the Appendix VI. In case of error like (a) the difficulty in identifying letters and 'kagunitha' can be observed. Whereas, in case of errors like (b), it can be noticed that though the readers identified letters and 'kagunitha' of a particular word correctly, failed to blend those individual sounds into words properly.

The analysis of the word substitution errors committed by all the three groups of readers, further showed that a number of common words were misread by all the three types of children. Even the substitutes (response words) were also common. Similarly another set of words were misread by both dyslexics and non-dyslexic poor readers. It can be inferred from the illustrative examples given that all the three types of children depend upon/mislead by same set of cues in identifying words.

Apart from these common sets each groups had committed different sets of word substitution errors. From the analysis it was not possible to identify any common feature of each set of word substitution errors specific to each group of children.

Thus, to conclude, whatever may be the reasons for committing word substitution errors, it was observed that there were variations in the extent of errors committed by these three groups of readers and there was no qualitative difference in the word substitution errors committed by them. Since, there were certain words which are substituted by same set of words by all the three groups it could be inferred that no cues have exclusively contributed or hindered for any group in reading words.

#### 6.1.2.2. Letter Substitution Errors:

Letter substitution error occurs when a child tries to identify individual letter and confuses it with another letter. In the present study, it was observed all the three groups of readers have committed this type of errors when they attempted to identify each letter in isolation, in order to identify the words. Thus, this was also a common type of error, which of course varied in frequency with respect to each group of readers. The frequency of letter substitution errors committed by each group of children are given below.

Group of readers		Dyslexics	Non-dyslexic poor readers	Normal readers
Number of errors	....	224	72	25
Number of readers	....	14	14	14
Mean	....	16	5.14	2.07

Thus, it is revealed from the above data, the knowledge of letters is very much limited in the case of dyslexics. Most of the errors committed by dyslexics can be attributed to this limitation. On the average, 16 letters were confused with another set of 16 letters. That means on the average, a dyslexic had to master 32 letters for accurate reading of words. Since in Kannada there are 50 letters, the dyslexic of the present study had not learnt even 50 per cent of the letters. In the same way non-dyslexic poor readers had to master 20 per cent of the letters and normal readers 7 per cent of the letters. Correct identification of words indicated that all the letters in it were identified correctly. Therefore, one can consider the difference between the frequency of errors committed among the three groups of readers as a significant one. But, the interesting



thing is that even the normal readers at grades-III and IV committed mistakes in identifying the letters. So, it was attempted to further analyse the data to see whether there were any differences among the three groups in the possible sub-types of letterer substitution errors. While analysing this type of errors, it was noticed that there was visual or auditory similarity and sometimes both between the stimulus letter and response letter. But in other cases there was no apparent similarity between stimulus and response letter. It was attempted to classify letter substitution errors on the basis of such similarity and to compare all the three groups with respect to such sub-types of letter substitution errors. Such an attempt was made systematically as discussed below.

(a) Basis for considering any two letters as visually similar:

Letters of Kannada alphabet are curvilinear in appearance. Each letter resembles at least one other letter and differs from it by one or more visual features. So, in order to say that any two letters resemble each other it was thought that it would be better to fix up the extent of similarity rather than going for the extent of difference. Since, it was difficult to quantify the extent of similarity, Kannada alphabet was analysed to identify the distinct visual features among the letters of it. Such an analysis helped to identify the common visual features among the different sets of letters of kannada alphabet. Similar attempts were made at the Central Institute of Indian Languages, Mysore, while teaching Kannada alphabet to non-Kannadigas and by Devaki (1978) while developing visual discrimination test. But the product of such an analysis made by the investigators differed slightly. On the basis of such an analysis it could be possible to get 12 distinct features among the letters of Kannada alphabet and to classify all the letters of Kannada alphabet based on their resemblance with any of those 12 visual features. Such a classification of letters is given in the Appendix VII. Since each letter resembles at least one other letter visually, there was equal probability for each letter to make a reader to get confused with each of the other letters in the group.

(b) Basis for considering any two letters as auditorily similar:

One standard classification of sounds of Kannada alphabet suggested by Nayak (1967) was followed to identify the letters which resemble each other auditorily. In this classification phonemes have been described according to the conventional articulatory terminology, with reference to 'point of articulation', 'manner of articulation' and 'aspiration' in case of consonants and the position of tongue and lips in case of vowels. The classification of consonants and vowels based on the above factors are given in the Appendix VIII.

Thus, all the consonants have been divided into two categories as stops and continents depending upon the 'manner of articulation'. Then phonemes of each categories have been classified into 6 different groups depending upon the point of articulation. The phonemes of the stops belonging to six groups may be either voiceless or voiced, which in turn differ in the presence or absence of aspiration which is of course insignificant. Therefore, in case of stop phonemes whose point of articulation is same can be considered as similar sounding. Thus, consonants like, p, ph; b, bh; k, kh; g, gh; resemble one another. That means each letter differs from one another in the presence or absence of voicing. The continuents have been further divided into nasals and orals. So, all the nasals can be considered as similar. Each nasal sound differs from one another in the point of articulation. Among orals all the voiced sounds can be considered as similar which also differ in terms of point of articulation. Voiceless orals have been further divided into different groups as fricatives, continuents, laterals, and flaps. The sound belonging to each group which differ in 'point of articulation' can be considered as similar. Thus, z and h; l and j; v and y; resemble one another /r/ does not resemble any other sound.

From the classification of the vowels, the vowels which resemble each other are given below:

/a/ and /ā/ /i/ and /ī/ /u/ and /ū/ /e/ and /ē/ /o/ and /ō/

These vowels differ from each other in length.

From the attempts to establish the basis for considering any two given letters are visually or auditorily



similar or in both of them, it is clear that each and every letter is having one or more visual counterparts (Table 6.1)). But the letter 'r' is not having auditory counterparts. Further, only some letters are having both auditory and visual counterparts. Such pairs of letter are given below:

/a/ /ā/ /k/ /g/ /ū/ /u/ /c/ /j/ /ē/ /e/ /v/ /d/ /o/ /ō/

**NOTE:-** From the Appendix VIII(b) 6.1 it can be seen that these letters of each pair have fallen into the same category.

After establishing the bases for considering any two letters as resembling each other visually or auditorily each response letter was compared with the stimulus letter in terms of visual and auditory features. Mean frequencies of letter substitution errors committed by different groups of readers, wherein there was auditory similarity, visual similarity or both or no similarity between stimulus and response letters are given below :

Type of similarity		Dyslexics	Non-dyslexic poor readers	Normal readers
Visual similarity	...	6.57	3.00	1.21
Auditory similarity	...	2.29	1.29	0.20
Auditory and visual similarity	...	1.57	1.00	0.20
No similarity	...	5.79	0.57	0.14

From the above data, it can be seen that whatever may be the type of similarity in letter substitution errors, the frequencies of errors were maximum among dyslexics, next in order were among non-dyslexic poor readers and normal readers. When the mean frequencies across the groups were compared with respect to type of similarity, it was observed that the difference between the three groups was considerably more in errors with visual similarity and also in errors without any similarity. In the latter, the difference between the three groups appeared to be the maximum. When the letter substitution errors where there is no apparent similarity between the letters are considered, it has been found that such errors were relatively more frequent among dyslexics as compared to the other two groups where such errors were quite rare. Similar observation can be made with reference to errors with visual similarity, although the difference in the frequency of such errors among the three groups is less compared to that of the errors without any similarity. But, in case of errors with auditory similarity and auditory-visual similarity the difference in the frequency among the three groups is not considerable.

From the data given above, it can be inferred that in all the three groups of readers letter substitution errors with visual similarity is more. In case of non-dyslexic poor readers and normal readers, errors with auditory similarity and auditory-visual similarity are lesser than that with visual similarity. Further, the errors without any similarity is least. But, in case of dyslexics the frequency of errors with different types of similarity is altered. Errors without apparent similarity are more in number compared to that with similarity in auditory features and auditory-visual features taken together. But, it may not be appropriate to compare the relative frequency of such letter substitution errors within each group of reader as the probabilities of such possibilities are not uniform within Kannada alphabet. The possibilities for committing errors without similarity are more. Next come in the order are errors with visual similarity, auditory similarity and auditory-visual similarity. Except, in case of the errors without any similarity the frequency of the remaining types of errors followed the order expected, in all the groups of readers. This also implies that committing letter substitution errors wherein there is no apparent similarity is the differentiating factors between dyslexics and other two groups of readers. Apart from the differential probability the more number of errors with visual similarity can be attributed to the existence of more than one visual counterparts for the most of the letters. Whereas, there is only one auditory counterpart and only one auditory-visual counterpart for each letter. Thus, if a child learns one out of the two letters which resemble auditorily and auditory-visually with each other, confusion can be avoided. But, to avoid errors with visual similarity the child has to learn all the letters which resemble the stimulus letter, visually. This implies the influence of nature of alphabet on correct identification of component letters.



From the analysis it can be noticed that most of the errors committed by non-dyslexic poor readers and normal readers had visual or auditory similarity or both. But, in case of dyslexics, most of the errors were without any apparent similarity. This has suggested that the errors committed by them are not at all errors as no adequate learning of those letters might have taken place. Thus, it appears that most of the dyslexics (12/14) had visual-verbal association difficulty. Whereas most of the non-dyslexic poor readers (9/14) and normal readers (12/14) were not having such difficulties. But, whenever there is close similarity between the letters even normal readers of grades-III and IV committed mistakes while retrieving their names. This indicates that letter confusion is a normal phenomenon even at grades-III and IV, whereas letter learning difficulty even at the grades-III and IV is specific to dyslexics only.

Several investigators have identified different types of errors committed by dyslexics while identifying English words and have classified them depending on the possible causes for the same. Such observation and hypothesis can be re-examined in the light of the above findings/observations made in the study about letter substitution errors committed by dyslexics and the neuropsychological processes related to reading.

Letter identification errors are generally classified as due to 'visuospatial difficulties' and 'correlating' difficulties (Ingram, 1967). The errors like, b-d confusions are regarded as due to visuopatial difficulties, i.e., difficulty in perceiving the correct form and orientation of the stimulus letter. The error like, reading 'n' for 'r', 't' for 's', are considered to be due to difficulty in correlating, i.e., associating difficulty. In the present study, the latter type of errors are also observed in case of dyslexics while reading Kannada, whereas the former type of error are not observed among them. This is because of lack of provision for committing orientation error in Kannada alphabet. That means it is not possible to differentiate any two letters of Kannada alphabet on the basis of orientation. In majority of the cases the difference lies in the presence or absence of some visual features. Thus, committing orientation errors is not the universal phenomenon among dyslexics.

Coming to the causative factors - visuospatial difficulties and correlating difficulties - the present study has revealed that dyslexics did not differ from the remaining two groups in visual discrimination. Therefore, more number of errors with visual similarity committed by dyslexics cannot be attributed to difficulty in visual discrimination. Similarly, error with auditory similarity cannot be attributed to difficulty in auditory discrimination as hypothesised by some investigators like, Lingren (1969); Johnston (1982); as the dyslexics of the present study did not differ from the other two groups of readers. Instead, all the letter substitution errors may be due to visual verbal association difficulty as dyslexics in the present study differed significantly from the other two groups in visual verbal association ability. The finding in the study that at grades - III and IV even normal readers committed mistakes while reading, wherein there was auditory and visual similarity indicates that visual verbal association is difficult in case of letters which are having auditory and visual or both the counterparts, but this is due to deficiency only in establishing association and not in visual or auditory discrimination. Therefore, the notion that confusions between the letters by dyslexics are due to visuospatial difficulties becomes questionable. They can also be considered as correlating errors. Thus, all the letter substitution errors may be considered as correlating errors which can be attributed to the deficiency in visual verbal association.

#### **6.1.2.3. 'Kagunitha' Substitution Errors:**

In order to read Kannada it is not enough if the child learns only letters of the alphabet, but should also learn 'Kagunitha'. But, while analysing the errors committed by all the three groups of readers 'kagunitha' substitution error that is substituting one 'kagunitha' for the other (/ku/ for /ki/; /ge/ for /go/; etc'), were noticed. In order to find out whether 'kagunitha substitution' errors can become differentiating factors between dyslexics and the other two types of readers, the frequency and nature of 'kagunitha substitution' errors committed by dyslexics were compared with that of the other two groups of readers. The frequency of kagunitha substitution



#### Analysis of the Errors

errors committed by different groups of readers are given below;

Groups of readers	Dyslexics	Non-dyslexic poor readers	Normal readers
Frequency of errors committed	737	212	75
Total number of readers	14	14	14
Mean frequency	53	15	5

From the above data, it can be noticed that kagunitha substitution error were more among dyslexics compared to the other two groups. The ratio of the errors between dyslexics, non-dyslexic poor readers and normal readers is 10.6 : 3 : 1 respectively. In fact, the scope for committing this type of errors is more for normal readers and non-dyslexics poor readers compared to that of dyslexics. This is because, the normal readers and non-dyslexic poor readers of the study were having better letter knowledge whereas dyslexics were poor in that.

While analysing kagunitha substitution errors committed by normal readers, a regular pattern was observed in them. Most of such errors were of the type where long vowels were substituted for the short ones. The other errors committed by them were of the type where short vowels were substituted for long vowels and where the substitutes resemble the stimuli visually. But, in case of non-dyslexic poor readers and dyslexics there was no such regularity. This irregularity indicates that actually they were not errors, but only suggest that dyslexics had not yet learnt 'kagunitha'.

#### 6.1.2.4. Blending Errors :

After recognising the letters and 'kagunitha' correctly those individual sounds have to be blended properly in order to perceive them as whole words. In the present study, it has been found that all the three groups of children committed errors while blending the individual sounds. The frequency of blending error committed by all the three groups of readers are given below :

Groups of readers	Dyslexics	Non-dyslexic poor readers	Normal readers
Frequency of errors	139	145	34
Total number of children	14	14	14
Mean	9.2	10.35	2.4

Since normal readers could identify more number of letters and their 'kagunitha' correctly, chances of committing blending errors were more for normal readers than for the remaining two groups. Similarly, chances for committing blending errors were moderate for non-dyslexic poor readers and minimum for dyslexics. But, the data given above reveals that lesser number of such errors were committed by normal readers indicating that normal readers did not have considerable difficulty in blending the sounds. But, from the data given above it can be seen that both dyslexics and non-dyslexic poor readers committed more mistakes than normal readers which indicates that both the groups were having sound blending difficulty to a greater extent. This finding is supported by the results in the study related to the performance of the three groups of readers on word synthesis test.

Sound blending errors have been considered as one of the major types of errors committed by dyslexics while reading English (Ingram, 1967). The present study has revealed that such errors were committed by dyslexics while reading Kannada also. Therefore it can be inferred that irrespective of the extent of phonetic nature of script of particular language, dyslexics have difficulty in blending.

Further, it was attempted to see whether dyslexics differ from both the groups at least in the possible types of blending errors. The discussion follows.

The blending errors committed by all the three groups of readers could be broadly classified into six categories. They were :



*Analysis of the Errors*

- a) Conversion of short vowel into long vowel and vice versa.
- b) Errors committed when nasal sounds come. ]vskip.1cm
- c) No response.
- d) Omission or addition of 'stress'.
- e) Producing different words or set of sounds.
- f) Addition or omission of sounds.

The illustration for each sub-type of blending errors are given in the pages.

a) Conversion of Short Vowel into Long Vowel and Vice Versa :-

This type of errors indicate that during blending the short vowel became long vowel and vice versa at any place of the word and such a conversion was not restricted to any particular vowel sound. It can be noticed from the examples given Appendix IX. Such type of errors were committed by all the three types of readers.

b) Errors Committed when Nasal Sounds were Used :-

Children's inability to blend the nasal sounds was manifested in different ways - omission, substitution, addition, or giving 'stress' to the next consonant. The illustrations for each type of situation are given in the Appendix IX. It appears that, sometimes the addition of nasal sound can be attributed to children's experience in blending similar sounds. For example, the word 'satayisu' was read as 'santayisu'. In this case the sounds /sa/ and /ta/ might have elicited the word 'sante' (means market). Similarly, the sounds /ma/ and /sa/, the word 'mamsa' (mutton) instead of 'masa' (month). Similarly, the sounds /la/ and /ka/ 'lanke' (the name of the kingdom of the Demon, Ravana). But, such an assumption does not explain all the cases. For example, /pa/ and /da/ as 'pamda'. 'ihapara' as 'ihampara', which do not mean anything sensible.

The reasons for the children of the study to consider the symbol 'o' as representing the nasal sound 'um' only may be the way practice given at schools during teaching 'kagunitha'. At schools they usually teach /ka/ + /o/ as 'kum' ; /ta/ + /o/ as 'tum', etc. But, actually the sound that is represented by 'o' depends upon the consonant which follows it, that is, it takes the sounds of the nasal which falls to the same category to which the consonant following 'o' falls. For example, /ka/ + /o/ + /ba/ is 'kamba', whereas /ka/ + /o/ + /the/ is 'kanthe'.

The remaining two sub-types of blending errors reveal that sometimes the nasal sound that was represented by 'o' was omitted and the consonant sound following it was stressed. For example, the word /banta/ was read as 'batta'. On the other hand, sometimes the stress was removed and replaced by a nasal sound. For example the word 'kattina' was read as 'kantina'.

c) No Response :-

Even after identifying the component letters the children of the study sometimes failed to form word out of them which was evidenced by their 'silence', after uttering the sound of each letter. The examples of such a response given in the page reveal that there might not be any apparent reason which can explain such errors.

d) Omission or Addition of 'Stress' :-

It has been noticed in the study that some errors were of the type where there was either omission or addition of a consonant sound, so that 'stress' was either added or removed. For example, 'akka', 'gellalu' as 'gelalu'; similarly 'chilaka' as 'cillaka', 'haleya' as 'halleya'.

There is no apparent reason to explain these type of errors.



e) Producing Different Words and Non-words :-

This type of errors were occurred when the child identified each and every letter of the word correctly, but while blending produced altogether a different word or non-word. For example, after identified the letters of the word 'rasa' correctly the child read it as 'agasa'; similarly 'mensu' as 'avana'. From the examples given in the Appendix IX two sub-types of errors can be noticed. In set 'A' the words produced out of the correctly identified letters of the stimulus words had entirely different set of sounds. The reason for such a distortion may be either forgetting the sounds of the letters or lack of knowledge about the relation between individual letter sounds and the word.

It is interesting to note that such type of errors were committed by dyslexics only. Majority of the blending errors were of this sub-type only.

In the set 'B' the words produced from the correctly identified sounds of the stimulus words differed from the stimulus word in terms of the vowel sounds. For example, 'huḥḥu' was read as 'haḥḥu'. This type of errors were committed by all the three groups of children. The possible reasons for explaining the set 'A' type of errors may also hold good here. But, here the extent of distortion is relatively less compared to that of set 'A' type of errors.

f) Addition or Omission of Consonant Sounds :-

While blending the correctly identified sounds sometimes the children of the study omitted and added consonant sounds. Such addition or omission had resulted in non-words. Illustrations are given in the Appendix IX.

Although, each word provides a number of possibilities for making such errors, the frequencies of such errors were relatively low among all the three groups of readers as compared to other types of errors.

**6.1.2.5. Reversal Errors :-**

While analysing the errors committed by the three groups of readers it was observed that there were errors in which the order of the sounds were reversed in the word or part of the word. Such errors were considered as reversal errors. 'kalakala' --- 'lakalaka' ; 'rasa' --- 'sara' ; 'yajamana' --- 'jayamana' ; 'ivaru' --- 'iruva'.

It was observed that all the three groups of readers have committed such errors while perceiving the whole words as well as while blending the individual sound into words. But their frequencies were very low compared to that of the remaining types of errors. The main reason for this can be that the list of the words they read did not include many words that provided for reversals resulting into meaningful words. This implies that reversal errors may not be due to any specific disability. It may be only due to mere guessing or to impulsivity. If it would be due to any specific disability there could have been many reversals wherein the resulted word is actually a 'non-word'. But in the present study majority of the reversals formed by the children resulted into meaningful words Appendix IX. Only two non-words were noticed. But, it is interesting to note that they were committed by non-dyslexic poor readers and there was letter substitution in those words.

Usually the reversals are attributed to orientation difficulty among dyslexics (O'Neill and Stanley, 1976 and Morley, 1949). But on the basis of the observation made in the study that reversals occurred only when there was provision for committing such errors it can be inferred that this type of errors cannot be attributed to any disability in visual perception.

Another important observation made in the study regarding the reversal errors is that all the children did not commit reversal errors. The number of children who have committed reversal errors in each group are given below:



Groups of readers	Dyslexics	Non-dyslexic poor readers	Normal readers
Number of children who committed reversal errors	2	5	3
Total number of children	14	14	14

Generally, the earliest investigators have considered that committing reversal errors has to be the distinct feature of dyslexics. But, it is interesting to note in the present study that less number of reversals were committed by dyslexics - (Dyslexics : 2; Non-dyslexic poor readers : 5; and normal readers : 3).

Thus, it can be inferred that such errors are quite infrequent among any type of reader in Kannada and are not specific to any category of readers.

This finding has been supported by Gerry Taylor, Paul Staz and Jarette Friel (1979) whose study did not support the hypothesis that dyslexics are more prone to make reversals in letter sequence. Even, Shankweiler, Donald, Liberman and Isabelle (1978) have questioned on the basis of findings of their own study, whether dyslexics can be differentiated from other poor readers on the basis of a high rate of reversal errors. In their study neither group typically displayed a higher proportion of reversals than other types of errors.

In general, by the comparison of the different types of errors committed by the three groups of readers it can be noticed that all the three groups of readers committed all the types of errors. Although with respect to certain types of errors, there is quantitative variations, there appears to be no qualitative difference in the types of errors committed by them. Thus, recalling the hypothesis of the study that there is no qualitative difference in the types of reading errors in Kannada committed by dyslexics as compared to the other two groups can be retained.

## 6.2. THE SIGNIFICANCE OF ERROR ANALYSIS AS A TECHNIQUE OF IDENTIFICATION AND CLASSIFICATION OF DYSLEXICS

From the analysis of the errors committed by all the three groups of readers, the following observations were made.

- 1) Generally, dyslexics made use of word attacking skills while reading words whereas normal readers generally perceive whole words. Non-dyslexic poor readers read both the ways.
- 2) All the three groups committed common types and sub-types of errors. Thus, there was no qualitative difference in the errors committed by the three groups of readers. Though there appears to be considerable difference between dyslexics and normal readers in the quantity of different types of errors, dyslexics did not differ from non-dyslexic poor readers considerably.
- 3) The analysis of word substitution errors indicated that all the three types of readers were misled by common set of cues or mental operations.
- 4) The analysis of the letter substitution errors committed by all the three groups of readers revealed that there was auditory or visual similarity or both of them between the stimulus letter and the response letter. But, in some cases there was no any apparent similarity between the stimulus letter and the response letter and such responses were more frequent among the dyslexics of the study compared to the other types of readers. Errors with visual similarity were more frequent in all the three groups.
- 5) The analysis of kagunitha substitution errors revealed that normal readers usually substituted long vowels for short vowels and vice versa, and sometimes substituted with other 'kagunitha' which



resembled the s stimulus 'kagunitha' visually. But, in case of dyslexics and non-dyslexic poor readers there was no such regularity.

- 6) Both dyslexics and non-dyslexic poor readers committed more number of sounds blending errors compared to normal readers. The sound blending errors committed by all the three groups fell into common sub-types. But dyslexics differed from the other two groups in the sub-type 'producing different word and non-word'. In this sub-type dyslexics produced non-words which had entirely different set of sounds after blending the correctly identified sounds, whereas, the other two groups did not commit such errors.
- 7) Reversal errors did not differentiate dyslexics from the other two groups.

Thus, except in one or two cases, dyslexics did not differ from the other two groups in the nature of reading errors. Similar observation was made by investigators like, Collette, Martha (1979); Gerry Taylor, Paul Staz and Janet Friel (1979); Shankwiler, Donald, Liberman and Isabelle (1978); who studied the reading errors committed by dyslexics.

Several hypothesis have been made to explain the errors committed by dyslexics. Confusion between any letters and reversals are generally thought to be as due to faulty or deficient visual perception (Morley, 1949; Waites, Lucius, 1980). But the present study has revealed that dyslexics did not differ from the remaining two groups in visual processing functions. This casts doubt on the hypothesis made by the above investigators that such confusions can be attributed to visuospatial difficulties. Since it was found in the present study that there was no significant difference between the three groups in auditory discrimination ability, the confusion between the letters which resemble each other auditorily cannot easily be attributed to deficiency in auditory discrimination ability. As dyslexics demonstrated deficiency in visual verbal association ability in the present study all the letter substitution and kagunitha substitution errors can be attributed to association difficulty only. The observation that in majority of the cases, normal readers and non-dyslexic poor readers substituted only those letters which are having visual or auditory similarity with the stimulus letters indicate that the similarity between the letters make the association between particular grapheme and phoneme difficult. As learning of such letters is a problem to normal readers themselves it is but natural for dyslexics who are deficient in association ability to take longer time to learn them. This may be the reason for dyslexics to commit such errors for much longer than other types of readers and with respect to other type of letter substitution wherein there is no apparent similarity between the stimulus letter and the response letter.

The idea that all the letter and kagunitha substitution errors can be attributed to association difficulty alone is supported by the Shankweiler, and Liberman (1978) that "the difficulties manifested in the common error pattern by dyslexics are chiefly outside the domain of visual perception. They are language related and are not specific to the visual perception of language". Apart from these investigators, others like, Liberman, Shankweiler, Orlando, Harris and Berti (1971) on the basis of their studies have concluded that the positional and directional errors commonly observed in poor readers are linguistic intrusion (mislabelling) errors rather than perceptual inaccuracies.

In this contest there arises two objections about the significance of error analysis.

Firstly, since as observed in the present study and the other supporting studies there is no significant qualitative and quantitative differences between dyslexics and non-dyslexic poor readers, does error analysis alone help in identifying dyslexics ?

Secondly, as dyslexics differed from other two groups only in association ability is it reasonable to classify dyslexics as visual, auditory or auditory visual on the basis of types of errors only as attempted by Boder (1971) and (1973). This doubt is also expressed by Miles (1991). (Rama & Lalithamma (1987), Ramaa etal (1993))



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*Analysis of the Errors*

Therefore, it appears that errors analysis alone does not help in identifying and classifying dyslexics. And therefore a set of criteria and diagnosis of neuropsychological abilities are very much essential to identify and classify dyslexics.

One important implication of the finding, that there is no difference among the three groups of readers in the nature of reading errors is that in order to explain the errors committed by dyslexics, it is not necessary to study dyslexics alone. If it is possible to understand the factors responsible for reading errors among normal readers, it is possible to understand the errors committed by dyslexics also as dyslexics are not 'different' from normal readers but are more 'deficient' than the latter in the abilities related to reading.

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## REMIEDIATION OF DIFFERENT TYPES OF DYSLEXICS

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### 7.0. INTRODUCTION

The remedial phase of the present study had two objectives.

- a) To plan out common remedial programmes for different types of dyslexics.
- b) To study the effectiveness of the above remedial programme in improving the speed and accuracy of words recognition in case of dyslexics.

Thus, remediation of dyslexia constituted two phases - preparation/planning phase wherein the remedial programme had to be prepared and validation phase wherein the remedial programme had to be tried out on dyslexics for their effectiveness in improving speed and accuracy of Kannada word recognition.

### 7.1. PLANNING REMEDIAL PROGRAMME

In order to meet the first objective of the remedial phase the data related to the following entering behaviours of dyslexics were thought to be relevant for planning/preparing remedial programme.

- i) Data related to strengths and weaknesses of each dyslexic in the neuropsychological processes underlying word recognition.
- ii) Data related to the types of errors committed by each dyslexic while reading Kannada.

The diagnostic phase of the study showed that there were different types of dyslexics - visual, auditory, auditory-visual and basic. And, further, it was found that the types of dyslexics were inadequate in word attacking skills, that is, grapheme-phoneme correspondence and word synthesis.

The latter suggested the need to enable the dyslexics to learn all the letters of Kannada alphabet, 'Kagunitha', and other accessory forms and also to acquire the skill of word analysis and synthesis. This necessitated the writing of a series of lessons. Since the objective of the present study was to develop common remedial programme to all the types of dyslexics in order to write such lessons, an analysis of the relevant learning principles that should underlie them, and treatment procedure that may be employed was thought to be necessary. Below are given their brief outlines.

#### 7.1.1. Principles Underlying the Remedial Programme

Principles suggested by various authors like, Tansley (1967), Newton (1960), Richardson, et al (1971) and Staulter (1951), were kept in mind in writing the lessons and also while administering them to dyslexics. Mainly they were:

- 1) Dyslexic children need to over-learn information so that it is not forgotten. Therefore, considerable time should be devoted to revision of earlier work.
- 2) Because the dyslexic child forgets quickly new material should be presented frequently and in a number of ways. Thus:
  - a) Learning appears to be optimal after the following stages have been followed :  
recognition, recall, relearning, recall.
  - b) Learned material should be presented in a variety of situations so that the child can generalise his knowledge.
- 3) Remedial help should refer to the precise skill to be learned rather than to an assumed gross deficit. Thus, b/d confusions may well be a product of directional confusion, but it is more productive if



the child is trained specifically on b/d discriminations, rather than on general directions.

- 4) In selecting the child's beginning reading vocabulary, it should be made sure that the words are within the student's range of experience and different with reference to sound and visual configuration.
- 5) Learning must be guided, controlled and made explicit in the early stages. This implies that training may be needed to clarify sensory experiences.
- 6) Treatment must be consistent and regular.
- 7) The child must be actively involved in the learning process, rather than passively assimilating. The child should be allowed to discover the rule if possible and then define it.
- 8) The child should be continually busy at a 'meaningful' task during the remedial session. Immediate feedback is essential for the child to evaluate the adequacy of his response. Also, the teacher should either prevent, or immediately correct, spelling errors to ensure continual reinforcement of correct spelling patterns and thus aid assimilation and memory.
- 9) Multi-sensory attack should be made using visual, auditory, tactile and kinesthetic links supported by spoken language, mnemonics and verbalisations.
- 10) Because, the dyslexic child has had a lot of school failure, it is possible that he has become very undermotivated when he is presented with the written word. To help him become more motivated the following tactics may be helpful:
  - i) the initial part of the remedial session should involve activities on which the child should achieve success as easily as possible, since this will act as a motivator.
  - ii) the learning task should be divided into sub-skills so that the child can master each of them easily and keep himself highly motivated throughout learning the task.
- 11) A more therapeutic approach is needed, that means, teaching must inspire the non-reader to new efforts and increased confidence. The establishment of good teacher-child relationships which encourage co-operation, hopefulness, renewed interest and enthusiasm, and a will to succeed is absolutely essential. The teacher must establish a partnership with the child in teaching what is in essence a problem for both of them.

#### **7.1.2. Main Features of the Remedial Programme**

The main features of any remedial reading programme are not only dependent on the objectives of such a programme, the principles that form the basis for it but also on the nature of the script of any language in which the programme is developed. Thus, the effectiveness of a remedial programme depends upon the extent to which the distinct features of script of any particular language are identified and made use of in planning the remedial programme. The script of Kannada language like that of most of the other Indian languages is characterised by perfect one to one correspondence. that means, almost all the distinct sounds of Kannada language are represented by distinct symbols. Thus, there are 50 symbols in the alphabet and in addition to that 36 X 16 sets of symbols representing consonant + vowel, consonant + diphthong and other sounds (vide Appendix X and XI). For details of kannada script see Prakash & Joshi, 1989. Apart from this there are other symbols representing consonants which are, in addition to other consonants, used to represent CCV sounds. Since there is considerable visual similarity, auditory similarity and auditory visual similarity among the different symbols (vide 6.1.2.2) of Kannada script, such a symbol system in addition to the number, further increases the complexity to master it. It appears more complex to dyslexics compared to normal readers to master it, as they are deficient in visual verbal association. Hence, greater practice is needed for dyslexics to learn all those symbols. One important advantage of such a symbol system in spite



of its complexity to learn is that with a given set of letters it is possible to coin a number of different words so that sufficient practice can be given during teaching to learn them adequately. The main features of the remedial programme given below reflect the objectives of such a programme, principles underlying them and also the extent to which distinct features of Kannada script are made use of.

The programme that was common for all dyslexics mainly constituted teaching of Kannada alphabet, 'kagunitha', and other accessory forms and to give practice in word analysis and word synthesis, through a number of lessons. These lessons have the following characteristics :

- 1) Each lesson has two specific objectives -
  - a) Providing opportunities to establish association between particular grapheme and phoneme.
  - b) Giving practice in analysis and synthesis of particular words.
- 2) Each lesson except the first one introduced only one grapheme at a time; the first lesson had two letters to be learnt.
- 3) The order of teaching graphemes does not follow the conventional sequence. Teaching of certain low frequency letters sometimes follows that of teaching 'kagunitha' and other accessory forms.
- 4) Each lesson includes almost all the possible words coined out of the graphemes taught in that lesson, as well as those in previous lessons. The number of words in each lesson may vary from 2 to 25. Thus, there was a provision for cumulative learning and practice.
- 5) The lessons were arranged in a particular order, which allowed revision and evaluation of the previous learning as well as practice for the present learning. So, the lessons should be taught in the same sequence.
- 6) By learning only one new letter, the child can read the remaining words of each lesson. Thus, the motivation of the child could be maintained at a higher level.
- 7) If the child could read the first word of any lesson on his own, it suggested that, that lesson need not be taught through special efforts.
- 8) The important feature was that the lessons neither followed an alphabetic approach nor an whole word approach completely. It followed an eclectic approach. Since the lessons were cumulative in nature, there was adequate opportunity for the child to practice and learn new letters. The child could make use of his letter knowledge and word synthesis ability in perceiving certain words, which might be a part of the child's sight vocabulary. The child could make use of his memory for words and word analysing ability in recognising individual letters. Thus, learning of individual letters and words occurred simultaneously and were mutually complementary. But, here there was no need for every child to learn one particular set of sight vocabulary. There was provision for each child to remember one or more words which he found easier to remember. Thus, through these lessons it could be possible to teach different types of dyslexics who, actually, had to be taught through different approaches. For details of the remedial programme see, Ramaa (1989).

### **7.1.3. Planning for Treatment Procedure**

After the lessons were written as above, the procedure for making use of them for remedial purposes was also outlined. Both these steps together constituted the planning phase of the treatment procedure. Although the principles that based the lessons were implied in the actual use of the lessons, the additional learning principles were implied in the approach followed in using the lessons. As mentioned earlier (vide Chapter - I and section 1.3), the approach was mainly multisensory. While learning each lesson, the child had to make use of auditory, visual and kinesthetic senses almost simultaneously. While learning each lesson opportunities were provided for listening, seeing, articulating orally and writing each letter.



### Lesson No.1

Specific objectives -

- a) to learn letters 'ma' and 'ra',
  - b) to learn the synthesis and analysis of the word 'mara' (tree), and
  - c) to apply the letter knowledge and word synthesis ability in recognising new words.
- a) Teaching the Letter 'ma' :
- 1) The letter 'ma' written on a card should be exposed to the child and its name should be told.
  - 2) The child should be asked to copy the letter and utter its name simultaneously.
  - 3) The child should recognize the letter 'ma' mixed up with other letters, which resemble 'ma' visually, such as 'va', 'ya' and 'pa'. When the child fails in recognising correct letter should be shown. Whether fails or succeeds in recognising, the child should point out the differences between all these letters. This would clear visual discrimination and help in remembering the visual feature of the letter 'ma'.
  - 4) After learning to recognize, the child should write the letter without looking into the model.
  - 5) The child should recognize 'ma' among several other letters and the words also. Thus, practice in recognition and recall would help the child to remember the visual form of the letter. More than that, since the child would recognize and write the letter telling its name simultaneously, grapheme-phoneme association would be established firmly. Thus, the child would see, write and hear a letter and learn it.

#### Teaching the Letter 'ra' :

The steps to be followed were similar to that of teaching the letter 'ma'.

#### b) Teaching the word 'mara' :

The child should be asked to blend the sounds 'ma' and 'ra' presented auditorily. If the child would do it, he could easily perceive the letters written together as 'mara'. Otherwise training in word synthesis could be given as follows :

- 1) The letters 'ma' and 'ra' written on separate cards had to be kept at a distance of about three inches apart. The child should be asked to name them separately.
- 2) The distance between both the letters had to be gradually reduced and finally had to be kept together and should be asked the child to perceive it as a whole. The visual closure would help in auditory closure also. If the child fails, the tutor should tell the name of the word.
- 3) The cards should be moved away and towards each other for about 3-4 times. Each time the child should tell the names of individual letters and word. The child should tell the sequence of letters in that particular word.
- 4) The child should form the word out of letters written on cards and that were mixed up with other letters.
- 5) The child should recognize the word among other words and should write it out without looking into the card.
- 6) In order to facilitate word analysis and synthesis simple devices like a card-board with slots to scan words could be made use of. One slot should be wide enough to reveal only one letter at a time whereas the other slot to see the whole word at a time. The appropriate movement of cards having words written on them, through the slot, would help in word analysis and



synthesis. Written exercises like the ones below also would aid in learning letters and word analysis and synthesis.

mara -----  
ma ra -----  
mara -----

All these steps would help the child to (i) remember the visual feature of letters 'ma', 'ra' and the word 'mara'; ii) to learn the names of 'ma', 'ra' and 'mara'; and iii) to analyse and synthesise the word 'mara'.

c) Application of the Above Learning in the New Context :

This would be made possible by asking the child to recognize the word 'Rama' (name of a girl) which consists of the same letters constituting the word 'mara', but in a different sequence. In order to read this word the child should perceive both the letters individually and then blend them together. Success in this would confirm the achievement of specific objectives of this lesson.

#### Lesson No.2

Specific objectives -

- a) to learn the letter 'sa',
- b) to learn the analysis and synthesis of the word 'sara' (chain), and
- c) to apply the letter knowledge and word synthesis ability in new situation.

The first word of this lesson was 'sara'. The steps to be followed in teaching this lesson were as follows:

- 1) The card having this word should be kept in front of the child and should ask the child to name the component letters of the word. As he had already learnt in the previous lesson, he would recognize the letter 'ra'.
- 2) The tutor should form the word 'sara' with letters written on cards. The child would recognize the letter 'ra'.
- 3) The two letters written on cards should be moved apart and the child should be asked to tell how many letters are there, how many letters he had already learnt. This would motivate the child to learn the letter 'sa'.

The steps to be followed to teach the letter 'sa' and the word 'sara' were same as that of the ones described in the previous lesson. The child would make use of his present and previous learning in recognising the remaining words of the lesson - 'rasa' (juice), 'sama' (equal), 'samara' (war). Thus, there would be adequate provision for cumulative learning and practice.

#### Lesson No.3

Special objectives -

- a) to learn the letter 'ga',
- b) to learn the analysis and synthesis of the word 'garagasa' (saw (N)), and
- c) to apply present and previous learning in new situations.

In the word 'garagasa', the child would already learnt the letters 'ra' and 'sa'. The specific objectives of this lesson could be achieved in the same way that would be followed in the previous lessons. The child would make use of his present and previous learning in recognising the remaining words of this lesson - 'maga' (son), 'gasagasa' and 'garagara' (non-words but describe the sound produced by any object).

The above planning of treatment procedure helped the investigator in making the treatment procedure as uniform as possible in case of all the dyslexics selected for remediation.

## 7.2. EVALUATION OF THE EFFECTIVENESS OF THE REMEDIAL PROGRAMME

### 7.2.1. Experiment Conducted to Evaluate the Remedial Programme.

In order to meet the second objective of the remedial phase of the study, namely, "to study the effectiveness of the remedial programme in improving the speed and accuracy of word recognition, in case of dyslexics" an experiment was conducted. The details of the experiment are given below :

#### Sample :

Remedial programme was tried out on 6 dyslexics only for the reasons mentioned in Chapter - III and section 3.3.5. But still it was made as representative as possible in terms of the neuropsychological strengths and weaknesses of dyslexics. The table below gives the profile of strengths and weaknesses of each dyslexic child in the neuropsychological processes underlying word recognition.

**Table 7.1 : STRENGTHS AND WEAKNESS OF DYSLEXICS SELECTED FOR REMEDIATION IN THE VARIOUS NEUROPSYCHOLOGICAL PROCESSES**

Neuropsychological processes	Dyslexics selected for remediation					
	1	2	3	4	5	6
Visual discrimination	A	A	C	B	B	B
visual sequential memory	B	C	B	C	A	A
Visual recognition	B	B	B	B	B	A
Visual recall	B	C	A	B	C	B
Auditory discrimination	A	C	C	A	B	A
Auditory sequential memory	A	B	B	A	A	A
Visual verbal association (word context)	A	A	A	B	B	A
Visual verbal association (in isolation)	B	B	A	C	B	A
Word analysis	C	A	A	B	A	B
Word synthesis	B	A	B	B	A	A

Note : A = Below average ability (deficiency)

B = Average ability (adequacy)

C = Above average ability (adequacy)

From the above table it is revealed that at least one dyslexic was deficient and at least one was adequate in each of the variables. Further, no child was poor in all in the variables. Thus, the sample was selected in such a way as to represent deficiency and adequacy in each of the neuropsychological processes related to word recognition, among dyslexics. The classification of the dyslexics based on strengths and weaknesses in the neuropsychological processes has revealed that the Cases 1 and 4 were visual dyslexics, the Cases 2,3 and 5 were auditory dyslexics and the Case 6 was auditory visual dyslexic. Thus, the sample included visual, auditory and auditory-visual dyslexics in the ratio 2:3:1. There were two girls and four boys, when the remediation was started they were studying in grades - IV and V. Two dyslexics were studying in grade-IV and other four in grade- V.

#### Design of the Experiment:

Because of the inter individual differences among dyslexics and difficulty in getting controls, a single case pretest-post-test design was thought to be appropriate in the context of the present experimental study. The design of the experiment can be represented as follows :



Pre-test : Measurement of speed and accuracy of word recognition, and letter recognition; level of reading comprehension; word analysis and word synthesis abilities.

Treatment : Administration of remedial programme.

Post-test : Measurement of speed and accuracy of word recognition and letter recognition; level of reading comprehension; word analysis and word synthesis abilities.

**Pre-test :**

Pre-testing was done by administering six tests that were in Kannada, namely, Kannada Oral Reading Test (Jaya Bai, 1958), Kannada Word Recognition Test (untimed), Letter Recognition Test (untimed), Reading comprehension Test, Word Analysis Test and Word Synthesis Test (all developed by the investigator).

**Controlling the Intervening Variables:**

In order to make the treatment uniform to all dyslexics and to avoid the influence of intervening variable like, special efforts to teach reading to dyslexics, parents were instructed not to make such efforts to either by tutoring at the home or by sending their child to tuition. They were asked to help their child as per the instruction given by the investigator.

**Treatment :**

The remedial programme prepared in the first part of the remedial phase (vide section 7.1) was tried out on dyslexics in the second part of the same phase. The experimental treatment consisted of administering the remedial programme individually, keeping in mind, the principles and procedure to be followed, which are already specified (vide section 7.1.1.). Same kind of treatment was given to all the types of dyslexics.

**Time required :**

The whole period of treatment required 16 sessions of one hour in case of visual and auditory dyslexics and 24 sessions of one hour in case of auditory-visual dyslexic. The investigator used to meet the visual and auditory dyslexics twice a week and auditory-visual dyslexic three times a week.

**Measures Taken to Overcome Specific Difficulties:**

In the beginning of each session there was an evaluation of previous learning in an informal way by asking the child to read certain words selected from the previous lessons. This informal evaluation was helped the investigator in observing the specific difficulties of each child and using proper measures to overcome them. The investigator observed that the dyslexics were getting confused with letters which either resembled each other visually or auditorily.

In these cases verbalisation of the differences, developing sight vocabulary, mnemonics around the specific features of the letters were found to be effective in establishing proper association between sound and symbols.

The realisation of the principle that in Kannada language vowels do not come in isolation, in the middle or at the end of words helped them in overcoming confusions between symbols representing the sounds 'e' and 'ye'; 'a' and 'ha'.

Perception of the similarity between one set of 'kagunitha' with the remaining 35 sets by the child reduced the amount of effort needed to learn 36 X 16 symbols if they had to be learnt as entirely different entities. That is, if a child could learn one set of 'kagunitha' accurately, he could learn the remaining 35 sets easily. Moreover, the conventional verbal description of each symbol (kagunitha) also helped in learning 'kagunitha'.

Keen observation and awareness of the kinesthetic experience by the children, during articulation of sounds and associating it with the details of the particular visual feature helped in acquiring the skills of word



analysis and synthesis. For example, in overcoming the confusion during blending the sounds 'ra' and 'ma' into 'Rama' (name of the boy) and 'ra' and 'ma' into 'Rama' (name of the girl), a link between the width of the mouth to be opened in both the situations and length of the lines of the letters ( ra and ra ) helped to a greater extent.

The knowledge of the principle that the sound that is represented by the symbol 'o' varies with the consonant sound which follows it, that is, the symbol 'o' usually represents the nasal sound which is similar to the consonant following it in terms of point of articulation. Thus, 'o' preceding 'pa' represents the sound 'um', 'e' represents 'un'.

Synthesising the words having symbols representing CCV sounds was made easier by teaching dyslexics to split the CCV sound in a proper way. Here the underlying principle is that during blending the first consonant of CCV sound loses its vowel sound, whereas its counterpart acquires it. For example, while reading the word 'mukta' it can be split into 'muk' + 'ta'. Similarly 'mukti' can be split into 'muk' + 'ti'.

Thus, during the course of treatment, the investigator identified certain characteristics/principles of teaching Kannada reading and developed an awareness of such characteristics among the dyslexics so that it could be possible to overcome certain specific difficulties faced by them.

**Post-test:**

Post-testing was done by administering all the tests that were administered during pre-test, to all the dyslexics.

**7.2.2. Analysis and Discussion of Results Related to Remedial Programme**

The remedial programme developed in the study for dyslexics was experimentally validated following the procedure as discussed above. The results related to this validation phase also helped in verifying the following hypothesis "speed and accuracy of word recognition of dyslexics tend to improve through the remedial programme employed in the study".

Since the experimentation involved a single case design, no statistical techniques could be employed for the analysis of results. Instead the pre-test-post-test observations on the criterion variables were compared in each individual cases. Hence, the analysis of results has been mostly qualitative in nature and validation of the remedial programme and verification of hypothesis are also based on such an analysis. The tables 7.2 to 7.7 given below provide data about pre-test and post-test performance of all the 6 cases on the criterion measures.

(i) Case 1 : (No.2 in Table 7.1)

Sex : Male; Grade : V; Type : Auditory Dyslexic

**Table 7.2 : PRE-TEST-POST-TEST PERFORMANCE OF THE CASE 1 ON ALL THE TESTS**

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	78	9	95	5	2.5
Word recognition test in Kannada	100	44	34	89	24	4.2
Kannada oral reading test	50-60 words/mnt	14	1	17	1	1
Reading comprehension test in Kannada	28+	15	--	21	--	--
Word analysis test in Kannada	33	26	--	26	--	--
Word synthesis test in Kannada	24	18	--	20	--	--



(ii) Case 2 : (NO.3 in Table 7.1)

Sex : Male; Grade : V; Type : Auditory dyslexic

TABLE 7.3 : PRETEST-POST-TEST PERFORMANCE OF THE  
CASE 2 ON ALL THE TESTS

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	71	5	92	7	2.5
Word recognition test in Kannada	100	37	16	92	20	4.2
Kannada oral reading test	50-60 words/mnt	7	1	18	1	1
Reading comprehension test in Kannada	28+	9	--	13	--	--
Word analysis test in Kannada	33	27	--	24	--	--
Word synthesis test in Kannada	24	15	--	19	--	--

(iii) Case 3 : (No.5 in Table 7.1)

Sex : Female; Grade : V; Type : Auditory Dyslexic

TABLE 7.4 : PRETEST-POST-TEST PERFORMANCE OF THE  
CASE 3 ON ALL THE TESTS

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	53	5	92	6	2.5
Word recognition test in Kannada	100	22	13	85	30	4.2
Kannada oral reading test	50-60 words/mnt	8	1	13	1	1
Reading comprehension test in Kannada	28+	6	--	19	--	--
Word analysis test in Kannada	33	30	--	27	--	--
Word synthesis test in Kannada	24	20	--	20	--	--

(iv) Case 4 : (No.1 in Table 7.1)

Sex : Female; Grade : IV; Type : Visual Dyslexic

Table 7.5 : PRETEST-POST-TEST PERFORMANCE OF THE  
CASE 4 ON ALL THE TESTS

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	77	5	92	4	2.5
Word recognition test in Kannada	100	56	16	98	10	4.2
Kannada oral reading test	40-50 words/mnt	9	1	27	1	1
Reading comprehension test in Kannada	28+	11	--	19	--	--
Word analysis test in Kannada	33	32	--	32	--	--
Word synthesis test in Kannada	24	18	--	20	--	--

(v) Case 5 : (No.4 in Table 7.1)

Sex : Male; Grade : V; Type : Visual Dyslexic

TABLE 7.6 : PRETEST-POST-TEST PERFORMANCE OF THE  
CASE 5 ON ALL THE TESTS

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	55	10	96	6	2.5
Word recognition test in Kannada	100	4	19	92	35	4.2
Kannada oral reading test	50-60 words/mnt	3	1	12	1	1
Reading comprehension test in Kannada	28+	0	--	13	--	--
Word analysis test in Kannada	33	30	--	30	--	--
Word synthesis test in Kannada	24	19	--	21	--	--

(vi) Case 6 : (No.6 in Table 7.1)

Sex : Male; Grade : IV; Type : Auditory - Visual Dyslexic



TABLE 7.7 : PRETEST-POST-TEST PERFORMANCE OF THE  
CASE 6 ON ALL THE TESTS

Tests	Expected score /Maximum score	Pre-test score	Time taken mts	Post-test score	Time taken mts	Average time required by normal readers of grades III and IV mts
Letter recognition test in Kannada	100	35	14	94	7	2.5
Word recognition test in Kannada	100	2	38	83	30	4.2
Kannada oral reading test	40-50 words/mnt	1	1	9	1	1
Reading comprehension test in Kannada	28+	0	--	8	--	--
Word analysis test in Kannada	33	24	--	24	--	--
Word synthesis test in Kannada	24	16	--	17	--	--

From the analysis of the pre-test post performance of all the cases, the following observations were made:

- (1) The pre-test scores on letter recognition test in Kannada ranged from 35 to 78, whereas post-test scores ranged from 92 to 96 indicating the improvement in the accuracy of letter recognition in all the cases. Further, it has been observed that in the post-test their performance was almost close to the level of performance expected on this test. There was a considerable decrease in the frequency of all the types of errors committed in the post-test compared to pre-test.  
The average time required to complete the tasks during and post-test were 8 minutes and 5.83 minutes respectively. But, it is interesting to note that only in four cases there was a reduction in the time required to complete the task in the post-test compared to the pre-test, whereas in the remaining two tests there was an increase in the time in the post-test compared to the pre-test.
- (2) The pre-test scores on Kannada word recognition test ranged from 2-56, whereas post-test scores ranged from 83-98 indicating the improvement in the accuracy of word recognition in all the cases. The post-test performance in all the cases was almost closet to the mastery level on this test. There was a considerable reduction in the frequency of all the types of errors committed while recognising the words in post-test compared to pre-test.  
The average time required to complete the tasks during pre-test and post-test were 22.56 and 20 minutes respectively. But, it is interesting to note a reduction in the time required to complete the task in the post-test compared to pre-test in only those four cases which required relatively lesser time in the post-test on letter recognition test also. The same two cases which required relatively more time in the post-test on letter recognition test required more time on this test also.



- (3) The number of words read per minute in the pre-test on Kannada oral reading test ranged from 1-14, whereas in the post-test from 9-27. The average number of words read per minute was 7 in case of pre-test and 16 in case of post-test indicating an average improvement by one grade on this test as during pre-test they were reading less than I grade level and during post-test they could read at the I grade level.
- (4) The pre-test scores on reading comprehension test in Kannada ranged from 0-15, whereas post-test scores ranged from 8-21. The mean score on this during pre-test was 5.16 and during post-test was 15.5. This suggests that in the pre-test their comprehension level was below that expected for grade-I children (expected score was 9) and during post-test their comprehension level was slightly more than the level expected for grade - II children (expected score was 14)
- (5) It has been observed in the study that out of the 6 cases in 4 case there was no any change in the pre-test and post-test scores on word analysis test in Kannada, whereas in two cases there was a decrease in the post-test scores compared to pre-test scores.

In five cases there was a slight increase in the post-test scores on word synthesis test compared to pre-test scores and in only one case there was no any difference between pre- and post-test scores.

From the above findings it can be inferred that irrespective of the initial position in letter and word recognition there was an improvement in all the types of dyslexics. The ranges of scores in the post-tests on letter and word recognition tests were very narrow compared to the ranges of scores in the pre-tests and also very close to the expected score indicating the effectiveness of the remedial programme in improving the accuracy of letter and word recognition to a greater extent in all the types of dyslexics and also among dyslexics of varied level of abilities that are related to reading performance. Hence, the research hypothesis that accuracy of word recognition of dyslexics tend to improve through the remedial programme can be retained when the speed of letter and word recognition is considered it can be noticed that there was a slight improvement in the rate of recognition even after the remediation in only 4 cases, who were of course still very poor compared to the normal readers of grade-III and IV. Apart from this in two cases there was a reduction in the speed of letter and word recognition in the post-test compared to the pre-test. This variation from the trend observed in other cases can be attributed to the undermotivation and more impulsivity among those cases as a consequence of inability to read in the pre-test which made them to complete the task within a shorter time compared to the post-test. Whereas in the post-test, because of the increased self-confidence they attempted to recognize each letter and word with greater interest which made them to take more time. Anyhow, from the findings it can be inferred that the remedial programme was less effective in improving the speed of letter and word recognition. Hence, the research hypothesis that speed of word recognition of dyslexics tend to improve through the remedial programme cannot be retained.

Though it is possible to attribute the improvement in the accuracy of word recognition to the increased accuracy of letter recognition which in turn can be attributed to the effectiveness of the remedial programme nothing can be said about the effectiveness of the remedial programme in improving the word synthesis which is essential to recognize the words. This is because majority of the errors in the pre-test on word recognition test were letter and kagunitha substitution errors and thus there was a less provision for committing blending errors. As a result there was no any reference in the pre-test to compare the post-test scores and to see whether there was any reduction in the number of blending errors which can be attributed to the remedial programme.



The observed improvement in the level of reading comprehension in all the cases in the post-test compared to the pre-test can be to a greater extent attributed to the increased efficiency in the recognition of words as they could read relatively more number of passages in the post-test compared to the pre-test with lesser mistakes. Anyhow, the low level of reading comprehension even in the post-test compared to the expected level for the respective grades can be partially attributed to the very slow rate of reading among all the cases.

Out of the 6 cases, in four cases there was no any improvement in the level of word analysis in the post-test in comparison with that of the pre-test. This suggests that the remedial programme was not effective in improving the word analysis ability. But, it is also possible to explain this apparent lack of improvement in two different ways. While giving the practice in word analysis the written words were used. Thus, there was visual analysis of the word prior to verbal analysis. Whereas, while testing since the words to be analysed were presented auditorily there was no provision for visual analysis which could help in verbal analysis. On the other hand, it may be also possible that the word analysis is a function of time. Such an inference is based on the observation that the pre-test scores of all the cases were more than that of the scores obtained by those cases when the same test was administered during the diagnostic phase of the study, that is, 7-8 months before the pre-test. During such an interval there was no any special effort to improve word analysis among the dyslexics. This indicates that there will be an improvement in word analysis among every individual along with the age. In that case the time gap between pre-test and post-test can be considered as very small to expect any improvement in word analysis.

The observation that in two cases there was a decrease in the level of performance on post-test compared to the pre-test cannot be explained easily.

The observation that in five cases there was a slight improvement in the word synthesis ability in the post-test in comparison with pre-test in one case absolutely there was no any change indicate that the remedial programme was least effective in improving the level of word synthesis among dyslexics. This observation can also be explained in the same way that is attempted in case of word analysis. During practice given to improve word synthesis, since written words were used, the visual closure helped in auditory closure (sound blending). Whereas during testing the component sounds of words were presented auditorily as a result there was no provision for visual closure which could help in blending the sounds. Like word analysis, word synthesis can also be considered as a function of time. Such an inference is based on an observation which is similar to the one made with respect to word analysis.

The observation that there was a considerable improvement only in the accuracy of word recognition, but not in the speed of word recognition indicates that apart from deficiency in visual verbal association dyslexics have deficiency in lexical encoding or word retrieval also as suggested by various investigators like, Enklin and Douglas (1971), Spring and Capps (1974); Perfetti and Hogaboam (1975), Spring (1976), Ellis and Miles (1981). Thus, dyslexics are having problem in both learning and retrieval. As a result reading should be taught through specially designed programme and sufficient practice should also be given for the increasing the rate of reading process.



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**MAJOR FINDINGS AND THEIR INTERPRETATION**


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**8.1 Differentiation of Dyslexics by Neuropsychological Factors**

- (1) Dyslexics are differentiated from normal readers only by four out of the ten variables selected for the study; they are auditory sequential memory, visual verbal association, word analysis and word synthesis. But, they differ from non-dyslexic poor readers only in visual verbal association and word analysis. This suggests the existence of three groups of readers. Further, it can be inferred that dyslexics are differentiated from both the remaining two groups by visual verbal association and word analysis abilities only. But, since the effect of deficiency on word analysis may vary with the nature of the script of any language concerned, that is, to what extent it is phonetic, visual verbal association may be considered the primary differentiating factor between dyslexics and non-dyslexics. Thus, a dyslexic can be defined as one who is essentially deficient in visual verbal association.
- (2) Along with the deficiency in visual verbal association, in comparison with other readers each dyslexic may or may not have deficiency in one or more visual and/or auditory processing skills. Thus, it is possible to get different types of dyslexics. Depending on the presence or absence of deficiencies in auditory or visual or auditory and visual processing skills in addition to deficiency in visual verbal association, it is possible to get four types of dyslexics as follows:
  - (a) Visual dyslexics - deficiency in visual processing skills.
  - (b) Auditory dyslexics - deficiency in auditory processing skills.
  - (c) Auditory-visual dyslexics - deficiency in both auditory and visual processing skills.
  - (d) 'Basic' dyslexics - deficiency in none of those skills.

The inconsistency observed in the findings of previous investigations regarding deficiencies in dyslexics, in particular, in auditory and visual processing skills, can therefore be attributed to the heterogeneity among dyslexics.

- (3) Though, normal readers are expected to be normal in auditory, visual and association skills, it appears that larger number of normal readers are deficient in visual processing skills compared to the two groups of poor readers. This indicates two things. On the one hand it suggests that normal readers are relatively more verbal oriented. On the other hand, it implies that deficiency in visual processing skills may not affect reading performance to a great extent. This may be due to the fact that children need not completely depend on visual skills while learning reading as tracing or kinesthetic experience is also provided in schools, at homes while teaching Kannada alphabet. Usually, in schools the letters of Kannada alphabet are written on the blackboard in a particular order (i.e., conventional) and the name of each letter is told by the teacher. The children are then asked to copy them and simultaneously utter the name of each letter. While writing, the children observe the details of each letter carefully. This helps the children to discriminate the letters visually. Perception of the similarities and differences between letters by children helps in memorising the visual features also. Thus, the extent to which deficiency in visual processing skills affects the learning of visual features of the letters can be reduced through kinesthetic experience. Since the child simultaneously utters the name of each letter, association between the letters and



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corresponding names is possible.

- (4) Like dyslexics, even non-dyslexic poor readers are relatively more deficient than normal readers in auditory processing skills. Hence, their reading retardation cannot be attributed to poor educational background only. Further, it suggests that compared to visual processing skills, deficiency in auditory processing skills, especially auditory sequential memory, affect reading performance to a considerable extent as in schools the names of letters are taught in a particular order, i.e., conventional. In schools, usually the sequence of the names of the letters of Kannada alphabet is taught independently or along with the visual exposure of the sequence of letters. Since, there is a rhythm in the sequence, children can master it without much difficulty. Most often they learn the sequence of names of letters at the pre-primary level itself. As a result of it, whenever they write the sequence of letters they can recall the sequence of names of those letters and can match the name with the visual feature of the letter. Thus, the children can practice themselves and learn the names of letters properly. Whereas children who are poor in auditory sequential memory cannot learn the sequence of names of letters, as a result, unless there is assistance by others each time, they cannot recall the corresponding names of each letter either while looking at or writing the sequence of letters. As a result of it proper learning of names of letters becomes difficult for such children. Thus, this conventional method of teaching Kannada alphabet is effective only in case of children with adequate visual and auditory sequential memory.
- (5) Visual verbal association skills seem to be the predominant factors in learning reading, as the most retarded group in reading, namely, dyslexics is more deficient in these skills compared to the other groups.

### **8.2. Nature of the Reading Errors Committed by all the Three Groups of Readers while Reading Kannada.**

- (1) There is no qualitative difference in the reading errors committed by the three groups of readers. However, dyslexics and non-dyslexic poor readers differ from normal readers in the frequency of different types of errors committed, whereas they do not differ significantly from each other. Dyslexics differ from the other two groups only in producing non-words with entirely different sets of sounds while trying to blend the correctly identified component sounds of the stimulus words, whereas such a response is not seen among the other two groups of readers. The above type of errors which are very frequent among dyslexics can be considered as the differentiating factors between dyslexics and the other two groups of readers. The reason for such a distortion characterised in these errors may be either forgetting the identified component sounds of the particular word or lack of knowledge about the relation between the individual letter sounds and the word.
- (2) All the three types of readers get confused usually between letters with auditory or visual or auditory-visual similarities. Even though wherever such apparent similarities between letters do not exist dyslexics get confused between them more frequently, whereas the other two groups get confused between them only rarely. In fact, the latter types of errors cannot be considered as errors at all; rather they suggest that the particular reader has a general difficulty in learning the letters. The type and frequency of letter substitution errors in all the three groups indicate that letter confusion is a normal phenomenon even at grades - III and IV, whereas general difficulty in learning the letters is specific to dyslexics only.
- (3) In most of the cases the substitute for the correct response while recognising a letter or word is



same in all the groups of children. Hence, it can be inferred that all the three groups of readers are misled by the same set of cues or mental operations while reading Kannada.

- (4) 'Visual-spatial difficulties' observed among dyslexics while reading English cannot be observed among dyslexics while reading Kannada. This may be so as there is no scope for committing orientation errors in Kannada since the letters of Kannada alphabet do not have mirror images, i.e., letters which can be differentiated only in terms of orientational differences like, b - d, p - b. Thus, committing orientation error is not a universal phenomenon among dyslexics.
- (5) Dyslexics commit relatively more letter substitution errors wherein there is visual or auditory similarity between the stimulus and response letters; this cannot be attributed to difficulty in visual discrimination or auditory discrimination respectively as there is no difference between dyslexics and the other two groups of readers in these variables. Since dyslexics are more deficient in visual verbal association all sorts of letter substitution errors can be attributed to difficulty in association or 'correlating'. Thus, letter confusions such as, b - d, p - b observed among dyslexics while reading English which are usually attributed to 'visual-spatial difficulty' can also be considered as due to 'correlating difficulties'.
- (6) The observation that even normal readers of grades - III and IV commit letter substitution errors wherein there is visual/auditory/auditory-visual similarity between the stimulus and response letters indicate that association between particular grapheme and phoneme is difficult in case of letters which have one or more auditory/visual/auditory-visual counterparts. But, this difficulty is due to deficiency only in establishing association and not due to deficiency in visual or auditory discrimination. This may be the reason for dyslexics to commit such errors where there is no apparent similarity between the stimulus and response letters, for a much longer time in comparison with other types of readers as well as other types of errors committed by themselves.
- (7) There is no qualitative and quantitative difference between dyslexics and non-dyslexic poor readers in the type of errors committed by them. Hence, it is not possible to identify and classify dyslexics objectively on the basis of the errors committed by them only.

### 8.3. Effectiveness of the Remedial Programme in Improving the Various Dependent Variables Among Different types of Dyslexics.

- (1) There is considerable improvement in the accuracy of letter and word recognition after the remedial programme among all the dyslexics, whatever may be their initial level in these two variables. The improvement is almost close to the mastery level which is the expected level. This indicates that the remedial programme is effective in improving the accuracy of letter and word recognition to a considerable extent among all the types of dyslexics and also among dyslexics of varied levels of neuropsychological skills that are related to reading performance.
- (2) In majority of dyslexic cases there is an improvement in the rate of letter and word recognition. In spite of such an improvement, their speed of letter and word recognition is still far below that of normal readers of the same grade. Thus, it can be inferred that the remedial programme is less effective in improving the speed of letter and word recognition.
- (3) In a few dyslexic cases the rate of recognition is reduced after remediation. In other words, their rate of recognition was considerably high before remediation compared to that of after remediation. The reason being, undermotivation and more impulsivity among those dyslexics as a consequence of



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inability to read before remediation make them to complete the task within a shorter time. Whereas after remediation because of the increased self-confidence they attempt to recognize each letter or word with greater interest to complete the task. The improvement in the accuracy of recognition supports this inference.

- (4) After remediation, the frequency of all the types of reading errors are reduced in the case of all dyslexics. But still they commit letter substitution errors wherein there is similarity between stimulus and response letters. This indicates that the letters having auditory/visual/auditory/visual counterparts are difficult to be learnt by them.
- (5) In almost all the dyslexics the level of reading comprehension is improved after the remediation. This improvement can be attributed to the greater contribution of increased efficiency in word recognition in spite of the possibility for slow rate of word recognition to inhabit the comprehension of the passage.
- (6) Since the level of word analysis remains constant even after the remediation, it suggests that the remedial programme is not at all effective in improving the level of word analysis among dyslexics. But, it is also possible to explain this apparent lack of improvement in two different ways. On the one hand, the mode of giving practice and the mode of testing are different. While giving the practice in word analysis, the written words were used. Thus, there is visual analysis of the word prior to verbal analysis. Whereas while testing, since the words to be analysed were presented auditorily there is no provision for visual analysis which may help in verbal analysis. On the other hand, it may be also possible that the word analysis is a function of time. Such an inference is based on the observation made in the study that, there was an improvement in the level of word analysis among dyslexics over a period of 7-8 months during which there was no any special effort to improve word analysis among them. This apparent lack of improvement in the word analysis even after remediation may be due to the smaller time gap between pre-test and post-test to expect any improvement in word analysis ability. But, when the time gap is widened and when there is improvement in word analysis after remediation, such an improvement cannot be attributed to the effectiveness of the remedial programme alone as it is difficult to control maturational factors.
- (7) In majority of the dyslexics there is a slight improvement in the level of word synthesis after remediation. This suggests that the remedial programme is less effective in improving the word synthesis of dyslexics. This observation can also be explained in the same way that is attempted in case of word analysis. During practice since written words are used, the visual closure helps in auditory closure (word synthesis). Whereas during testing the component sounds of words are presented auditorily, as a result, there is no provision for visual closure which may help in blending the sounds. This suggests that training should be given through auditory modality to a considerable extent to improve word synthesis. Like word analysis, word synthesis can also be considered as a function of time on similar grounds.
- (8) There is a considerable improvement in the accuracy of letter and word recognition, but not in the rate of such recognition. This indicates that apart from visual verbal association, dyslexics have deficiency in lexical encoding or word retrieval also. Thus, dyslexics are having problem in both learning and retrieval. As a result reading should be taught through specially designed programme and sufficient practice should also be given for the automatization of the reading process.



#### **8.4. EDUCATIONAL IMPLICATIONS**

- (1) Since dyslexics find it very difficult to learn reading and writing even in one language, 'three-language-formula', i.e. , learning, reading and writing in Mother tongue/ Regional language, National language (Hindi) and International language (English), which is compulsory in Indian schools should not be insisted on dyslexics. They should be allowed to study all the subjects through Regional language/ Mother tongue; learning, reading and writing in languages other than Regional one should be introduced at later years of schooling and even then they should not be considered for grade promotion.
- (2) Because of the inability to read there is every possibility for dyslexics to lag behind in other academic subjects also. As a result there is a considerable gap in the amount of knowledge between dyslexics and normal readers. In order to minimise such a gap during the lower primary level, i.e., grades - I though IV. considerable time should be devoted to improve reading and writing among dyslexics. Instead of prescribing textbooks for Science and Social Sciences, and make the children of lower primary schools dependent on books to acquire those knowledge, child should be made to acquire the above knowledge through multi-modal experience and active participation. The mastery of any academic subject should be tested orally rather than through writing at the lower primary level. Thus, the load on the dyslexic as well as on other poor readers can be reduced. As a consequence they can be easily motivated for academic achievement.
- (3) Non-dyslexic poor readers are also to be taught through special methods of teaching reading as they may be also poor in auditory processing skills as observed in the present study.
- (4) Since children with marked difference in ability to learn are admitted to the same school the teacher should select such method/methods of teaching reading which takes/take into consideration of the differential ability among children to acquire the skills of reading and writing. The method that is adopted in the present study can be considered as one among those methods. The programme books to teach reading with clear instructions about the method of teaching the lessons of those books should be supplemented to the prescribed textbooks for all the children of grade-I. One such manual is prepared by Ramaa (1989). These books with instructions may guide not only teachers but also parents, so that they can supplement to the efforts made at schools in enabling their children to master reading and writing skills. The programme books similar to the ones used in the present study are helpful in giving practice in both reading and writing. Moreover, the children can be motivated to identify many more possible words that could be included in each lesson as practice items. Such books help in asserting the entering reading behaviour of children so that the teacher can teach the letters which he has not yet mastered. Continuous assessment is possible through such books. For some more guidelines see Ramaa (1992)

#### **8.5. SUGGESTIONS FOR FURTHER STUDY**

- (1) The studies similar to the present one are to be replicated with larger sample size and methodological sophistication.
- (2) Apart from deficiency in reading, more and more behavioural symptoms which are unique to dyslexics need to be explored.
- (3) Remedial programmes which improve the speed of reading and skill of writing need to be developed.
- (4) The attempts to identify the etiological factors of dyslexics should be continued.



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- (5) The analysis of the reading errors committed by dyslexics of different languages should be made.
- (6) Apart from dyslexics, non-dyslexic poor readers are also to be studied thoroughly.

Specific studies that can emerge out of the present study would involve testing the following hypothesis.

- (a) Normal readers are more deficient than non-dyslexic poor readers and dyslexics in visual processing skills.
- (b) Non-dyslexic poor readers as conceived in the present study are more deficient in auditory processing skills compared to normal readers.
- (c) Dyslexics differ from the other two groups only in producing non-words with entirely different sets of sounds while trying to blend the component sounds of words.
- (d) The different types of letter substitution errors can be attributed to deficiency in visual-verbal association alone.
- (e) Word analysis and synthesis abilities are functions of time and are less susceptible to improvement through training programmes.
- (f) Dyslexics are more deficient than non-dyslexic poor readers in lexical encoding/word retrieval.
- (g) The extent of influence of visual, auditory and visual verbal association skills on reading performance is in an increasing order.
- (h) The remedial program developed for dyslexics is helpful in improving reading performance among other categories of readers like Educable Mentally Retarded, Slow learners, Socially disadvantaged and Emotionally disturbed. An attempt has been made by the investigator in improving the kannada reading performance of Educable Mentally Retarded (EMR) children by using the remedial programme developed for dyslexics. The findings revealed the effectiveness of the program in improving accuracy of word recognition among EMR children. For details see Khader & Ramaa (1987), Ramaa (1991 & 1993). It seems that the program must be effective in the case of other categories of readers also. This supports the recent trend-non-categorical approach of teaching for children with different types of milder disabilities/handicapping conditions.



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# Appendix-I

## Visual Recall Test

### Set-I

T-I

O-O

U-U

### Set-II

O-O

V-V

⊕-⊕

### Set-III

es-g

g-g

J-2

### Set IV

b-b

b-b

b-b

### Set V

b-o

W-g

W-g

M-M

---

APPENDIX - II

Word Analysis Test in Kannada

I

- |               |               |
|---------------|---------------|
| 1) ಆಟದ        | 7) ಗುರುಗಳು    |
| 2) ಕೃಮುಗಿ     | 8) ಅಡಗಿಶೂಂಡರು |
| 3) ರಘುಕ್ರಿಯುಳ | 9) ಬಹುಮಾನ     |
| 4) ಮುಗಿದಿತ್ತು | 10) ಹೂಳಿಯಾಗಿ  |
| 5) ಒಂದರಿಂದ    |               |
| 6) ಹಾಕಿದಳು    |               |

II

- |               |              |
|---------------|--------------|
| 1) ಅಡ್ಡಿಪಡಿಸು | 8) ಸಂಗ್ರಹಾಲಯ |
| 2) ಅಂದುಕೊಳ್ಳು | 9) ನಮಾಝ      |
| 3) ಉಪಯೋಗಿಸು   |              |
| 4) ಒಂದುಗೂಡು   |              |
| 5) ಕಲಿಕೆಲವು   |              |
| 6) ಕಳ್ಳಗಂಡಿ   |              |
| 7) ಗಂಡುಗಡ್ಡೆ  |              |

III

- |                    |                    |
|--------------------|--------------------|
| 1) ಮನೆಯೊಳಗಿಲ್ಲ     | 7) ಅಭಿಪ್ರಾಯಪಟ್ಟನು  |
| 2) ಕುಣಿಕುಣಿದಾಡುತ್ತ | 8) ಪರೀಕ್ಷಿಸಬೇಕೆಂದು |
| 3) ಮೈಮೇಲಿರುವ       | 9) ಗುಂಪುಗುಂಪಾಗಿ    |
| 4) ಹುಲ್ಲುಗಾವಲು     |                    |
| 5) ಕೂರೆ ಕೂರಿದಹ     |                    |
| 6) ಹೊಂಚುಹಾಕಿತು     |                    |

IV

- |                            |
|----------------------------|
| 1) ಫಲಾಹಾರ ಮಂದಿರದಲ್ಲ        |
| 2) ಜೀವನತ್ಯಗಲಿರುತ್ತವೆ       |
| 3) ಸಿರಿಗನ್ನಡದೇಳಿಗಿಯನ್ನು    |
| 4) ಗರ್ವಪಟ್ಟುಕೊಳ್ಳಬೇಡ       |
| 5) ಪರ್ವತಶ್ರೇಣಿಯಾದೊಂದರಿಂದಲೇ |



APPENDIX - III

Word Synthesis Test in Kannada

I

- 1) ನಿ ..... ಜ
- 2) ಬೀ..... ಗ
- 3) ಅ ..... ರ್ನ
- 4) ಸಂ ..... ತೆ
- 5) ಎ ..... ತ್ತು
- 6) ಬಿ ..... ಹೀ..... ಟು

II

- 1) ನ್ನ ..... ಲ್ಲ
- 2) ಶ್ಯ ..... ತಿ
- 3) ನೆ ..... ಟ್ತು..... ಗೆ
- 4) ನ ..... ತ್ತು..... ನ
- 5) ಅ ..... ತ್ತು..... ತ್ತು
- 6) ಕ್ಯ ..... ನೀ..... ಡು

III

- 1) ಅ ..... ನೇ.....ಕ
- 2) ಮತ ..... ನ..... ರ
- 3) ಷಂ ..... ಗಾ..... ರಿ
- 4) ಪ್ರ ..... ಯುತ ..... ನಿ..... ಸು
- 5) ನಿ ..... ರುದ ..... ಯೋಜ ..... ಗ
- 6) ಇಂ..... ಗ್ನೀ ..... ಷ

IV

- 1) ನ ..... ನಿ..... ವೇ ..... ಶ
- 2) ಶು..... ಕ್ನ..... ಪ..... ಷ
- 3) ಸ್ವೀ..... ಕ..... ರಿ..... ಸು
- 4) ತ್ರಿ ..... ಕ..... ರ..... ಣ..... ಶು..... ದಿಂ
- 5) ಲ್ಯಾಂ ..... ಟೀ..... ಸು
- 6) ಜ..... ಗತ..... ಪ್ರ..... ಸಿ..... ದಂ

Appendix - IV  
Visual Verbal Association Test - I

<u>Practice items</u>	<u>Sounds</u>	<u>Testing items</u>
<u>Set I</u>		
C oo	sa ra	oo a
<u>Set II</u>		
p oo	ā ne	eo oo
w s	ma ga	p s
<u>Set III</u>		
o eo ē	ka ma la	ō eo
oo ē x	ni ra fe	o ē
		oo x
<u>Set IV</u>		
L oo o	da va la	oo oo
o oo s w	ja ru gu ppe	o o
		oo l
		s w
<u>Set V</u>		
oo eo	nā yi	oo oo
o o s z	ba le gi da	o o
L e eo z s	da ya ma di su	L z
		eo s s
		oo s





Appendix - V

Visual Verbal Association Test - II

Set I

ep pa  
oo va

Set II

h ka  
ee ma  
θ ga

Set III

e ca  
f ta  
ee ja  
gp na

Set IV

f ta  
bo da  
v da  
ee ya  
b ra

Set V

no na  
n sa  
ne nu  
np su  
oo se  
o ne

## Appendix - VI

### Word substitution errors

#### Examples of Stimuli:

#### Responses

ಇಳುಕು

—

ಇಳುಗು

ಇಲ್ಲ

—

ಇಲ್ಲ

ಇಯವು

—

ಇಯವು

ಅಕ್ಕಿ

—

ಅಕ್ಕಿ

(a) Word substitution Errors due to difficulty in letter and *Karyatha* identification;

#### Stimuli

#### Responses

ಇಡಿಸು

—

ಇಡಿಸು

ಇಲ

—

ಇಲ

ಇತರ

—

ಇತರ

(b) Word substitution Errors due to difficulty in blending the sounds

#### Stimuli

#### Responses

ದು... ಡಿ

—

ದುಡಿ

ಯ... ವ... ರ... ಇ

—

ಯವರನ

ಯ... ಉ

—

ಯುಲ





Appendix - VII

Common Visual Features among the Letters of Kannada Alphabet

Sl. No.	Common Visual Features	Letters
1.	ಲ	ಲ ಲಿ ಲಿ ಲಃ ಲಃ
2.	ಉ	ಉ ಉ
3.	ಋ	ಋ ಋ ಋ ಋ ಋ ಋ
4.	ೠ	ೠ ಋ ಋ ೠ ಋ ಋ
5.	ಋ	ಋ ಋ ಋ ಋ ಋ ಋ
6.	ೠ	ೠ ಋ ಋ ೠ ಋ ಋ ೠ

Continued....

Sl. No.	Common Visual Features	Letters
7.	o	ಯ ರ್ಯ ಹ
8.	୪	೪ ಕ
9.	ಖ	ಖ ಖು ಖಾ
10.	಼	ಇ ಣ
11.	ರ	ರ ರ ಗ ಕಾ ಕ
12.	ೞ	ೞ ೞ



APPENDIX - VIII (a)

MAXIMUM INVENTORY OF KANNADA C O N S O N A N T S

	Labial	Dental	Retroflex	Palatal	Velar	Glottal
<u>Stops</u>						
Voiceless						
Unaspirated	p	t	t̡	c	k	
aspirated	ph	th	th̡	ch	kh	
Voiced						
Unaspirated	b	d	d̡	j	g	
aspirated	bh	dh	dh̡	jh	gh	
<u>Continuants</u>						
<u>Nasal</u> (all are voiced)	m	ṅ	n		ŋ	
<u>Oral</u>						
Voiceless	f'	s	ṣ	ś		
Voiced	v	z'	ḷ	y		h

APPENDIX VIII (b)

Front Unrounded:

i	high short	ɪ
$\bar{i}$	high long	<del>ɪ̄</del>
e	mid short	e
$\bar{e}$	mid long	ē

Central Unrounded:

a	low short	ʌ
$\bar{a}$	low long	ʌ̄

Back rounded:

u	high short	ʊ
$\bar{u}$	high long	ʊ̄
o	mid short	ɔ
$\bar{o}$	mid long	ɔ̄

Thus, the following sounds can be considered as similar:

a	and	$\bar{a}$	e	and	$\bar{e}$
i	and	$\bar{i}$	o	and	$\bar{o}$
u	and	$\bar{u}$			



APPENDIX - IX  
Sound Blending Errors

Examples:

- (i) Conversion of short vowel into long vowel and vice versa

ಪದ	ಪಾದ
ಪಾಠ	ಪಥ
ವಾಹಕ	ವಹಾಕ
ಬಹುವ್ರಾಣ	ಬಹುವ್ರನ
ಜಿಲಕ	ಜೀಲಕ
ದೂಡಿ	ದುಡಿ
ಗಲ್ಲಲು	ಗೀಲ್ಲಲು

- (ii) Errors committed when Nasal sounds are Present

(a) Nasal sound omission

ನಂಬು	ನಬು
ಅಂದವಾಗಿ	ಅದವಾಗಿ
ಬಂಡಿ	ಬಡಿ
ತುಂಜಿ	ತುಜಿ
ತಂಗಿ	ತಗಿ

(b) Nasal sound addition

ಸತಾಯಿಸು	ಸಂತಾಯಿಸು
ಲಕಲಕ	ಲಂಕಲಂಕ
ಮಾನಲು	ಮಾಂನಲು
ಇಹವರ	ಇಹಂವರ
ಪದ	ಪಂದ

(c) Nasal sound substitution

ತಂಗಿ taŋgi	ತಮಗಿ tamgi
ಜೊಂಗೆ coŋge	ಜೊವಗೆ comge
ಬಂಟ banta	ಬಮಟ banta

(d) Omission of nasal sound and addition of stress

ಬಂಟ  
banta

ಬಟ್ಟ  
batta

ಬೊಂಬೆ  
bombe

ಬೊಂಬೆಬ್ಬ  
bobbe

(e) Omission of stress and addition of nasal sound

ಕಟ್ಟಿನ  
kattina

ಕಂತಿನ  
kantina

ಎಟ್ಟಿನ  
ettina

ಎಂತಿನ  
entina

(iii) No response

ಕಾ..... ನು

ಬ..... ಒ..... ಟ

ಎ..... ತ..... ರ

ಲ.... ಕ..... ಲ..... ಕ

ಹಿ.... ನು..... ಮೂ..... ತು

(iv) Omission or addition of stress

ಅಕ್ಕ

akka

ಅಕ

aka

ನಿಲ್ಲ

nilu

ನೀಲು

nilu

ಗೆಲ್ಲಲು  
gellalu

ಗೆಲಲು  
gelalu

ಜಿಲಕ  
cilaka

ಜಿಲ್ಲಕ  
cillaka

ಹಳೆಯ  
haleya

ಹಳ್ಳಿಯ  
halleya



(v) Producing different word or nonword

A		B	
ಠಕ್ಕರು	ಖಗರು	ಝುಣು	ಹಣುಣು
ರನ	ಅಗನ	ಕಾಲು	ಕಲುಣು
ತೌಡು	ಅವಳು	ಕಾನು	ಕಾನುನು
ವೆಣಸು	ಅವನು	ದೂಡಿ	ದೊಡ್ಡಿ
ಜಗಳಗಳು	ಜಮರ	ಎತ್ತರ	ಎತ್ತರ
ಕುರುಡ	ಅವೆರಡ	ಗುಡಿಗಳು	ಗೂಡಿಗಳು

(vi) Addition or Omission of sounds Examples

ಇಹವರ	ಇವರ
ಜಗಳಗಳು	ಜಗಳಗಗಳು
ಕಾವಲುಗಾರರು	ಕಾವಲುಗರು
ಅಂಗಗಳು	ಅಂಗಳು
ಅಂದವಾಗಿ	ಅಂದರವಾಗಿ

Reversal Errors Examples:

ಎ) ರನ	ನರ
ಲಕಲಕ	ಕಲಕಲ
ಂಯಜಮಾನ	ಜಂಯಮಾನ
ಇವರು	ಇರುವ
ಬಿ) ಕೈಜಳಕ	ಕೈಜಗಳ
ಐರಾವತ	ಐಬರತ

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## Appendix - X

### Letters of Kannada Alphabet

ಅ	ಆ	ಇ	ಊ	ಉ	ಊ
a	ā	i	ī	u	ū
ಋ	ೠ	ಎ	ಐ	ಓ	ಔ
ೠ	ೡ	e	ē	ai	o
ಌ	಍	ಅಂ	ಅಃ		
ಠ	ಠ	ಅಂ	ಅಃ		

ಕ	ಖ	ಗ	ಘ	ಙ
Ka	kh	g	gh	ṅ
ಚ	ಛ	ಜ	ಝ	ಞ
c	ch	j	jh	ṇ
ಟ	ಠ	ಡ	ಢ	ಣ
t	th	d	dh	ṇ
ತ	ಠ	ದ	ಢ	ನ
t	th	d	dh	n

Continued....



ए	ए	२	२	ए
P	P	b	bh	m
अ	०	e	ए	०
Y	r	l	v	१
ए	२	०	१	
१	१	h	l	

---

## Appendix - XI

### Examples      Kagunitha

(a)    క    కా    కి    కిఁ    కు    కూ    కు    కు    కె    కే  
 Ka    Kā    Ki    Kī    Ku    Kū    Ku    Kū    Ke    Kē  
 క    కా    కి    కిఁ    కు    కూ    కు    కు    కె    కే  
 Kai    Kai    Kai    Kai    Kai    Kai    Kai    Kai    Kai    Kai

(b)    బ    బా    బి    బిఁ    బు    బూ    బు    బు    బె    బే  
 ba    bā    bi    bī    bu    bū    bu    bū    be    bē  
 బ    బా    బి    బిఁ    బు    బూ    బు    బు    బె    బే  
 be    bē    bai    bo    bō    bu    bam    bah;

(c)    న    నా    ని    నిఁ    ను    నూ    ను    ను    నె    నే  
 na    nā    ni    nī    nu    nū    nu    nū    ne    nē  
 న    నా    ని    నిఁ    ను    నూ    ను    ను    నె    నే  
 ne    nē    nai    no    nō    neu    nam    naha



Dedicated to

*To my beloved Father and Great Teacher*

**Late Sri. S. Subbiah**

APPENDIX - X.II

Lessons in the Remedial Reading

Programme:

Example of Lessons:

Lesson 1:

ಮರ	marā
ರಮ	Rama

Lesson 2:

ಸರ	sara
ಸಮ	sama
ರಸ	rasa
ಸಮರ	samara

Lesson 3:

ಗರಗಸ	garagasa
ಮಗ	maga
ಗರಗಸ	garagara
ಗಸಗಸ	gasagasa

Lesson 4:

ಅಗಸ	agasa
ಅಗಸರ ಮಗ	agasara maga
ಅಗರ	agara
ಅರಸ	arasa



Lesson: 31

ಕಾಗದ	kagada
ಕಾಲ	kala
ಕಾನನ	kanana
ಕಾಟ	kata
ಸರಕಾರ	sarakara
ಕಾವಳ	kavala

Lesson : 32

ಗಾಯ	gaya
ಗಾಯನ	gayana
ಗಾಣ	gaṇa
ಗಾಳ	gaḷa
ಗಾಢ	gadha

Lessons to teach accessory forms:

Examples of words included

ಅಕ್ಕನ	akkana
ಅಕ್ಕಿಗೆ	akkige
ಅಗ್ಗ	agga
ಮಗ್ಗ	magga
ಹಪ್ಪನೆ	haccane
ಪೆಪ್ಪು	peccu
ಅಜ್ಜ	ajja
ಮಜ್ಜಿಗೆ	majjige

ಅಟ್ಟು	atta
ರಟ್ಟು	rattu
ಅಣ್ಣ	anna
ಬಣ್ಣ	banna
ಅತ್ತು	attu
ಇತ್ತು	ittu
ಇದ್ದನು	iddanu
ನಿಡು	nidde
ಅನ್ನ	anna
ನನ್ನ	nanna
ಅಪ್ಪ	appa
ಕಪ್ಪು	kappu
ಹಬ್ಬ	habba
ಕೊಬ್ಬರಿ	kobbari
ಅಮ್ಮ	amma
ಒಮ್ಮೆ	Omme
ಅಂಚೂಕ	ayya
ಉಂಚೂಕಿ	Uyyale
ಕರ್ರಗೆ	Karrage
ಸರ್ರನೆ	sarrane



ಮೆಲ್ಲು	mellu	ಸತ್ಕಾರ	saṭkara
ಬೆಲ್ಲ	bella	ನಿಸರ್ಗ	nisarga
ಅವ್ವ	avva	ಮಾರ್ಗ	marga
ಮಾಡವ್ವ	mada vva	ನಷ್ಟ	naṣṭa
		ನೂಕ್ತ	śūkta
ಬಸ್ಸು	bassu	ಸ್ನಾನ	snana
ಮೆಸ್ಸು	messu	ಆತ್ಮ	atma
ಕಳ್ಳ	kalla	ಶಿನ್ತು	śiṣṭu
ಬೆಳ್ಳಗೆ	bellaḡe	ತ್ಯಾಗ	tyaga
		ಸೂತ್ರ	sūtra
		ವಜ್ರ	vajra
ಕಂಬ	kamba	ಸರ್ವ	sarva
ಅನಂದ	ananda	ಉತ್ಸಾಹ	Utsaha
ಬಂತು	bantu	ರಾಷ್ಟ್ರ	raṣṭra
ಅಂಗಳ	aṅḡala	ಸ್ಮೃತಿ	smruṭi
ಅಂಕಣ	aṅkana	ಸ್ತ್ರೀ	stṛi
ಪಂಜ	paṅca		
ಬಂಜೆ	baṅje		
ತಂಟೆ	ṭante		
ಬಂಡೆ	bande		
ಪಂಪ	pampa		