

PSYCHO-NEUROLOGICAL ASPECTS OF LEARNING DISABILITIES



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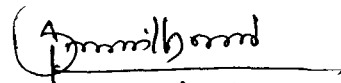
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“Where is the knowledge lost in information
Where is the wisdom lost in knowledge”.

.....**Tagore**

“Knowledge is useless
unless transformation of character”

.....**Swami Vivekananda**

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LIST OF ABBREVIATIONS

- LD : Learning Disabled**

- NLD : Non Learning Disabled**

- DSM : Diagnostic and Statistical Manual of Mental Disorders**

- APA : American Psychiatric Association**

- RAS : Reticular Activating System**

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Chapter I

INTRODUCTION

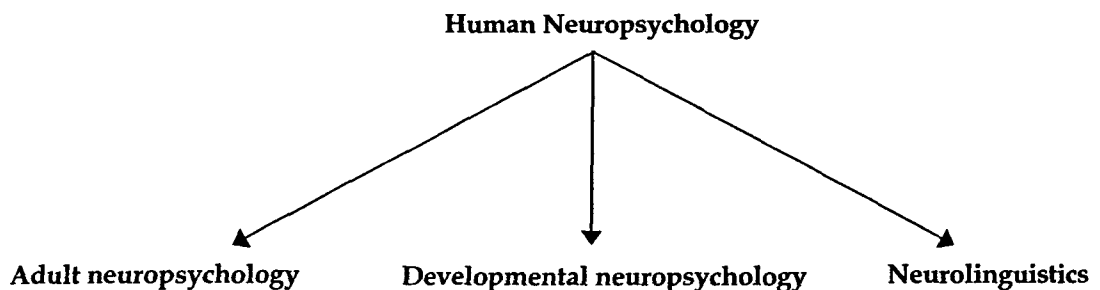
- ❖ *Human Neuropsychology*
- ❖ *Learning Disability*
- ❖ *Neuropsychology of Learning*
- ❖ *Assessment*

HUMAN NEUROPSYCHOLOGY

The term neuropsychology in its English version originated quite recently. According to Bruce, it was first used by William Osler and then later appeared as a subtitle in D.O. Hebb's "The Organization of Behaviour: A Neuropsychological Theory". The term was given wide publicity when it appeared in 1960 in the title of a collection of K.S. Lashley's writings- The neuropsychology of Lashley- (Kolb and Wishaw, 1996).

Neuropsychology is the study of neural mechanisms underlying human behaviour. The discipline is based on a systematic analysis of disturbances of behaviour following alterations of normal brain activity by disease, damage or experimental modification.

Human neuropsychology may be divided into adult neuropsychology, developmental neuropsychology and neurolinguistics.



Adult neuropsychology : The study of disturbances of the established pattern of behaviour

Developmental neuropsychology : The study of, disturbances of the acquisition of cognitive functions regardless of the pathological origin.

Neurolinguistics : Dealing with disturbances of verbal performance following cortical lesions.

Neurolinguistics may be divided into the study of language pathology of adults and that of children. Neuropsychology is the inter section of the neuroscience (neurology, neuroanatomy, neurophysiology, neurochemistry) and the behavioural science (Physiological psychology, developmental psychology, psycholinguistics, and linguistics). From physiological psychology neuroscience borrows models and methods adapting them as necessary (Hecan and Albert, 1978).

In short neuropsychology is the clinical and experimental field devoted to the study, understanding, assessment, and treatment of behaviour directly related to the function of the brain. Although the field works are most commonly conducted on individuals who have brains which are in some way abnormal. Neuropsychology also looks at individual differences within normal people due to differences in brain functions or organization (Corsini, 1994).

Historical Development

The relationship between brain function and behaviour was recognized as early as 3500 B.C. in the Edwin Smith Papyrus, with some evidence suggesting that this relationship had been observed since the upper Paleolithic period. The Papyrus contains reports of some 48 cases of observation and description of treatment of actual cases of many of them suffering from traumatic lesions of various parts of the body including many

injuries to the head and neck. Translation of the papyrus was undertaken in 1920 and the detailed examination of the text and commentary was published by Breasted in 1930. It is in this papyrus that a word for brain appear for the first time. The papyrus opened the door on cortical localization of function with its description of injuries to the brain (Walsh, 1978).

By 500 B.C. Pythagorus had identified the brain as the site of human reasoning. While ancient theorist agreed that human thought and intellectual abilities were found in the brain, there was disagreement over which brain structures were responsible for intellect. The predominant pre-renaissance view localized thought in the ventricles, the fluid filled cavities that cushion the brain from trauma. Later theorists identified the center of mental processes in such areas as the pineal glad. Lancisi theorized that reasoning was located in the centre of the brain, and that Corpus Callosum was responsible for mental functioning (Corsini, 1994).

Since the Second World War, neuropsychology has undergone considerable development, transformation and extension. Tentative first step in the creation of the discipline are seen as far back as the introduction of phrenology by Gall and Spurzheim in the publication of cerebral dominance for language attributed to Mare Dax and in the earliest works about language by Bouillaud.

The first global theory of how the brain work was the phrenological theory of Franz Josef Gall and Johanncasper Spurzheim. They made a number of important discoveries in neuroanatomy that alone give them a place in history. They proposed that the cortex and its gyri are composed of

functioning cells that are connected with the brain stem and spinal cord. They found that the cortex projects to the spinal cord and they recognized that the spinal cord contains cells that project to the muscles. Thus, the cortex could control behaviour through its projection to the spinal cord. They also recognized that the two symmetrical hemisphere of the brain are connected by the corpus callosum and thus could interact with each other (Kolb and Whishaw, 1996).

From this anatomical basis, Gall then proposed a theory of how the brain produce behaviour, suggesting that different cortical areas have different functions. He noticed that students with good memories had large, protruding eyes. He thought it possible that a well developed memory area of the brain located behind the eyes could cause them to protrude.

Gall and Spurzheim identified a long list of behavioural traits, such as wit, inquiry and faith. Many of these traits were borrowed from English or Scottish psychology. Each was assigned to a particular portion of the skull and, by inference, to the underlying portion of the brain. Spurzheim called the study of the relationship between the skull's surface features and a person's faculties phrenology (Kolb and Whishaw, 1996).

Gall and Spurzheims research was misguided for four reasons. First, the psychology faculties bore little relation to real behaviour: faculties such as faith, self-love, and veneration are impossible to define and to quantify objectively. The second cause of phrenologists failure was their belief that the superficial features of the skull, the analysis of which they called cranioscopy, could be used to estimate brain size and shape. The third

problem was that phrenology invited quackery and thus indirectly, ridicule by association. In the eyes of the phrenologists contemporaries, however, there was a more damning criticism, which was the fourth cause of their failure (Kolb and Whishaw, 1996).

Definitive establishment of the speciality was made by Broca, who clearly demonstrated the relationship of a lesion in a particular region of the brain to the alteration of a particular function. The localization theory was given credibility in 1861 by Paul Broca. On the basis of autopsies completed on two patients who had lost the ability to use expressive speech. Broca reported that he had found the brain area where motor speech is localized. Broca's work led to countless investigations attempting to localize specific psychological functions. These led to numerous articles announcing various discoveries: the localization of receptive speech by Carl Wernicke in 1874, motor and sensory areas by Gustav Fritsch and Hitzig in 1870 and word blindness or ability to read by Kliesmaul in 1877. (cited by Corsini, 1994)

Theoretical Considerations

There are major theoretical schools within neuropsychology. Localizationist and Equipotential positions form the basis for the major schools of thought.

Equipotential Theory:

Equipotential theory involves the assumption that all areas of the brain make an equal contribution to overall intellectual function. Thus a particular area of brain injury is unimportant: only the amount of brain injury determines

the behavioural deficits. Equipotential theories assume that all forms of brain injury are essentially alike, differing only in degree. Many equipotential theorists place a strong emphasis on deficits in abstract or symbolic ability, which are presumed to accompany all forms of brain damage.

The equipotential view has heavily influenced the development of psychological tests. Numerous researchers have attempted to find tests that measure the basic deficit common to all brain injured patients in order to find the ideal test or tests.

Localization Theory:

Localization theory assumes that each area within the brain is responsible for specific psychological skills. Thus where an individual is injured becomes the primary concern of the organic brain assessment. Extent of injury is important only insofar as a larger injury will involve more areas of the brain and thus disrupt more skills. However similarly seized lesions in different parts of the brain will produce significantly discrepant effects. Localization theories differ in the kinds of psychological skills that are thought to be localized. Some theorists would localize, in specific centers of the brain, such complex skills as reading and writing. Other theorists like Luria in 1973, emphasize the localization of skills such as auditory analysis. Kleist in 1933, argue for the localization of personality traits such as patience.

Alternatives:

Psychological research has not wholly supported either the localization

or equipotential theory. The equipotential theory cannot account for the specific, limited deficits that occur in some patients without any general impairment in abstract abilities or other similar skills. Localization theories are hard pressed to explain why a specific deficit, such as dysgraphia (inability to write) may occur with deficits almost anywhere in the left hemisphere and with many injuries in the right hemisphere.

Unable to accept either theory, many have looked toward an alternative. The creation of one such model has been credited to Hughlings Jackson, an English neurologist, whose primary works were published in the last half of the nineteenth century. Jackson observed that most psychological functions are not unitary abilities but are made up of more basic skills. According to Jackson, although very basic skills can be localized, all observable behaviour is a complex interaction of numerous basic skills, so that the brain as a whole is involved in most actual behaviour. Thus his theory combines both localization and equipotential viewpoints to form a theory that can account for the experimental evidence generated to support both views.

Jackson's view can be seen in their most developed form in the theories of the Russian neuropsychologist A.R. Luria. In Luria's view, all behaviour is based on functional systems, pattern of interaction among the localized areas of the brain necessary to produce a given behaviour. Any injury that interrupts any part of the functional systems will disrupt all behaviour based on that system. The more complex the behaviour, the more complex the functional system on which it is based. Consequently, highly complex intellectual skills such as the ability to abstract are most sensitive to

brain injury, because a great many functional systems must be involved to produce the behaviour (Corsini, 1994).

The development of the Gestalt theories radically modified existing modes of thought concerning cerebral localization. The very bases of the localizationist theories were overturned. The distinction between primary or elementary function and secondary or higher functions was no longer acceptable. According to Gestalt theory the loss of one fundamental attribute of brain function could account for disturbances of recognition (agnosia), of language (aphasia), or gestures (apraxia). The work of Carl Lashley strongly suggested that cerebral organization was not rigidly dependent upon structural peculiarities of specific regions of the brain. (Hecan & Albert, 1978)

One persistent idea in neuropsychology is that functional properties of the nervous system become more fixed and specialized overtime. In the context of cerebral asymmetry this means that more evidence of lateralization should be expected with increasing age. This prediction has some experimental support, but the situation is complex. In general, research on the development of speech functioning after damage to the left hemisphere suggests that there are three critical age ranges: less than 1 year, 1 to 5 years, and older than 5 years. If damage occurs before 1 year, disruption of speech is quite extensive. If damage occurs between 1 and 5 year, the recovery of speech is usually possible, with the right hemisphere reorganizing to take over most of the functions lost by the left. Injuries to the left hemisphere after 5 years of age, however, show no recovery of functions. (Corsini, 1994)

Neuropsychology is strongly influenced by two traditional foci for experimental and theoretical investigations in brain research. They are the brain hypothesis and the neuron hypothesis.

The idea of brain hypothesis is that the brain is the source of behaviour; and the neuron hypothesis, the idea is that the unit of brain structure and function is the neuron.

Modern Developments:

Until 1900 the science of neuropsychology didn't develop much because of three possible reasons. In the 1920's neurologist such as Henry Head rejected the classical approach of Broca, Wernicke, and others, arguing that their attempts to correlate behaviour with anatomical sites represented approaches little better than those of phrenologists. Then two World Wars disrupted the development of science in many countries. In addition, psychologists traced their origin to philosophy rather than to biology.

A number of modern developments have made a contribution to the growth of neuropsychology as an identifiable discipline in the neuroscience, neurosurgery, psychometrics and statistical analysis; and technological advances.

The development of neurosurgery as a practical solution to some types of brain abnormality has a profound influence on neuropsychology. In animal research the tissue removal or lesion technique was developed to the point that it became one of the most important source of information about brain behaviour relationships. In turn, information about behaviour obtained from

patients who had received surgery was very useful for diagnostic purpose in new patients.

It was only through technological advance that the internal structure of neuron could be visualized, their electrical activity recorded, and their biochemical activity analysed and modified. It is only through technology that the process of disease, degeneration, and regeneration in the nervous system can be understood.

In summary, neuropsychology attempts to bridge the chasm separating brain and behaviour, body and mind. Although there are levels of analysis within neuropsychology, by and large neuropsychology has been focused on the level of analysis of behaviour that is molar enough so that the domain it studies are not completely outside the view of functional, cognitive psychology. Thus neuropsychology finds spatial cognition and acceptable category but has rejected categories such as general purpose, short-term and long term memory and has generally avoided concepts like the self, will, consciousness and object relations. The long term goal of neuroscience is to provide a computational account of molar functions; our current preliminary notion about the cognitive architecture will eventually be explained in terms of the working of neural systems. (Cicchetti & Cohen, 1995)

LEARNING DISABILITY

Large number of children enter schools in which they are required to master a core curriculum. Some of them are completely unable to meet any demand of the school system they enter, some learn but only with great

difficulty, some have to repeat one or more grades, some graduate but fail to master certain subject area and some even graduate without mastering basic knowledge in any area. For those who fail, the educational experience often leave emotional and attitudinal scars that are carried through out life. The difficulties that individuals encounter in school can have a number of causes. A child may be disturbed by an unhappy home life, be bored by school, dislike school, dislike a teacher, have no aptitude for school, have low intelligence, or have a physical handicap, including brain damage. Some school system may be equipped to assess these kinds of problems and deal with them objectively. Most have no resources for either assessment or remediation. Whether or not a school system is equipped to deal with learning problems of an individual, neuropsychology now receives enough attention, that the question of whether the child has brain damage or a cognitive problem (Kolb & Whishaw, 1996)

The term learning disability is used to describe a specific group of children, adolescents and adults who have problems in learning. These problems are generally in the areas of reading, writing, spelling and mathematics. Parents and teachers usually discover the problem when the child fails to cope with school work. Teachers may notice a great difference between the child's oral performance, which is usually very good and the written work. Surprisingly there is a great deal of individual variation among children with a learning disability.

Learning disability is found across all ages and in all socio-economic classes. It is not a type of mental retardation as mistaken by many people, in

fact IQ scores can be in very high range. However, a learning disability can occur along with other handicapping conditions, for examples with sensory impairment, emotional and behavioural disorders and mental retardation. In such cases it is considered as a secondary and not the primary handicap (Nakra, 1998).

The learning problems associated with emotional and behaviour disorders are common in children referred to clinics and in general population epidemiologic surveys. Up to 15% of the school-age population may have academic difficulty during their school careers. The exact prevalence of the learning disorders in the academic skills areas is unknown because various studies have used different criteria to define cases.

Academic achievement is highly valued in our society. We often compare the performance of our school children with that of children in other culture to estimate whether we are succeeding or failing as a world leader and economic force. On a personal level because parents often invest a great deal of time and emotional energy to ensure their children's academic success, it can be extremely upsetting when a child with no obvious intellectual deficits does not achieve as expected". (Durand & Barlow, 2003)

Learning difficulties often show up in school work and also they may affect many other parts of a person's life, including work, daily routines, family life and friendships. For some, problems in learning are relatively specific and affect a narrow range of ability, whereas others may be challenged almost daily across many different tasks and social situations. Each type of learning disability, whether it is related to reading, writing, mathematics, or

language, is characterized by its own distinct definitional and diagnostic issues.

We now recognize that learning disabilities, though challenging, do not have to be a handicap. Many well known persons with known or suspected learning disabilities used their talents in ways that are exceptional. Some of those persons are:

The inventor Thomas Edison; The physicist Albert Einstein; The British Prime Minister Winston Churchill; The U.S. Presidents Woodrow Wilson, George Bush and The actor Tom Cruise (Mash and Wolfe, 1999).

Today people from every walk of life recognize the term learning disability. It is a separate category in the special education literature. The term has gained almost universal acceptance among educators and the general public. Nevertheless, the precise definition of learning disabilities is still being debated. The following themes remain critical to understanding learning disabilities today.

- 1) Learning disability is an interdisciplinary field of research and practice that is international and multicultural in scope.
- 2) Neurological dysfunction may be presumed or suspected but learning disabilities have a variety of possible causes.
- 3) Learning disability is in part a social construction.
- 4) Learning disabilities designate a heterogeneous group of disorders.
- 5) Learning disabilities vary in severity and pervasiveness.
- 6) The hallmark of learning disabilities is intraindividual differences.

- 7) Individual with specific learning disabilities are a very diverse group.
- 8) Learning disabilities may coexist with other disabilities or with giftedness.
- 9) Students with learning disabilities must learn systematic approaches to tasks.
- 10) A primary responsibility of educators is to minimize the contribution of poor teaching to learning disabilities.
- 11) Learning disabilities are developmental disorders persisting over the life span.
- 12) Advances in the field of learning disabilities comes through careful, persistent research.

(Hallahan, Kauffman and Lloyd, 1996)

However the U.S. centres for Diseases Control (1987) based on the available data concluded that 5% to 10% was a reasonable estimate of persons with learning disabilities.(Harris, 1995)

Definitions

Definitions of learning disabilities are frequently critiqued because they almost universally state that neurological impairment is the presumed cause of the problem. However even the most severe critics of the concept agree that at least a few children may have specific neurological impairment that interfere with school learning (Coles, 1987).

Formal definition of learning disabilities include assumption that the individual has adequate intelligence, opportunity to learn by instruction, and

home environment, still does not succeed. These features are illustrated by the definition of dyslexia devised by the World Federation of Neurology (Kolb & Whishaw, 1996).

Learning deficits may be identified in children who are normally intelligent and in children with specific language dysfunction. In the law, children with learning disorders are defined as follows:

“Those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in an imperfect ability to listen, think, speak, read, write, spell or do math calculations. The term include such conditions as perceptual handicaps, brain injury minimal brain dysfunction, dyslexia and developmental aphasia. The term does not include children having learning problems which are primarily the result of visual, hearing or motor handicaps, of mental retardation, of emotional disturbances, or of environmental, cultural or economic disadvantage” (U.S. Congress: Public Law, 1975, 94-142).

The above definition was first formalized in 1967 by the National Advisory Committee on Handicapped Children (the definition later incorporated in PL. 94-142). (Harris, 1995).

The National Joint Committee for Learning Disabilities, (NJCLD) made up of representatives of the American speech- Hearing Association, the

Association for children and Adults with Learning Disabilities, the Council for learning disabilities. The International Reading Association and the Orton Dyslexia Society, issued an alternative definition:

“Learning Disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span” (Nakra, 1998).

According to Durand and Barlow (2003) Learning disorders are characterized by performance that is substantially below what would be expected given the Person’s age, IQ and education.

Historical Perspectives

When considering the history of learning disabilities, it is helpful from the outset to make a distinction between learning disabilities as an applied field of special education and learning disabilities as an area of research on individual differences in learning and performance. In the former sense, the field shares many attributes with other political-social movements, while in the latter sense it is loosely jointed, interdisciplinary area of scientific inquiry.

The beginning of scientific work of immediate relevance to learning disabilities was probably that of Joseph Gall at the beginning of the nineteenth

century. Gall described a number of cases in which specific loss of mental function in adults occurred as a result of brain damage.

Over the next century many clinical studies of speech and language disorder were reported among the best known are those of Bouillaud Broca, Jackson, Wernicke and Head. The major goal of these works were to document the specific loss of various abilities like speech, language functions in adults who had previously shown these abilities and to identify the type of brain damage associated with the different kinds of functional disturbances. Of relevance to the study of learning disabilities, this work did establish the fact that specific type of mental impairment can occur as a result of damage to isolated region of the brain. (Wong, 1991)

The first systematic clinical studies of Specific learning disability were reported in 1917 by James Hinshelwood, a Scottish ophthalmologist. He examined a number of cases in which adults suddenly lost the ability to read while other areas of mental functioning remained intact. As with cases of sudden loss of oral language facility, the loss of reading ability was attributed to damage to specific areas of the brain. In addition to his work on loss of function with adults, Hinshelwood also saw cases of children who had extreme difficulties in acquiring reading skills.

Following Hinshelwood, the next major figure to report clinical studies of children with reading disabilities was Samuel Orton, an American child neurologist. Based on his clinical examination of children over a 10 year period, Orton developed an explanation for reading disability that was

quite different from Hinshelwood's. He proposed that the difficulty was caused by delay or failure in establishing dominance for language in the left hemisphere of the brain. He used the term "Strophosymbolia" or twisted symbols, to refer to that fact that reading disabled children as he observed them, frequently had special difficulties reading reversible words, (saw as was, not as ton) or letters (b as d, p as q) correctly. His theory explained reversals as resulting from confusion between the visual image of these stimuli projected on the two different brain hemisphere. According to his theory, these projections were mirror images of one another, and because neither hemisphere image was consistently dominant. However, his broad emphasis on dysfunction in the language related areas of the brain as a cause of specific developmental dyslexia is consistent with important current theories by Galaburda, 1988 and Shankweiler & Liberman, 1989. (cited by Wong, 1991)

(1) Immediate Precursors to the Field of Learning Disabilities

The description so far given is part of the overall history of ideas concerning specific learning disabilities in children. However, the research and clinical activity that led most directly to the initial establishment of a formally organized field of learning disabilities was conducted by Heinz Werner and Alfred Strauss at the Wayne country Training school in Northville, Michigan. In fact the historical threads between the work of Hinshelwood and Orton and the development of learning disability movement in special education are quite tenuous. In retrospect, their work has assumed greater historical importance with the developing recognition that the vast

majority of Learning Disability children have reading as their primary academic problem.

The work of Werner and Strauss was fundamentally different from that of Hinshelwood and Orton in that they sought to describe deficient general learning processes rather than to describe and explain failure on a specific academic task. Their work was interpreted as establishing the existence of a subgroup of children who, presumably because of mild brain damage, experienced specific limitations in their ability to process certain kinds of information. They centered mostly on what today would be called distractibility, hyperactivity and visual perceptual and perceptual motor problem. Werner and Strauss were influenced heavily by the work of Kurt Goldstein, who had studied the behaviour of soldiers with head wounds during World War I. Goldstein observed that a number of behavioral characteristics were reliably found in many of his patients: inability to inhibit responding to certain external stimuli, figure-background confusion, hyperactivity, meticulousity and extreme emotional lability.

Werner and Strauss sought to document the presence of similar behavioural-cognitive difficulties in a sub group of children at their school. These children were presumed to have brain damage because of their medical histories and other aspects of behaviour. They compared the behaviour of these "brain damaged" children with that of other mentally retarded children who were presumed not to be brain damaged. Their general conclusion were that brain damaged children showed specific difficulties in attention (distractibility) and perception. From these observations, Werner and Strauss

concluded that the brain damaged children needed special educational interventions designed to overcome the weaknesses.

It is interesting to note that the scientific support for Werner and Strauss idea about unique processing disabilities in brain damaged children was exceedingly weak. In 1949, Sarason attacked their work because of the way they formed their group of children with and without brain damage. Werner and Strauss sometimes assigned children to the brain damaged group on the basis of behaviour alone, even in the absence of direct evidence from neurological tests or medical history. Unfortunately, some of the behaviour that led to selection of children as brain damaged were very similar to those that were studied in the experiments. The circular reasoning involved in attributing experimental differences between groups to brain damage is obvious (cited by Wong, 1991).

Although the scientific work of Werner and Strauss on learning deficiencies resulting from brain damage does not stand up well to close scrutiny, their ideas strongly influenced a number of colleagues who carried their work forward. For example, William Cruickshank showed that cerebral-palsied children of normal intelligence exhibited some of the same intellectual characteristics as the “brain-damaged” retardates in earlier studies (cited by Wong, 1991)

At about the same time another former staff member at the Wayne Country Training School, Kephart, wrote “The Slow Learners in the Classroom” (1960). In this work he embellished a theory first proposed by Werner and Strauss: that perceptual-motor development is the basis for all

higher mental development, such as conceptual learning. A suggestion derived from this theory was that training in perceptual motor skills should be helpful to many children experiencing learning difficulties in school.

It should be emphasized that during the 1940's and 1950's and in to the early 1960's, there was no field of learning disabilities. Instead researchers and clinician were observing a variety of problems in children of normal intelligence that seemed to interfere with learning. Children manifesting these difficulties went by a variety of labels including minimally brain damaged, perceptually impaired, aphasic or neurologically impaired. In addition to perceptual-motor-processing difficulties, a variety of disorders with auditory and language processes were also being studied.

Language disabilities were also emphasized in the work of Kirk, who had served for a brief time as a staff member at the Wayne country training school with Werner and Strauss. In 1961, he published the experimental version of the "Illinois Test of Psycholinguistic Abilities" (Mc Carthy and Kirk 1961). The purpose of this instrument was to examine a child's strengths and weaknesses in the area of language processing. It stimulated the development of a number of educational programs that specified unique interventions for children with different patterns of disabilities. (Wong, 1991)

(2) Formal Beginnings of the Learning Disabilities Movement

The term 'learning disability' had its origin in an address given in 1963 by Kirk. He argued for better descriptions of children's school problems, but he excluded children with sensory handicaps and mental retardation from

the children he called learning disabled. His definition and address were influential because members of his audience got together and formed the Association for children with Learning Disabilities, (ACLD) and this society in turn popularized the label. The establishment of the ACLD represents the formal beginnings of the learning disabilities movement as a social-political-educational movement. Its goal was to mobilize social and political concern for the plight of learning disabled children and to create public sector service for them. (Kolb & Whishaw, 1996)

The learning disabilities movement approached the first challenge by selecting and promoting ideas about learning disabled children that emphasized their differences from other children currently receiving services in their schools. The main distinction between learning disabled and other children having trouble in school was that their learning problems were the result of inherent and specific difficulties in performing some of the psychological processes required for learning. This idea implies that these children were genuinely handicapped through no fault of their own, their parents or their teachers. In differentiating learning disabled children from those with behaviour disorders, the idea that learning disabled children's learning problems are inherent (caused by brain dysfunction), and not the result of environmental influences, was also important.

The first major legislative success came in 1969 with the passage of the children with Learning Disabilities Act, which authorized the U.S. Office of Education to establish programs for Learning Disabled students. Further support for professional development came through the Leadership Training

Institute in Learning Disabilities at the University of Arizona. In 1975, the learning disabilities field achieved a firm basis in law with the passage of P.L. 94-142, which required all states to provide an appropriate public education for children with learning disabilities.

The field of learning disabilities claims for a unique professional identity by its focus on identifying and remediating the specific psychological processing difficulties of learning disability children. Many of the leading professionals at the time place emphasis on visual-perceptual and visual motor processing difficulties as a fundamental cause of learning disabilities. By 1977, dissatisfaction with the processing orientation to diagnosis and remediation of learning disabilities had become so widespread that the federal regulations implementing P.L. 94-142 did not require assessment of psychological processes as part of the procedures to identify learning disabled children for public school programs. Although learning disabilities were still defined as resulting from deficiencies in the basic psychological processes required for learning, learning disabled children were diagnosed primarily in terms of a discrepancy between general measures of intelligence and measures of achievement in specific areas of learning (Wong, 1991).

As cited by Myers and Hammill (1976) Wiederholt in 1974 conceptualized the history of learning disabilities along two dimensions- a developmental phase dimension and a type of disorder dimension. He noted that the personalities who made significant contribution to learning disabilities could be grouped as belonging to three distinct stages or phases, that is, the foundation phase, the transition phase, and the integration phase (Myers and

Hammill, 1976). A schematic presentation of the history of learning disability is presented in Figure 1.

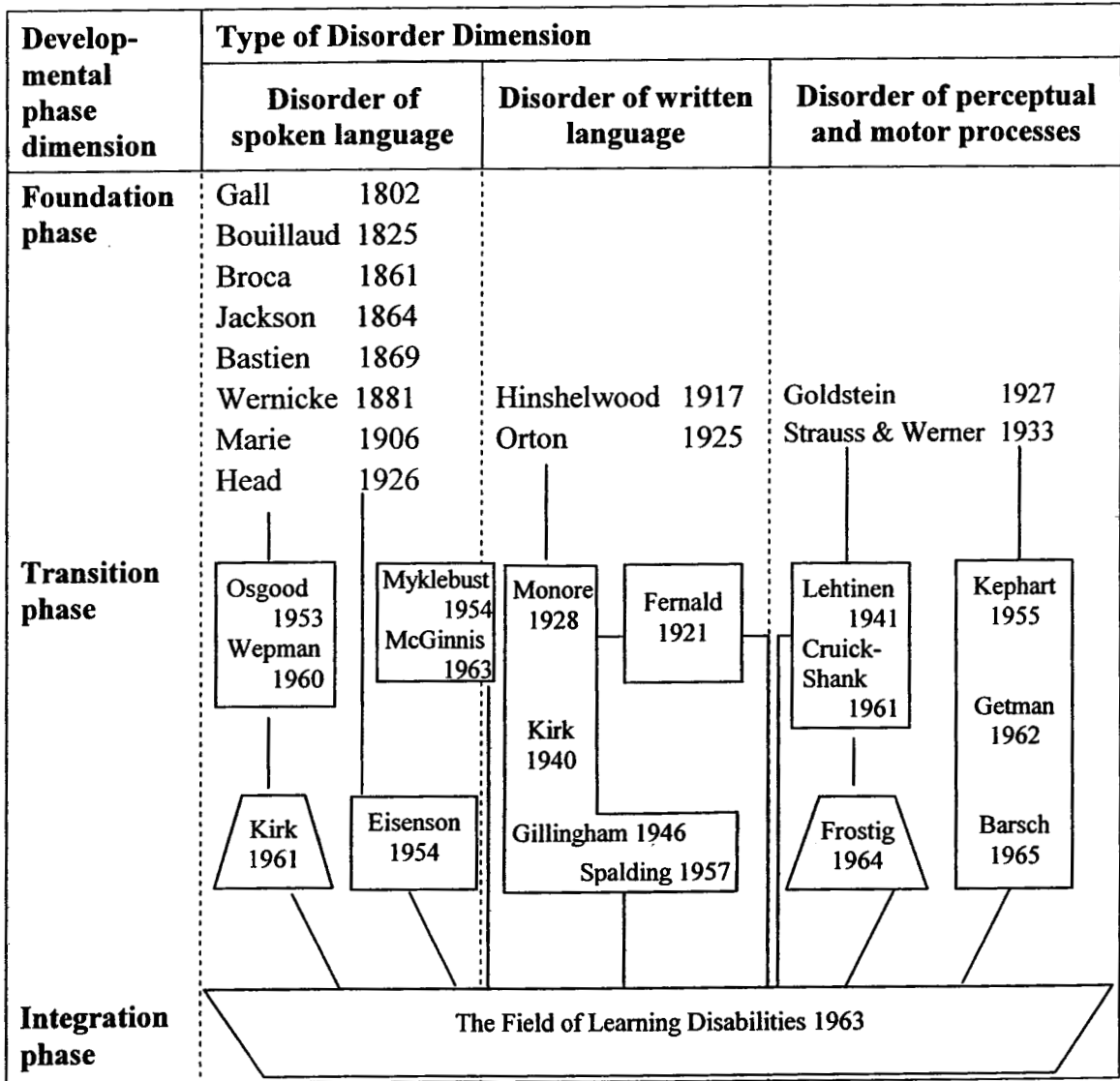


Figure 1: Schematic Presentation of the History of Learning Disability

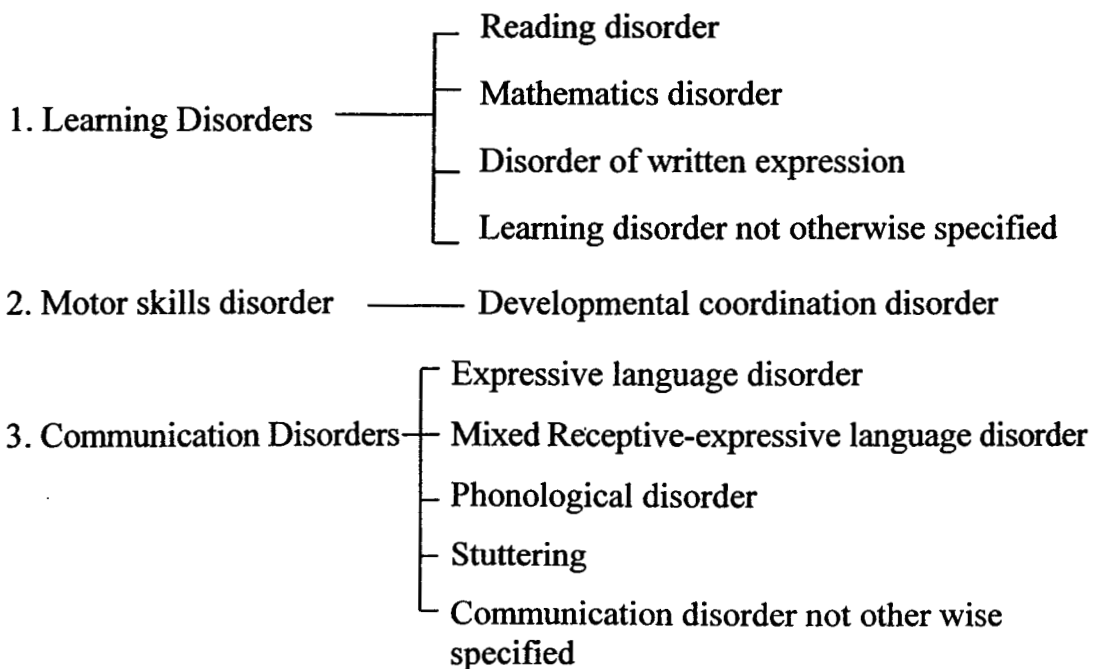
Types of Learning Disabilities

The classification and incidence of learning disabilities reflect the emphasis placed on appropriate conduct and certain academic specialties in school system. Good behaviour, reading, arithmetic and spelling are emphasized, and classification of learning disabilities reflects this emphasis.

There are many different kinds of learning disabilities. Most people are familiar only with dyslexia, which is a reading disorder. Infact, because dyslexia is so prevalent, it has almost come to be synonymous with learning disability. This section discusses the different kinds of learning disabilities related to listening and speaking, reading, writing, spelling and arithmetic. A child may experience difficulty in one area or across many areas.

In short the classification of learning disability is not unique, because the classification given from the educational perspective is different from the clinical perspective (neurological).

The first classification system of learning disability is reported by the American Psychological Association. Their division of classification is according to age at presentation. They classified learning disorders (formerly academic skills disorders) under three main headings.



Another classification system of learning disability is by James. C. Harris in the year 1995. This classification system is purely based on the academic skills impairments. DSM IV definition excludes children whose learning problems are due to known neurological disorders; public law 94-142 including brain injury and dysfunction. The use of specific neuropsychological testing to identify the underlying cognitive abnormalities or impairment is leading to a more specific characterization of DSM-IV disorders. The following is the classification given by James.

1. Reading disorder (dyslexia)
2. Spelling disorder.
3. Mathematics disorder (dyscalculia).
4. Disorder of written expression.
5. Social-Emotional learning disabilities.

The third classification system placed emphasis on conduct and certain academic specialities in school systems. This classification is put forward by Kolb and Whishaw in the year 1996.

1. Verbal disabilities.
2. Non- verbal disabilities.
3. Hyperactivity.
4. Cerebral Palsy
5. Hydrocephalus

The fourth classification of learning disability is done by Onita Nakra in the year 1997. His classification is also based on some of the academic skills like listening, speaking, reading, writing, spelling and arithmetic.

DSM IV describes problems with reading, writing and arithmetic as learning disorders, for obvious reasons, other developmental problems can be grouped with them as well. Baker and Cantwell in the year 1989 says that the exact classification of learning disability is a subject of debate. The problems are tied to a given time and place, and we should expect their definition to change. To use a forced example, a person living in a non-literate society is never going to have a problem with reading or writing. In short, the following types are generally recognized as learning disorders.

1. Reading disorder (Dyslexia)

Reading is an integral part of education and every day life. It appears to be a skill that, given the right opportunities, people acquire almost with effortless ease. When parents are confronted with a child who is unable to read, they react with predictable dismay and bewilderment. Their tendency is to blame the school, the teacher or the syllabus for their child's inability to read. However, dyslexia or reading disability is a problem that is on the increase in India and its wide presence has to be acknowledged and dealt with. In fact, reading disabilities affect 2 to 8 percent of elementary school children (Nakra, 1998).

The research section on developmental dyslexia of the World Federation of Neurology defined dyslexia in two ways.

1. Dyslexia is a disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportunity; it is dependent up on fundamental cognitive disabilities which are frequently of constitutional origin.

2. Dyslexia is a disorder in children, who, despite conventional classroom experience fail to attain the language skills of reading, writing and spelling commensurate with their intellectual abilities.

Reading disorders are most commonly diagnosed on educational grounds based on detection in school and results from psycho educational test batteries that are administered to children who have been identified as reading delayed.

Over the years, researchers have tried to determine what characteristics are shared by dyslexia readers as a group. From a large number of studies conducted, the following conclusions can be drawn as recorded by Nakra (1998).

1. The dyslexia readers is more often a boy than a girl. Male out number of females approximately 4:1.
2. The dyslexic reader has average or above average intelligence. However verbal IQ tends to be significantly below performance IQ.
3. Severely disabled reader often have comprehension difficulties and cannot understand the meaning of a given passage.
4. Members within a family may show similar reading problems.
5. Dyslexia reader tends to be spatially disoriented, with pronounced left-right confusion.
6. There may be poor figure-ground discrimination and motor and visual motor patterning. Fine motor movements tend to be clumsy.

7. Speech difficulties are also a typical characteristic of the dyslexic reader. Stuttering, lispings, cluttering are quite common. Slowness in learning to talk is often indicative of later problems in reading.
8. There is tendency to be hyperactive, impulsive and distracted. Most dyslexia readers have a short attention span and low frustration level.
9. Dyslexia readers tend to have an inefficient visual memory system.
10. Longitudinal studies confirm that severely dyslexic readers continue to manifest severe reading problems as adults, despite intensive remedial intervention.
11. Dyslexia reader functions one grade below expectancy in the primary classes and two or more grade levels below in later school years.
12. There is little or no progress despite intensive instruction.

2. Spelling disorder:

There is considerable overlap between reading and spelling difficulties; however the processes involved in reading and spelling may be different. Mastery of spelling require a considerable degree of linguistic competence, and an understanding of meaning in context may be as important as knowledge of sound-symbol correspondences. Spelling problems tend to last longer than reading problems. Phonological rather than visual skills are important in the development of spelling, although visual memory for spelling patterns may play a major role in spelling proficiency (Harris, 1995).

Children with both reading and spelling difficulties tend to have a more generalized language disorder, where as those with specific problems in

spelling, but little problems in reading, more often have phonetically accurate spelling errors.

Frith in the year 1985 suggests three stages in spelling. They are:

- 1) logographic - Where spelling is symbolic and not connected to phonology
- 2) alphabetic - Where children spell words out by working out all the phonemes in the words and representing them with letters.
- 3) orthographic - Where children begin operating on larger segments, using analogies in spelling and also morphemic units.

In the year 1992, Goswami says that children with phonological difficulties show they also have difficulties in spelling.

3. Mathematics disorder

Mathematics disorder is a disorder of numerical competence and arithmetic skill that is manifest in children with normal intelligence and without neurological injuries. It may occur along with reading disorder, but is separable from this condition. Mathematical disorder is a heterogeneous condition. There may be both intrinsic and extrinsic influences on the acquisition of academic skills in mathematics. The extrinsic factor relate to the complexity of mathematics, poor skill instruction, and lack of mastery of pre-requisite math skills. Intrinsic skills relate to general intelligence, quantitative reasoning ability and visual-spatial ability.

Four basic factors may be involved in maths achievement. They are: language, conceptualization, visual-spatial ability and memory. Proficiency in mathematics involves more than computational skills. It also includes a systematic plan toward problem solving and adequate working memory to complete the task.

In the 1930's and 1940's children with mathematic disorders were found to have associated minimal brain damage or dysfunction. The recognition of minimal brain dysfunction with mathematical problems led to the concept of developmental mathematics disorder. The initial research on mathematics disorder addressed the relationship of visual-spatial skills to problems in numerical computation. Because of its involvement in visual-spatial skills, the right hemisphere was thought to be involved. However the evidence supports the involvement of both hemisphere in computation and problem solving tasks. Although children with math disorder or dyscalculia generally show the same symptoms as adults with acalculia, there may be some basic math concepts, in retrieval of number of words and facts, and in forming numerals and sequencing them appropriately.

4. Disorder of Written Expression (Dysgraphia)

Writing is the most important form of communication and in the hierarchy of language abilities, it is usually the last to be learned. Written language allows one to communicate with others, to express ideas and feelings and share knowledge. In school, the quality of written expression demonstrates that the child has mastered concepts and measures of academic learning in test. Writing is a complex skill that needs coordination of several

abilities. It also requires the acquisition of skills in a certain logical sequence. When a child enters school, there is a distinct hierarchy of writing tasks he is likely to encounter.

Nakra (1998) defined the problem in the following manner.

i. Agraphia

- (a) Acquired-loss of previous ability to write resulting from brain injury or brain disease.
- (b) Developmental (congenital) – unusual difficulty in learning to write which is out of harmony with other intellectual accomplishments and manual skills of the individual.

ii. Dysgraphia - extremely poor handwriting or the inability to perform the motor movements required for handwriting.

Jordan (1977) identified six key characteristics and behaviour associated with dysgraphia.

The three major areas of written expression in which children generally have problems are (a) handwriting (b) spelling and (3) concepts and other technical aspects associated with written expression. Usually these are interlinked problems and it is expected that a child having difficulties in anyone of these areas will experience a spill-over in the other too.

5. Social-Emotional learning disabilities

In addition to poor academic skills, there were serious problems with social skill acquisition. Moreover social skills were found to involve certain cognitive functions that were needed to discriminate social cues. As a result,

the learning disabled child often had difficulty in social understanding that led to chronic difficulties in interpersonal relationships with others. Children with these type of learning disorders neither appropriately interpreted emotional responses of others nor made correct inferences about others emotional behaviour. Consequently, they were often isolated, not actively engaged with their peer group, and were frequently rejected by peers. These learning disorders have been referred to as “non-verbal learning disability”, “right hemispheric’s learning disability”, or social-emotional learning disabilities”. (Harris, 1995). Brayan (1977) and Burininks (1978) had also reported of such problems.

Brumbach, Staton and Wilson in 1980, reported the co-occurrence of depression, learning disability, attentional deficits, and left sided neurological signs and suggested possible right hemisphere pathology. Weintraub and Mesulam in the year 1983 described emotional, interpersonal and cognitive components of “developmental learning disabilities of the right hemisphere”.

6. Learning disorder not other wise specified

According to APA (1994), this category is for disorders in learning that do not meet criteria for any specific learning disorder. This category might include problems in all three areas (reading, mathematics, written expression) that together significantly interfere with academic achievement eventhough performance on tests measuring each individual skill is not substantially below that expected given the person’s chronological age, measured intelligence, and age-appropriate education.

7. Developmental coordination disorder

This may be manifested by marked delays in achieving motor milestone (eg. Walking, crawling, sitting), dropping things, “clumsiness”, poor performance in sports, or poor handwritings. The above said disturbances significantly interferes with academic achievement or activities of daily living.

8. Expressive language disorder

The scores obtained from standardized individually administered measures of expressive language development are substantially below those obtained from standardized measures of both nonverbal intellectual capacity and receptive language development.

9. Mixed receptive expressive language disorder

The scores obtained from a battery of standardized individually administered measures of both receptive and expressive language development are substantially below those obtained from standardized measures of non-verbal intellectual capacity. The difficulties with receptive and expressive language significantly interfere with academic or occupational achievement or with social communication.

10. Phonological disorder

Formally this disorder is also known as developmental articulation disorder. Children with this disorder may have trouble controlling their rate of speech or they may lag behind playmates in learning to make speech

sounds. The difficulties in speech sound production interfere with academic or occupational achievement or with social communication.

11. Stuttering

Disturbances in the normal fluency and time patterning of speech (in appropriate for the individual's age), that interfere with academic or occupational achievement.

12. Communication disorder not otherwise specified

This category is for disorder in communication that do not meet criteria for any specific communication disorder: for example, a voice disorder (ie., an abnormality of vocal pitch, loudness, quality, tone or resonance).

13. Learning disabilities in adolescents and adults

The need for providing services to learning disabled students at the college level was felt in the United States of America as late as the 1970's. College programmes for learning disabled person began to emerge, when it was found that having a learning disability need not imply that one could not aspire for advanced goals in life. Learning disabled adults, too, want to obtain more knowledge to grow, develop and work towards professional careers. Recently the DSM reference book included "Other", a catch-all that includes certain co-ordination disorders and learning handicaps not covered by the other terms in the classification of LD.

In addition to the above categories speech and language disorders are now considered as an indication of learning disability. People under this

condition have difficulty in the production of speech, using spoken language to communicate or understanding what others say.

Under speech and language disorder there are:

- Developmental articulation disorder
- Developmental expressive language disorder
- Developmental receptive language disorder

(www.fly.hiway.net)

14. Other learning disabilities

The DSM also lists additional categories such as “motor skill disorders” and “specific developmental disorders not otherwise specified”. These identification include delays in acquiring language, academic and motor skills that can affect the ability to learn. Apart from this coordination disorders, that can lead to poor penmanship as well as certain spelling and memory disorders.

(www.fly.hiway.net)

Unfortunately relatively small number of research has been conducted about behaviours of learning disabled adult. Moreover each student has a different pattern of characteristics, and to the generalization about the development of learning disabled adult is damaging, to say the least. The following section summarizes the findings established by Cronin and Gerber in the year 1982. According to them learning disabled adolescents have typical difficulties in the following areas.

- a) Cognitive development

- b) Language
- c) Perceptual motor
- d) Academic
- e) Social
- f) Affective

They also added that despite the rather negative slant of this list of characteristics, it should not be assumed that learning disabled college students are incapable of having successful careers. They have many positive attributes too.

Characteristics of Learning Disabilities

The characteristics observed in children with specific learning disorders are quite different from normal children. It is not true to say that all underachieving students are learning disabled. There is so much of individual variation within the learning disabled group that it is not possible to lay down clear-cut characteristics. Myers and Hammill (1976) identified the following six characteristics of learning disabled children. They are (1) motor activity (2) emotionality (3) perception (4) symbolization (5) attention and (6) memory.

Literature cites as many as fifteen categories, many of which are redundant. However, based on the frequency of occurrence, the following ten characteristics have been identified as widely prevalent in individuals with learning disability.

1. Hyperactivity
2. Perceptual impairment
3. Emotional lability
4. General coordination deficit
5. Disorder of attention
6. Impulsivity
7. Disorder of memory and thinking
8. Specific learning disabilities in the areas of reading, arithmetic, writing and spelling
9. Disorder of speech and hearing
10. Equivocal neurological signs and electroencephalographic irregularities.

From the above characteristics, emotional lability, general coordination deficits, disorder of speech and hearing, specific learning disability in the area of reading, arithmetic writing and spelling, motor activity etc... are already discussed in the kinds of learning disabilities. The rest of the characteristics are briefly mentioned below.

Disorder of attention:- To succeed in school, a child must be able to focus or fix his attention on a given task; he must also be able to break his focus at the appropriate time and move on to a new task. Attention is the ability to concentrate on a task long enough to grasp its essential features. Short attention and lack of concentration have been found to be the most obvious qualities in learning disabled individuals.

Hyperactivity:- Another term one finds frequently associated with learning disability is hyperactivity. Hyperactivity is a much misunderstood term and widely misused. Blackman and Goldstein (1982) suggested that when the learner does not know how to respond to incoming stimuli, he produces an incorrect response by either ignoring the relevant feature of the task or responds with excessive activity. The impulsive learner choose the very first action he thinks will solve the problem, without taking time to analyse all the attributes of the task. This leads him to go on to the next action, thus producing hyperactive behaviors. It is also possible to respond quickly and accurately.

Memory disorder:

Person with learning disorder are generally characterized by inefficient memory system. This means that they are unable to spontaneously use rehearsal strategies, decode information in a meaningful way or reorganize information. Early research suggested this occurred because they could not retrieve stored information efficiently.

Perceptual motor problems:

Perception is the cognitive ability to receive and make sense of incoming stimuli. For a long time, learning disabled person were considered deficient in perceptual skills and were treated specifically for improving this deficiency. Over the years results have shown that this kind of training has no benefit for academic achievement. However, learning disability continues to be associated with poor perceptual ability, perceptual motor problem, etc...

Disorder of Symbolization:- Symbolization is one of the highest forms of mental ability and is involved with both concrete and abstract reasoning. At this level of operation the brain integrates perception and memories, as well as other associations, and generates thought processes or chain which may greatly exceed the limits of any given stimulus. The integrity of symbolic processes is an essential criterion which underlies children's acquisition of basic learning skills.

Identification Checklist for the Learning Disabled

Sharma (1988) had developed a criteria for identifying LD children is given below:

- Has difficulty in telling the time, remembering the order of days, months and seasons and mathematical tables.
- Find it difficult to organize his work and is often late in submitting his class work.
- Seems dull and slow in responding to others.
- Cannot recall correctly the oral instruction when asked to repeat.
- Does not seem to listen to or understand instructions given at home or in the class (asks for repetition):
- Excessive inconsistency in the quality of performance, from time to time seems to bright in many ways, but does poorly in academic work.
- Easily distracted even by a slight disturbances.
- Left and right confusion.
- Gets so excited when out of the class for a short period.

- While reading misses out lines or reads them twice.
- Feel difficulty in synthesizing a word after spelling its component letter (example: says b/e/g but he can not say beg, or may say bad instead)
- Makes wild guesses at words whether they make sense or not (for example huge for hurt, turned for trainer)
- Read the word backwards ('on' for 'no', 'saw' for 'was').
- Puts letter in the wrong order (reading 'felt' as left act as 'eat')
- Shortens words ('sunly' for 'suddenly' member for remember)
- Misreads words which look similar ('help' for 'held', house for 'horse')
- Has difficulty in recollecting words.
- Misread number ('6' as '9', '3' as '8')
- Write letter in the wrong order (time for 'item')
- Mirror writes ('ram' for 'mar')
- Reverses letter ('b' as 'd', 'p' as 'q')
- Mirror writes numbers ('6' as '9', 9 as 'p')
- Omits letters ('limp' as 'lip', went as 'wet')
- Adds letters (want as 'whart', what as 'whart')
- Does not write the appropriate letter when the sounds are given.
- Can not pick out letter of the alphabet when the name of the letter is called out.

- Does not match the letters when asked to
- Feel difficulty in academic subject. Sometime the student is deficient in only one subject or a combination of subjects.

Causes of Learning Disabilities

Research in the area of learning disability has primarily focused on assessment and remedial education. Factors related to etiology or causes have been considered of secondary importance. Unfortunately it is not possible to speak of any single factor or group of factor as directly causing a learning disability. It is better to speak of associated factors rather than seek out cause and effect relationships. Literature cites many different causes related to learning disability, but their roles remain ambiguous and tentative. Research has helped us see that the causes are more diverse and complex. New evidence seems to show that most learning disabilities do not stem from a single, specific area of the brain, but from difficulties in bringing together information from various brain regions.

In reviewing the literature we can also find that there is some disagreement among authors about the causes of learning disabilities.

According to Myers and Hammill (1976) the two probable reasons for learning disabilities are: Organically based etiologies and Environmentally based etiologies

In the year 1989, Gaddess identified mainly three group of factors that led to the impairment of learning process as 1) Physiological, 2) Psychological and psychiatric and 3) Sociological or environmental.

Peterson (1996) in his book titled 'The psychology of abnormality' cited three major causes of learning disability: 1) Minimal brain damage (MBD), 2) Environmental factors and 3) Socialization.

In the same year Kolb and Whishaw also identified four major factors that are most often cited as possible causes of learning disabilities. They include- 1) Structural damage, 2) Abnormal cerebral lateralization, 3) Maturation lag and 4) Environmental deprivation.

In the year 1997, Onita Nakra identified six major causes that are responsible for learning disabilities- 1) Neurological damage, 2) Maturation lag, 3) Genetic factors, 4) Biochemical factors, 5) Nutritional deficiencies and 6) The role of the environment.

The recent research in the area of causes of learning disabilities was done by Elias (1999) on dyslexic children, and identified five aspects that are responsible for learning disabilities. They are 1) Errors in fetal brain, 2) Genetic factors, 3) Tobacco, Alcohol and other drug use, 4) Problem during pregnancy or delivery and 5) Toxin in the child's environment.

Chadha (2006) cited four major causes that responsible for learning disability. They are, 1) Genetic factor, 2) Parental causes, 3) Perinatal causes and 4) Postnatal causes

Thus the causal factors include a broad spectrum of factors which could be incorporated in the categories pointed out by Gaddes.

Eysenk (2000) identified the following factors that responsible for learning disability. The factors are:

1. Genetic Factors

The fact that learning disabilities tend to run in families indicate that there may be a genetic link. For example children who lack some of the skills needed for reading, such as hearing the separate sounds of words, are likely to have a parent with related problem. However, a parent's learning disability may be slightly different from the child. A parent who has a writing disorder may have a child with an expressive language disorder. Hallgren in the year 1950, found that 88 percent of the families of dyslexia children showed similar learning problems. Hermann in 1959, examined dyslexia in twins and reported that of the twelve sets of identical (monozygotic) twins, all members were dyslexic. For this reason, it seems unlikely that specific learning disorders are inherited directly. Possibly, what is inherited is a subtle brain dysfunction that can in turn lead to a learning disability. (cited by Nakra, 1998)

2. Biochemical factors

Chemicals play an important role in brain activity, controlling and releasing electrical nerve impulses between neurons. Absence or even excessive amounts of biochemical substances cause a biological imbalance. For example, a delicate balance of acetylcholine and cholinesterase is needed for neural transmission. Metabolic disorder of biogenic amines such as serotonin and dopamine have been of particular interest to researchers. There appears to be some relationship between these chemicals and hyperactivity (frequently associated with learning disability) (Nakra, 1998)

3. Nutritional deficiencies

The developing child require adequate nutrition, specially so in the first six months. A poor diet and severe malnutrition can reduce the child's ability to learn by damaging intersensory abilities and delaying development. Cott in 1972, linked nutritional deprivation to poor biochemical functioning in the brain.

4. Maturation lag

The maturational lag hypothesis postulates that the cognitive functions involved in language, reading and other complex behaviour are organized hierarchically and that the levels of the hierarchy develop sequentially during ontogeny. Should one level of the hierarchy be slow to develop the entire hierarchy is retarded in development. Since higher functions depends on the integrity of lower ones. Bender in the year 1973, observed that if differential stages in the development of the brain are delayed, there occurs a maturational lag. Some typical symptoms he mentioned were.

1. Slow maturation of language skills, specially reading
2. Delayed development of motor skills.
3. Uneven performance pattern on measures of intellectual development.
4. Visual motor problems.
5. Incomplete or mixed dominance.
6. Right left confusion.
7. Immaturity (more often seen in males).
8. Tendency for members within a family to show similar symptoms.

A fair amount of research supports Benders view that maturational delay is associated with learning disability.

5. Socialization

Mc Guinness in 1985, suggest that learning problems results from the way we socialize boys versus girls. Boys were encouraged to engage in gross activity (e.g., running, jumping) where as girls are encouraged to pursue fine motor activity (e.g. sewing). According to this line of theorizing, skills at fine motor activity facilitates language development. We therefore can make sense of why girls are unlikely to develop learning problems, because so many of them involve language. It may well be that there is no single etiology of learning difficulties, but that several factors- from genetic to socialization entwine to bring them about. The mix may change from disorder to disorder and from child to child.

Learning difficulties have consequences far beyond narrowly intellectual ones. The child who falls behind in school because he cannot speak or read as well as his peers is apt to become frustrated and disappointed. His parents might became panic. His classmates might tense or ostracize him. His teachers might ignore him. All of this sets the stage for emotional or conduct difficulties later in life, which occurs at greater than chance rates among those once diagnosed with learning problems (cited by Peterson, 1996)

6. Problem during pregnancy or delivery

Other possible causes of learning disabilities involve complication

during pregnancy. In some cases, the mother's immune system reacts to the fetus and attacks it as if it were an infection. This type of disruption seems to cause newly formed brain cells to settle in the wrong part of the brain or during delivery, the umbilical cord may become twisted and temporarily cut off oxygen to the fetus. This, too, can impair brain function and lead to learning disability (cited by Elias, 1999).

7. Tobacco, Alcohol and other drug use

Many drugs taken by the mother pass directly to the fetus. Research shows that a mother's use of cigarettes, alcohol, or other drugs during pregnancy may have damaging effects on the unborn child. Scientists have found that mothers who smoke during pregnancy may be more likely to bear smaller babies. This is a concern because small newborns, usually those weighing less than 5 pounds, tend to be at risk for a variety of problems, including learning disabilities.

Alcohol also may be dangerous to the fetus's developing brain. It appears that alcohol may distort the developing neurons. Heavy alcohol use during pregnancy has been linked to fetal alcohol syndrome, a condition that can lead to low birth weight, intellectual impairment, hyperactivity and certain physical defects. Any alcohol use during pregnancy may influence the child's development and lead to problems with learning, attention, memory or problem solving.

Drugs such as cocaine—especially in its smokable form known as crack—seem to affect the normal development of brain receptors. These brain cells

parts help to transmit incoming signals from our skin, eyes and ears and help to regulate our physical response to the environment. Because children with certain learning disabilities have difficulty understanding speech sounds or letters, some researchers believe that learning disabilities as well as ADHD, may be related to faulty receptors. Current research points to drug abuse as a possible cause of receptor damage (cited by Elias, 1999).

8. Structural damage

Since the symptom of brain damage in adulthood resemble childhood learning disabilities (for example dyslexia), the causes of learning disabilities may be similar to structural damage resulting from birth truma, encephalitis, anoxia, early childhood accidents and so forth. It is not necessary to have direct brain damage to have neurological deficits. Thus it has been proposed that learning disabilities may result from malfunction of some portion of the cerebral cortex rather than from direct damage. One view of the brain dysfunction hypothesis holds that the dysfunction result from defective arousal mechanism.

In comparing people with and without learning disabilities scientists have observed certain differences in the structure and functioning of the brain. For example, new research indicates that there may be variation in the brain structure called the palnum temporal, a language related area found in both sides of the brain. In people with dyslexia, the two structure were found to be equal/small in size. In people who are not dyslexic, the left planum temporal was noticeably larger. Some scientist believe reading problems may be related to such difference (Kolb and Whishaw, 1996)

Since males are thought to show greater deviance from this asymmetrical pattern, the possibility that testosterone plays a role is suggested. During embryonic development the male fetal gonads produce high level of testosterone, comparable to the levels of adult males. Levels fall just before birth, rise and fall again just after birth, and rise yet again at puberty. It is proposed that the embryonic surges of testosterone delays the development of the left hemisphere, allowing the right hemisphere both space and time for greater development. Thus, male in general have some comparatively better developed areas in the right hemisphere. It is proposed that testosterone also produce some casualties manifested brain changes and learning disabilities.

The first examination of the brain of an individual with a reading disability was made by Drake, who examined the brain of a 12 year old boy who died of cerebral hemorrhage. In school he had been impaired in arithmetic, writing and reading, but he had normal intelligence. Autopsy showed that there were atypical gyral patterns in the parietal lobes, an atrophied corpus callosum, and neurons in the underlying white matter that should have migrated to the cortex. (Kolb and Wishaw, 1996)

Studies show that many children with frontal lobe dysrhythmias have learning problems. Hearing is essential to the normal development of speech and because in most subjects the left hemisphere is dominant for language, normal temporal lobe function and left hemisphere action are necessary for a child's learning to speak, read and write normally. When the left hemisphere is damaged or dysfunctions, there may be impairment in the child's language development (aphasia) and when there is inferior temporal lobe function on

one or both sides, he or she may suffer from some degree of auditory imperception or agnosia.

At least three general conclusions can be drawn from studies examining brain patterns in individuals with learning disabilities. First, there is substantial evidence for brain abnormalities in individuals with learning disabilities. Second, not all individuals with learning disabilities display brain abnormalities, or the same abnormalities. Third, some individuals in the control groups, although not learning disabled, display some abnormalities that are found in those with learning disabilities.

9. Errors in the Fetal Brain

Throughout pregnancy, the fetal brain develops from a few all purpose cells into a complex organ made of billions of specialized, inter connected nerve cells called neurons. During this amazing evolution, things can go wrong that may alter how the neurons form or interconnect. In the early stages of pregnancy, the brain stem forms. It controls basic life functions such as breathing and digestion. Later a deep ridge divides the cerebrum-the thinking part of the brain- into two halves, right and left hemisphere. As new cells forms, they move in to place to create various brain structures. Nerve cells rapidly grow in to form networks with other parts of the brain. Through out pregnancy, this brain development is vulnerable to disruptions. If the disruptions occurs early, the fetus may die or the infant may be born with spread disabilities and possibly mental retardation. If the disruption occurs when the cells are becoming specialized and moving into place, it may leave errors in the cell make up, location or connections. Some scientist believe

that these errors may later show up as learning disorders (cited by Elias, 1999).

10. Psychological and Psychiatric

The psychological and psychiatric factor influencing learning behaviour are frequently difficult to tease out, although it is clinically evident that large number of children with emotional problems do badly in school. Glasser in 1969 has stressed the need for love, self-worth and successful achievement for competent learning and the large scale Isle of Wight study carried out in England has shown the important relationships between education and good physical and mental health (cited by Nakra, 1998).

11. The Role of the Environment

There are several factors in the child's environment which may result in a learning disability. In economically deprived homes, the child may not be exposed to adequate sensory, linguistic and cognitive activities. For example, if a child is never given the opportunity to go to school, this would obviously result in the absence of basic academic skills. An emotionally unstable home life may deprive the child of any motivation to learn. Some researchers. In 1971, Bruner believe that poor quality teaching in schools can also cause a learning disability. (cited by Nakra, 1998).

A Kenyan Study showed that among 441 students referred by primary schools for poor academic, learning disabilities and emotional problems were the commonest causes.

Indian studies also demonstrate a high prevalence of child development

disorder and their linkage to poor scholastic performance. A survey of 1535 primary school children from Bangalore city found that 18% suffered from psychological disturbances and 15% from learning disability. LD are common in poor children for a variety of reasons. These include biological factors related to poor nutrition and greater exposure to environmental toxins such as poor learning environment at home and lack of parental supervision. On the basis of a psychological screening test one study in rural Maharashtra found that more than 80% of the 172 children in the dropout group had some degree of learning disability (Patel and Desouza, 2000)

12. Toxins in the child's environment

Researchers are looking into environmental toxins that may lead to learning disabilities, possibly by disrupting childhood brain development or brain processes. Cadmium and lead, both prevalent in the environment, are becoming a leading focus of neurological research. Cadmium, used in making some steel products, can get in to soil, then into the foods we eat. Lead was once common in paint and gasoline, and is still present in some water pipes. A study sponsored by the National Institute of Health of animals showed a connection between exposure to lead and learning difficulties. In the study, rats exposed to lead experienced changes in their brain waves, slowing their ability to learn. The learning problems lasted for weeks, long after the rats were no longer exposed to lead. In addition, there is growing evidence that learning problems may develop in children with cancer who had been treated with chemotherapy or radiation at an early age. This seems particularly true

of children with brain tumours who received radiation to the skull.(cited by Elias, 1999)

13. Brain dysfunction

According to Taylor in 1989, children who have experienced head injury, central nervous system infection, neurological problem or epilepsy are at higher risk for learning problems than are other children. They also suggest that not all children with a history of these condition develop a learning disability (cited by Kendall & Hammen, 1998).

14. Motivational or cognitive

According to motivational approach, learning disabled children may experience an initial degree of failure, come to doubt their abilities, and fail to put forth effort on future task. Their expectation for success would thus be lower. Tarnowsky and Nay in 1989, found that learning disabled youth are less likely than non-disabled youth to attribute success to their ability, yet more likely to attribute failure to a lack of ability. (cited by Kendall and Hammen, 1998)

15. Information Processing Characteristic

Keogh and Margolis in 1976, Kistner and Torgeson in 1987, and Wong in 1985, found that there is significant difference among learning disabled and non disabled in the information processing characteristics. (cited by Kendall and Hammen, 1998)

16. Lesch-Nyhan Syndrome:

Lesch-Nyhan Syndrome is an 'x' linked genetic disorder which only

affects males. The characteristics of this syndrome include tightening of the muscles and self-injurious behaviour (eg. Lip biting) as well as learning difficulties. (Eysenck, 2000)

17. Tuberous Sclerosis:

It is a genetic disorder which occurs once in every 30,000 births. About 60% of children suffering this disorder have learning difficulties. They also suffer from seizures and they have small bumps in their skin. (Eysenck, 2000)

18. P.K.U.:

Disrupted metabolic processes cause learning difficulties in some cases. PKU is a disease in which the infant is unable to metabolise the amino acid phenylalanine. As a result the concentration of phenylalanine increases and this causes permanent brain damage. (Eysenck, 2000)

19. Tay-Sachs disease:

This was another type of metabolic disease. It is usually found in the descendants of European Jews, and causes learning difficulties. (Eysenck, 2000)

20. Anoxia:

One of the environmental factor that can causes learning difficulty is anoxia or lack of oxygen. If there is prolonged lack of oxygen learning difficulties often occur because anoxia often cause brain damage. (Eysenck, 2000)

21. Congenital hydrocephalus:

Even if properly treated with surgery during the neonatal period, congenital hydrocephalus is associated with a markedly increased risk of learning disability. Finding of a Japanese study showed learning disability in seven of 38 cases followed up to a mean age of 7.4 years.

22. Meningitis and Encephalitis:

This condition in infancy and early childhood are still important causes of learning disability and other major disabilities, even though most of those affected have excellent outcomes.

23. Traumatic Brain Injury:

Traumatic brain injury increases the risk of learning disability as well as several adverse behavioural outcomes. A study conducted with 299 young children in urban U.S.A., those exposed to both violence and trauma related psychological stress had a decrease in IQ of about 7.5 points and a reduction of 10 points in reading achievement.

24. Prematurity:

Prematurity, particularly birth weight of around or below 1000gm, is a well known risk factor for learning disability.

25. Chemical factors:

Radiation, chemotherapy and intrathecal corticosteroid treatments have all been implicated in learning disability and borderline intelligence. Reanalysis of the data on prenatally exposed survivors of the atomic bombing

of Hiroshima and Nagasaki reveals that severe learning disability occurred if the fetus had been exposed from the 8th through 15th week of development, within this period the increase in prevalence of learning disability was directly related to the dose of radiation.

26. CATCH-22 or 22q11-deletion syndrome

22q 11-deletion syndrome is one of the most common genetic syndromes associated with learning disability. And it is believed that it affect one in 3000 children.

27. Fragile 'x' Syndrome

Young boys with this syndrome shows more deficits in motor skill, increased initial avoidance, attention deficits, and hyper activity.

28. Prader-Willi-Syndrome:

Which is caused by loss of the paternal condition of the proximal portion of the long arm of chromosome 15(ie. deletion or maternal disomy or imprinting of 15 q 11-13), is associated with distinct physical and behavioural characteristics as well as a very high rate of learning disability.

29. Smith Magenis Syndrome:

It is caused by a lesion on chromosome 17, this rare syndrome is associated with severe to mild learning disability and extreme behavioural problems.

30. Other medical conditions

There is important links exist between learning disability and medical

conditions other than the behavioural phenotype syndromes. The medical conditions are epilepsy, cerebral palsy, hypothyroidism, autism etc...

Epilepsy is much common among people with learning disability than in the general population. Rates ranges from 14% to 44%.

Cerebral palsy is also over represented in learning disability. About 30% of people with combination of learning disability and cerebral palsy have epilepsy.

Hypothyroidism is common in Down's syndrome, and arises occasionally in other people with learning disability. If untreated, hypothyroidism itself can lead to learning disability.

Theoretical Models of Learning Disabilities

Reddy, Ramar and Kusuma (2003) have reviewed and compiled various studies and approaches to learning disabilities and have proposed seven theoretical models. The models are

1. A specific-area brain defect model
2. The perceptual- motor model.
3. The language development model.
4. Information processing model
5. Learning strategy deficit model
6. Behavioural theory model
7. Other models some times used.

Each of these models are briefly mentioned in the next sections.

1. A Specific-Area Brain Defect Model

According to this model learning disabilities are associated with defects in specific areas of the brain. This observation is made on the basis of four kinds of studies. They are studies on localization of functions, neuroimaging studies, postmortem studies, electro physiology studies. This is elaborately included under neuropsychological theories later.

2. The Perceptual Motor Model

The perceptual motor model relates learning disabilities to intermediate problems caused by brain dysfunction. According to this model perceptual disturbances or abnormalities are caused by brain injury or brain dysfunction. This model also says that perceptual disturbances or abnormalities are the major causes of learning disabilities. This was supported by the studies conducted by Hallahan and Cruickshank (1973).

The intermediate effects brought about by brain dysfunction/defect are visual perception disorder and language disorder. Language disorder culminates in severe reading disability and other learning difficulties. Perceptual motor theorists believe that higher level mental processes develop out of and follow the consistent, integrated development of the motor system. They also have the opinion that early perceptual motor system abilities are the essential base for later conceptual abilities.

Gerald Getman in the year 1965, an optometrist, provides a detailed description of perceptual. Motor model, view the manner in which learning take place. If this learning sequence does not take place in normal manner, a

learning disability may result. Getman in his “The visuo-motor complex in the Acquisition of Learning Skills” provides the following eight steps by which learning take place in a normal manner.

1. Innate responses
2. General motor development
3. Special motor development
4. Ocular motor development
5. Speech, motor and auditory integration system
6. Visualization or recall
7. Perception
8. Intellectual development

3. The Language Development Model

The language developmental model emphasises the role of language in the development of all other abilities. Myklebust (1964) used the term psycho-neurological learning disabilities to indicate that the disability is behavioural while the cause is neurologic. He believes that there are different types of learning disabilities and that lumping them together may lead to lack of success in intervention strategies. In his model there are both verbal and non-verbal learning disabilities because the brain receives, organizes, and categorizes experiences, both verbally and non-verbally. He firmly states that the child’s greatest problem may be non-verbal learning. Research indicates that this might be caused by hemisphere of the brain in which the damage or dysfunction is located. Myklebust believes that disability occurs at the level of perception, imagery, symbolization or conceptualization.

4. Information Processing Models

Information processing theory is a cognitive theory of learning that describes the processing, storage and retrieval of knowledge from the mind. It also focuses on how input is transformed, reduced, elaborated, stored, retrieved and used.

Sensory register is the first component of the memory system where information is received and held for very short period of time. Information in this store is thought to include a mental representation of the physical stimulus. The existence of sensory register has important educational implications. First, children must pay attention to information if they want to retain it and second, it takes time to bring all the informations seen in a moment in to consciousness. Hallahan and Reeve (1980) say that poor recognition of information by students in the learning disabilities are due to attention deficits. McIntyre, Mazer and associates also supported this view.

Torgesen et al., (1991) says that learning disabled students suffer short-term memory difficulties.

Swanson, Chochran and Ewers (1989) conducted a study to determine the extent to which learning disabled readers suffer from working memory deficiencies. The result suggests that working memory of students with learning disabilities is inferior to that of non-learning disabled readers. It warrants the studies that suggest that memory deficiencies among learning disabled students are localized to a short term storage to be re-evaluated within the context of a model that incorporates the operations of working memory.

Brainerd et al (1987) and Swanson (1987c) reported that storage and retrieval problems are primarily sources of individual differences in long term memory performance. Numerous studies have also shown that students with learning disabilities are less skilled than non handicapped peers in the use of rehearsal strategies used to store information in long term memory (Bauer, 1979a). Swanson (1984b) also provides evidence suggesting that long-term memory deficits may arise from failure to integrate visual and verbal memory traces of visually presented stimuli at the time of storage or retrieval.

5. Learning-Strategy Deficits Model

The learning strategy deficit model presumes that learning disabled students may have information or knowledge that they cannot access under most or certain conditions. They also have learning strategies that they cannot activate. They have not learned how to monitor their own progress. As a result they have learning difficulties. This model gives emphasis on metacognition and cognitive behaviour modification.

Research in metacognition has established that learning disabled readers differ from skilled readers in that they tend to equate reading with decoding; they do not monitor their comprehension while reading, and they lack effective strategies for reading disabled students evince strategy deficiencies and thus metacognitive training has been promoted in the classes of learning disabled.

According to Hresko and Reid (1981) and Mercer (1983) cognitive behaviour modification (CBM) is one of the major practical methods whereby we can provide assistance to students who experience strategy deficits.

6. Behavioural Theory Model

Behavioral learning theories tend to emphasize observable behaviour. The underlying principle of behaviourism is that human behaviour is made up of a variety of responses that can be observed and related to other observable events.

Many of the more popular behavioral techniques have been used to good advantage with learning disabled students. (Cooper, et al., 1987; Schloss and Sedlak, 1986; and Kazdin, 1982) Most important of them are direct instruction, programmed instruction, mastery learning and the Keller plan.

7. Other Models Sometimes Used

The Genetic Epistemology Model is sometimes mentioned as learning disabled model (Hresko and Reid, 1981; and Mercer, 1983), and Piagetian theory is of unquestionable value in understanding learning a pre-requisite to successful efforts with students who experience learning disabilities. According to Reid, learning disabled students apparently progress through recognized developmental stages in the same sequence as students, who learn normally, their performance may differ qualitatively.

Maturational Lag or Delay Model (Kinsbourne, 1983; Mercer, 1983; Wallace and Mc Loughlin, 1979) is another model sometimes mentioned as a

learning disabilities model. According to this model, there has been some delay in the development of certain central nervous system components.

Neurologist had framed different sets of theories based on the neurological functioning or defects underlying learning disabilities which are elaborately described in a separate section.

NEUROPSYCHOLOGY OF LEARNING

Learning being a complex cognitive process. The neurological processes related to many simple cognitive function like attention, perception, memory, etc might play a role in bringing out the effects in performance. Similarly it has been experimentally proved that some psychological factor can influence each of these cognitive functions. Therefore it is imperative to assume that there are certain neuropsychological factors behind learning.

Thus in order to study the neuropsychological aspects of learning disabilities, it is necessary to look into two major aspects of learning. The psychological functions related to learning and the neurological functions or factors associated with psychological functions of learning.

Psychological Functions Related to Learning

Learning may be defined as a relatively permanent change in behaviour due to experience. Learning is a complex phenomena which envelops more than one psychological function. They are attention, perception, imagery, concentration, memory, thinking, language abilities, reasoning etc... All these functions are generally termed as cognitive functions.

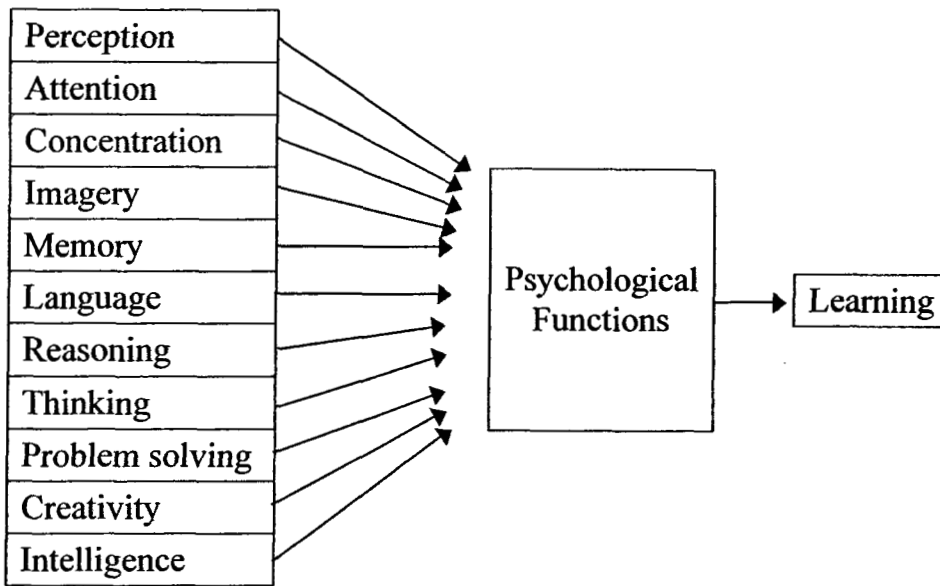


Fig 2: Psychological Function Related to Learning

Perception

According to Coon (2004) perception is an active process of assembling sensations into meaningful patterns that represent external events.

Perception refers to the process of integrating, organizing and interpreting sensory information in a way that is meaningful (Hockenbury and Hockenbury, 1998). Perception works through orchestrated stages of information processing and complex computations. Sensory registration is the beginning point of numerous processes that transform and store the initial internal representation of a stimulus input. Pattern recognition refers to the processes responsible for identifying the stimulus.

Perception always occurs in two levels- conscious level and unconscious level. Perception is greatly affected by learning, motives, values, attention

and expectations. When it occurs at the conscious level there need the psychological process of attention.

Attention

According to Eysenk (2004) attention refers to our ability to select some aspects of incoming stimulation for further analysis. Attention refers to the process of selecting only certain stimuli and concentrating cognitive processes on them. As William James in the year 1890, told that ‘Every one knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible trains of thought. Focalization, concentration of consciousness are of its essence’’. Attention allows us to focus on what is important at the moment and to ignore the rest. Without attention, the world would overwhelm us with sensory information. Perception without attention, would be a swirl of confusion as the mind tries to comprehend everything stimulating the sense at once. There are mainly two kinds of attention i.e., divided attention and selective attention. In divided attention, people must attend to several simultaneously active messages, responding to each as needed. Selective attention is closely related to divided attention. In selective attention, people are confronted with two or more simultaneous task and are required to focus their attention on one while disregarding the other. Attention has no independent status apart from the perceptual process. The process of attention is different from person to person and situation to situation depending on the capacity of the person and the nature of the stimuli.

Concentration

Concentration is another psychological function closely related to perception and attention. Concentration refers to the exclusive restricted attention to one object or areas of study. The law of excitation and inhibition which describes the concentration of nerve processes within restricted cortical areas. (Wolman, 1973)

Memory

Many people think that memory is “a dusty store house of facts”. In reality memory is an active system that receives, organizes, alter and recover information (Coon, 2004). The life of an individual has meaning only because of memory. Our immediate and distant past defines who we are, what we believe, what we can do and what we feel. The loss of perception or attention would be tragic, but one would still possess a sense of identity as long as memory remained intact. The loss of memory, in contrast, would robe one of one’s very life and person hood. Memory refers to the mental processes that enable us to acquire, retain and retrieve information. Rather than being a single process memory involves three fundamental processes: encoding, storage and retrieval.

There is an intimate relationship existing between learning and memory. It is the brains capacity for memory that allows most learning to take place. Not only learning inferred through performance measures based on memory of prior experience, but as we have also seen, what is learned in a

particular situation (for example learned helplessness) is often influenced by the presence or absence of memories of previous events. Similar relationship exists between memory and other cognitive processes. For example, when driving a car we must remember what to attend to and what can be ignored. Many forms of cognition involve creative aspects, but all of our cognitive processes are closely tied to the content of memory. (Price and Glickstein, 1987)

Thinking

Thinking is an internal representation of a problem or situation (Coon, 2004). The term thinking refers to a variety of cognitive activities including problem solving, planning decision making, judgement, remembering etc... in carrying out these activities we rely on the contents of long term memory to a large degree. Apart from the retrieval failure human memory also constrains the cognitive activities involved in thinking because of the limited capacity of short term memory. By no means is all thinking constrained by the limited capacity of short term memory. Much of what is meant by thinking goes on beyond our conscious awareness, and only the products or results of these mental processes as generative processes products. That is generative processes serve to lead to new ideas. Such processes are thought to play an important role in language.

Language

According to Harley in 2001, language can be defined as a system of symbols and rules that enable us to communicate (cited by Eysenck, 2004).

Our language constitute what is perhaps the most striking difference between human and all other species. In no other species do we find such a complex vehicle for communication as the language used by humans. As we shall see this complexity is revealed in the way sounds make up words, in the way words makeup phrases or sentences and in the way sentence convey meaning. Another reason for treating language separately is its central importance in human cognitive activities. Language spoken or written serves as the medium through which most knowledge is communicated. We use language constantly in our daily activities for a variety of social, intellectual and personal purposes. Thus language serves as an important medium for observing the results of cognitive activities in human beings.

To make the learning most effective certain psychological functions are more essential. They are problem solving creativity etc. Problem solving is a process in which thinking and behaviour directed toward attaining a goal that is not readily available. At the same time creativity is a group of cognitive processes used to generate useful, original and novel ideas or solutions. These two processes play a dominant role in the process of learning.

Thus it is evident that all these psychological functions determine the success in learning and that learning is not a single function.

Neurological Functions Related to Learning

Literature on these functions indicate that these cognitive functions have neurological correlates. Major findings related to the neurological

correlates. Major findings related to the neurological dimensions of various psychological functions in learning is briefly mentioned in the next few sections.

Neurological Correlates of Attention

Attention depends on awareness and implies the ability to respond to a particular type of stimuli. Attention to specific aspects of the perceived universe depends on both awareness as a general property and on the specific anatomical structure that mediate the sensory phenomena involved. (Goetz and Pappert, 1999).

In 1973, Luria identified that frontal region of the human cortex have been related to the ability to maintain attention and direct behaviour. (Cited by Requin, 1978)

Corbetta in the year 1991 find out that different cortical areas are activated in different attentional tasks. The parietal cortex is activated for attention to location and the occipital cortex is activated for attention to features such as colour and form.

The PET and ERP studies shows that different region of the posterior cortex are involved in different aspect of selective attention.

According Laberge, et al. in the year 1990, attention relies on complex interaction among many neural areas. The six main areas that involved in attentional processes are reticular activating system, superior colliculus, pulvinar of the thalamus, cingulate cortex, posterior parietal lobe and frontal

lobe and all of which are in the cortex. And each of these areas have different functions in relation to attention.

- RAS : alerting and arousal aspects of attention
- Superior Colliculus : Aids in shifting attention to new location or object by controlling eye movement
- Pulvinar of the Thalamas : Plays important role in selective attention.
- Cingulate cortex : Imparting emotional significance during attentional processing.
- Parietal lobe : important for spatial aspects of attention and the allocation of attentional resources to a particular stimulus or task.
- Frontal lobe : Selection of a particular motor responses and for recruiting attentional resources in service of a goal or a plan.

From the above findings it is clear that the process of attention is controlled by different cortical areas of the brain.

Neurological Correlates of Memory

Memory is the recording and retrieval of knowledge. It accounts for all knowledge gained from experience, facts that are known, events that are remembered and skills that are gained and applied. Memory is not a unitary faculty but rather an ensemble of various forms of learning that differ in their use, their operating characteristics, and the neural network that mediate their processing.

In 1957 Scoville and Milner identified that human hippocampus has its role in memory, particularly in declarative and episodic memory. This stems primarily from the evidence that patients with damage to the hippocampal formation are severely amnesic.

After one year, Penfield and Milner studied 90 patients with medial temporal lobe epilepsy who underwent unilateral partial temporal lobotomy, including hippocampus formation and para hippocampal gyrus, the uncus and the amygdala. They attributed the memory loss in these patients to the resection of the hippocampal formation. This was supported by the studies conducted by Guyton in the year 1976.

The clinical observations of Milner in the years 1955, 1959, 1965, have suggested that the hippocampus may be important to memory formation in man. Similarly stimulation studies have shown that the hippocampus is involved in some way in memory process by Gold, et al., in 1974; Kesner and Wilburn in 1974. (Cited by Mc. Gaugh and Colin, 1975)

The evidence from four fields of neuroscience i.e., Animal ablation studies by Zola-Morgan, Squire, Amaral and Suzuki, 1981; Squire and Zola Morgan, 1991; Gaffan and Murray, 1992; Meunier, Bachevalier, Mishkin and Murray, 1993; Suzuki, Zola Morgan, Squire and Amaral, 1993; Murray, 1996; Human lesion studies by Kartsounis, Rudge and Stevens, 1995; Rempel-Clower, et al, 1996; Varghakhadem et al, 1997; Epilepsy surgery by Scoville and Millner, 1957; Penfield and Milner, 1958; Henke and Wieser, 1996; and Functional imaging by Grasby et al., 1994, Kapur, et al., 1994; Shalliece et al., 1994, Tulwing, Kapur, Markowitsch et al, 1994, Andreasen

et al., 1995; Fletcher et al, 1995, clearly shows the role of hippocampus in memory (cited by Nilsson and Markowitsh (1999).

As reported by Eichenbaum et al in the year 1992 that hippocampus may mediate the representation of spatial and temporal memories. This finding was also supported by Kandel et al (2000).

In conclusion, the above evidences from four different fields of research draws a heterogeneous picture of the functions of the hippocampal formation in memory.

Neurological Correlates of Language

Language is the cognitive aspect of symbolic communication. It is the ability to converse, comprehend, repeat, read and write. Language ability depend on central processing for either comprehension or formulation for expressing the sounds and symbols of prepositional communication, (Cited by Goetz & Pappert, 1999).

In the year 1861, Paul Broca, a French Neurologist identified the area in front of the left motor strip that control the muscles of face, jaw, tongue and speech muscles. This area is known as Broca's area and is the cortical centre largely involved in the articulation and expression of spoken speech. In 1874, Carl Wernicke, a young German neurologist identified the lateral surface of the left temporal lobe as the cortical centre. It was Wernicke who made the assumption that the two areas Broca's and Wernicke's were connected (cited by Gaddes, 1989).

However, if these brain centers are damaged, diseased or structurally mal formed the child will have difficulty in acquiring language skills. When the dysfunction is in the language centers and is mild, the child is said to have a specific learning disability involving reading and language arts (Gaddes, 1989). These findings was supported by the studies conducted in later years by Curtis, 1874; Springer and Deutsch, 1981; Kandel, Schwartz and Jessell, 2000.

As reported by Seeley, Stephens and Tate in the year 1995, that the language function has four phases. They are speaking words, generating words, seeing words and hearing words. Different areas of the brain are involved each of these phase.

- Speaking words - Primary motor cortex
- Generating words - premotor area and Broca's area
- Seeing words - visual cortex
- Hearing words - primary auditory cortex and wernicke's area

So it is clear that the language function is controlled by Broca's and Wernicke's area in the brain.

Neurological Correlates of Impulsivity

Impulsivity refers to difficulty in awaiting turn, often interrupts or intrudes on others, and often bursts our answers before questions have been completed.

Numerous data suggesting a biological substrate operative in many disorders of impulse control. Patients with structural lesions of the central

nervous system or brain may manifest reduced control of various impulses (Popkin, 1989).

Lezak (1995) reported that frontal lobe damage may cause problems in stopping that are often described as impulsivity, over-reactivity and difficulty in holding back a wrong or unwanted response. This findings was also supported by Syndulko (1978).

Neuropsychological Theories Associated with Learning Disabilities

A number of theories provide speculation regarding the etiology of specific learning disabilities; many of these theories rest up on unavailable empirical support. Researches agree that the population with learning disability is both complex in nature and heterogenous in composition. The purpose of this section is to discuss the assumptions and concepts underlying neuropsychological theories associated with learning disorders which could be related to specific area brain defect model. In particular, anatomical, physiological and behavioural evidences supporting the view that group difference in hemisphere organization tend to characterize the population with learning disability. In doing so, application of neuropsychological theories for interpreting and conducting research in learning disabilities may become more evident.

Theories of Hemisphere Specialization and Cognitive Performance

One of the central issues of neuropsychology is the asymmetrical organization of functions in the brain. Ever since physical differences in the two hemispheres were noted, researchers have been attributing function

to structure. Most studies have shown lateralization or the presence of hemispheric specialization in performance. There are many ideas or models about laterality and asymmetry of functions. Several of these neuropsychological models are outlined below.

Vaughan and Bos (1994) have cited Zaidel's three models of functional hemispheric asymmetry. He stated that first two are anatomically motivated and the third model is more psychologically motivated.

Zaidel's first model is called "direct access". This model reflects the belief that the hemisphere that receives the sensory input first, process it. Laterality differences are attributed to differences in the perceptual cognitive competencies of the two hemispheres. Split brain and lesion studies support the direct access model.

The second model is called "Callosal relay". Kimura in the year 1967 called it the "verbal-non verbal model". This theory assumes the specialization of each hemisphere to perform specific functions. Verbal stimuli presented to the right or left side of the body will be directly processed by the left hemisphere. Thus verbal stimuli presented to the right side of the body will be processed by the left hemisphere, but verbal stimuli presented to the left side of the body will be presented to the right hemisphere and transferred across the corpus callosum to the left hemisphere to be processed. The right hemisphere is considered specialized for non-verbal information directly. Hemispheric lesion studies also support the callosal relay model.

The third model is called “dynamic shift”. Kinsbourne called it “attention model”. Kinsbourne agrees with Kimura that hemispheric specialization does not explain lateral advantages. Kinsbourne believes that an aroused hemisphere “primes” the attention centers to focus on perceptions in that particular perceptual field of the body. Hellige in the year 1983 said that over loading of hemisphere activation can lead to eventual shift of control to the other hemisphere. This model accommodates both direct access and callosal relay of lateral specialization. (Cited by Vaughn and Bos, 1994)

Individual differences in structural function, according to the direct access model, would be attributed to individual hemispheric specialization or inherent variability. According to the callosal relay model, individual difference in structural function could be attributed to the individual difference in callosal connectivity.

In 1981, Goldberg and Costa introduced another behavioural model called “novel information”. This theory suggests that the verbal-non-verbal theory is too simplistic. They believe that the right hemisphere is functionally specialized to process new information and the left hemisphere is specialized to process familiar information. Bakker in the year 1979, supports this theory in finding that beginning readers process written stimuli primarily with the right hemisphere.

Lenneberg believes that the left hemisphere gradually gains control over language and that lateralization is established around puberty. In 1973, Krashen altered this “developmental” model by changing the age of left hemisphere establishment to 5 years of age.

Although some research has provided support for each of the theoretical positions, there has been little consensus regarding theoretical explanation for learning disabilities. The next section outlines the progress that has been made in the neuro-psychological study of learning disabilities.

Laterality, Cognitive Deficits and Learning Disabilities

It is hypothesized that the population with learning disability has an anomalous pattern of cerebral language lateralization as compared to the majority of right handed individuals. Orton in the year 1937 asserted the idea that disordered language processes in individuals with learning disability were due to faulty development within the left hemisphere. The original theory was premised on the observation that since a very small area of destruction in exactly the same part of the opposite or nondominant hemisphere was followed by no language disorder at all, language disorder in children must be preceded by some sort of maldevelopment or lack of development in the dominant hemisphere.

Theories that can be considered to have developed from Orton's original proposals include the deficit and delay models.

The deficit model proposes that cerebral dysfunction underlies the inability to acquire appropriate reading skills. Cerebral dysfunction or deficit, may take the form of faulty hemispheric organization, of abnormal development of neural cells, or of patterns of abnormal cellular connections.

The delay model or the maturational lag, is a developmental theory proposing that dyslexia is due to difficulties in the establishment of cerebral

dominance. Although the delay model continues to enjoy a moderate level of acceptance, in 1984 Spreen, Tupper, Risser, Tuokko and Edgell reported that the beginning of hemispheric specialization to be present at or near birth.

Anatomical and Behavioural Differences

Due to the lack of hard evidence, early theories of cerebral dominance centered up on the study of functional asymmetry. It is only recently that technology has allowed for the parallel findings of anatomical asymmetry, enabling more tangible speculations regarding the neuroanatomical basis for language. In 1968 Geschwind and Levitsky offered proof that the language areas in the left hemisphere are significantly larger than the corresponding areas in the right hemisphere, specifically the planum temporal was larger in the left hemisphere. Levitsky demonstrated that lesion involving the planum temporal on the left side are likely to produce Wernicke's aphasia. This findings makes more robust the suggestion that the left planum temporal contains functional areas necessary for language.

Subsequent studies have confirmed the findings of an anatomical asymmetry in the left hemisphere. In 1973 Witelson and Pallie found the left planum to be significantly larger than the right. In addition to offering an anatomical basis for functional asymmetry, it is suggested that the language area in the human infant is larger either at birth or shortly thereafter. Wada, Clark and Hamm in 1975 also offered subsequent confirmation on left hemisphere anatomical dominance in both infant and adult postmortem brains. These findings render the fact of hemispheric asymmetry of the temporal speech region in the area of the planum temporal well established.

Analyses of individuals with dyslexia and learning disability often suggest abnormalities in brain structures. Drake in 1968 performed a postmortem study on a 12 year old dyslexic boy. He discovered an abnormal corpus callosum and an abnormal convolutional pattern in both parietal lobes. In 1979, Galaburda and Kemper examined 19 year old dyslexic boy and discovered abnormalities in the left planum temporal. The patient had a well-documented history of developmental dyslexia, severe problems in reading, moderate difficulties with arithmetic and mild disturbance in right-left discrimination.

Up on examining the brain, it was found that this patient lacked the asymmetry found in the majority of the people. Most people have large left temporal (Planum temporal) region different than that of the right region. The planum temporal regions in the patient with dyslexia were discovered to be symmetrical in the two hemispheres. The abnormality was defined to the left region only.

These neuroanatomical findings also suggest that a prenatal alteration of brain development underlies specific language impairment and may even reflect a transmittable biological factor that places some families at risk for language development. (cited by Vaughn and Bos, 1994)

Anatomical and Physiological Asymmetries Examined Through Neuro-Imaging

Obrzut, Hynd, Obrzut and Pirozzolo in the year 1981 found that dyslexic children are better able to switch attention from one ear to the other

in a study of 7 to 13 year olds. The left year advantage (LEA) could mean that dyslexics lack efficient bilateral communication, which is the function of the corpus callosum. Obrzut, Hynd and Zellner in 1983 also supported this theory.

Perhaps most of the work linking dichotic listening performance in population with LD has been conducted by Obrzut and his associates. Through systematic studies with listening asymmetries, the relationship between cognitive deficits in children with LD and cerebral organization is becoming clearer. Based on a review of studies that have used the dichotic selective-attention paradigm, it can be inferred that child with LD are deficient in their ability to process auditory receptive language unilaterally in the left hemisphere. These studies have indicated that right hemisphere attentional activation interferes with left hemisphere verbal processing in children with LD. (cited by Vaughn and Bos, 1994)

Autoimmune Theory

In 1984 Geschwind stated that there is a link between left handedness and learning disorders, such as dyslexia. Geschwind and Colleagues also found learning disorders to be linked to migraine and autoimmune diseases.

Vaughn and Bos (1994) have cited a few studies by Geschwind, Geschwind and Behan; Geschwind and Galaburda; and Marx. According to them, autoimmunity occurs when the immune system begins attacking the body's own tissue, which is associated with childhood allergy problem and is

the cause of such disorders as ulcerative colitis, atopic diseases such as asthma, myasthenia gravis, celiac disease, and inflammation of the thyroid and the colon. It is proposed that a common origin may account for the anomaly in the immune system as is already understood in the case of learning disorders. As impairment of the left hemisphere is noted in disturbance of language function and in a significant number of left handers, it is hypothesized that autoimmunity's roots may be traced to left hemisphere malformation.

Further, testosterone slows the growth of the convexity of the left hemisphere in *utero* (italics in original), accounting for a greater number of left handers in males. When the testosterone effects are more marked, abnormalities in the formation of the left hemisphere will result. This would account for the greater frequency of learning disorders in males.

In two related studies by Geschwind and Behan in 1982 found the frequency of immune disease among left handed subjects to be 2.7 times that in the control group of right handers. They also found a significant number of left handers reporting learning disorders. (cited by Vaughn and Bos, 1994)

ASSESSMENT

Assessment is an integral part of educational process. Educational assessment can be defined as the process of collecting data for the purpose of specifying and verifying problems and for making educational decisions about students.

Hallahan, Kauffman and Lloyd (1996) stated that the primary purpose of assessment is to contribute to the amelioration or remediation of learning disabilities. This statement emphasizes that learning disability can be accurately measured and classified and such measurement and classification will lead logically to remedial intervention.

Reddy, Ramar and Kusuma (2003) had precisely put it as follows. There are various assessment procedures for gathering various types of information. These assessment procedures can be classified into two categories as:

- 1) Informal assessment
- 2) Formal assessment

Informal Assessment

Informal assessment is the evaluation of information primarily gathered through observations of student behaviour, written examinations, discussions, select strategies and measure outcomes. Through informal assessment, teachers can directly monitor students behaviour as well as evaluate the instruction and the learning environment. There are various types of informal assessment techniques that can be used to measure the student characteristics. They are:

1. Curriculum based assessment
2. Criterion referenced tests.
3. Observation.
4. Interview, questionnaire, checklists.

II. Formal Assessment

Formal assessment measures are generally individually administered tests that are norm-referenced or standardized, designed to compare students performance. There are a number of tests employed in formal assessment for identification of learning disability. They are

1. Measures of intelligence.
2. Measures of academic functioning.
3. Measures of certain cognitive area.

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Chapter II

REVIEW OF RELATED LITERATURE

- ❖ *Memory and Learning Disability*
- ❖ *Attention and Learning Disability*
- ❖ *Language and Learning Disability*
- ❖ *Impulsivity and Learning Disability*
- ❖ *Present Study*

REVIEW OF LITERATURE

Research Projects do not develop in a vacuum. The researcher involved in a program of study has to be thoroughly familiar with their own work and also the work of others in the same or related area. According to Cresswell (1994) the literature in a research has several purposes.

1. It shares the result of other studies that are related to the study being reported.
2. It relates the study to the larger.
3. It provides framework for establishing the importance of the study as well as comparing the result of the study with other findings.

The literature used in qualitative and quantitative study is also different. In qualitative research the literature is used in a manner consistent with the methodological assumptions.

Quantitative studies include a substantial amount of literature to provide direction for the research question or hypothesis. In planning a quantitative study the literature is often used to introduce a problem in the introduction (Cresswell, 1994).

Based on the literature so far available new study is planned and designed. Therefore, for the present study, the available literature-theoretical as well as empirical is reviewed. However all the studies are not presented only the recent ones and the very relevant earlier studies are included in this chapter.

The studies available in Learning Disability is further classified into four major categories. They are Memory and Learning Disability, Attention and Learning Disability, Language and Learning Disability and Impulsivity and Learning Disability.

MEMORY AND LEARNING DISABILITY

Silver and Tipps (1993) examined verbal and nonverbal memory in children (10-12yrs old) with reading disabilities (RD) who demonstrated lower verbal IQ (VIQ) relative to performance IQ (PIQ) and the converse. The Verbal and Nonverbal Selective Reminding Tests were administered to 13 RD children with $VIQ < PIQ$, 14 RD children with $PIQ < VIQ$, and 14 controls. Contrary to predictions, memory functions were not found to parallel intellectual functions. Ss with lower PIQ displayed poorer storage and retrieval of verbal information along with poorer retrieval of nonverbal information. These results suggest that children with reading disabilities who obtain relatively lower PIQ might be expected to experience more memory problems than children with lower VIQ regardless of modality of input.

Hurford and Shedelbower (1993) examined the relationship between discrimination and memory ability in children with reading disabilities in 2 experiments. In Exp 1, 64 2nd, 3rd, and 4th graders with and without reading disabilities were assessed to determine if phonological memory played a role in the discrimination task (DT). The poor performance of the young disabled readers on the DT disappeared when the amount of phonological information to be encoded was reduced. Results of Exp 2 with 10 2nd-grade disabled readers show that differences in performance resulted because of differential

memory processing. Young disabled readers may be unable to hold phonemic information in memory long enough to make adequate discriminations.

Swanson (1994) investigated (1) the degree to which working-memory differences among children with learning disabilities (LDs) reflect specific or generalized working-memory processes and (2) whether dynamic assessment yields similar diagnostic classifications of children with LDs as initial testing. Performance of 143 children (mean age 10.78 yrs) was compared on verbal and visual-spatial working-memory measures under initial, gain, and maintenance testing conditions. The results showed that (1) LD subtypes are comparable during initial testing, but children with math disabilities improve on verbal working-memory tasks when compared to children with reading disabilities during dynamic testing; (2) LD subtypes are inferior to average children but superior to slow learners across working-memory processing; and (3) ability group classifications change under dynamic when compared to initial testing.

Lorsbach, Wilson and Reimer (1996) conducted study on difficulty in suppression of information that becomes irrelevant during a sentence processing and memory task in 21 language/ learning disabled and 20 nondisabled 4th graders. In study trials, Ss were asked to predict and remember the terminal nouns for a series of sentences that highly constrained a terminal noun. For half the study trials (fillers) predictions were confirmed by presenting the expected ending. For the other trials (critical trials),

expected endings were disconfirmed with low-probability endings (target nouns). Memory for critical trials' disconfirmed and target nouns were tested implicitly with a sentence-completion task in which memory for disconfirmed and target nouns associated with individual study sentences were measured in terms of priming effects. Disabled Ss had more difficulty than nondisabled Ss inhibiting the activation of irrelevant information and sustaining the activation of relevant information.

Zhang, Zhang and Zhou, (1998) studied the validity of the hypothesis that dyslexics have special cognitive profiles. Ss were 59 children with dyslexia (aged 11-13 yrs) screened from 967 5th-grade students and 59 normal children in China. Ss with dyslexia were divided into 2 subgroups of reading retardation: "cut-off" Ss and definitive low achievement Ss. Ss were assessed with the Reading Achievement Scale in vocabulary, comprehension and reading including the tests of visual-space, figure memorization, language comprehension, short-term memory of story (oral), non-language short-term memory, phonetic ability, visual attention, and general information comprehension. The results of tests were compared between groups and subgroups. The predictions of 8 cognitive tests on reading proficiency were studied with multiple stepwise regression analysis. The results show that the decrease of memory, processing, and comprehension of vocabulary and information was the main cognitive profile; and that the ability for general information could distinguish relatively cut-off Ss from definitive low achievement Ss that indicates that the ability for general information may be used in distinguishing general reading and special reading retardation.

Reynolds and Ceil (1998) studied the reliability of performance on the test of memory and learning (TOMAL) on adolescent learning disabled sample of 5 and 19 years old. In the current study 99 adolescents, diagnosed with various learning disabilities in the public school were included. A matched sample was drawn from the standardization sample and alpha computed for this group. The alpha values of two groups were highly similar across 14 subjects, although adolescents with learning disabilities often have memory deficits.

Johnson, Altmaier and Richman (1999) examined the interaction of attention deficit and learning disabilities on the immediate memory abilities of children. Forty children of 7 and 13 year old diagnosed with attention deficit hyperactivity disorder were matched with 40 children who were independently diagnosed with undifferentiated attention deficit disorder. The findings revealed that, children with attention deficit and a comorbid learning disability had greater memory deficits.

Rana and Sangwan (2000) examined the relationship of memory between average and learning disabled (slow learner) children in 80 learning disabled and 80 average children (aged 4 to 6 years). Subjects were administered Stanford Binet Intelligence Scale to control the IQ of the subjects, where as the memory of these children was assessed by standardized cognitive test. The results indicate that average learners were found to excel in memory than learning disabled (slow learners). Among the slow learner children, girls performed better as compared to their counterparts.

Kramer, Knee and Delis (2000) conducted a study about verbal memory impairments in dyslexia. The study used the California Verbal Learning Test-Children's Version (CVLT-C) to assess verbal learning in 57 dyslexic children and 114 controls matched for gender, age and WISC-R vocabulary score. The area investigated are recall and recognition, use of learning strategies, and interference effects. The data suggests that the dyslexic have less efficient rehearsal and encoding mechanisms, resulting in deficient encoding of new information, but normal retention and retrieval.

Zhang, Zhao and Fu (2000) compared the characteristics of meta memory between learning disabled children and Non Learning Disabled children. The sample was 62 learning disabled children and 565 Non Learning Disabled children aged 9-11 years of 5th grade students. Subjects intelligence was assessed with Raven's Standard Progressive Matrices. Subjects academic achievements were computed with 't' scores transferred from subjects average scores of Chinese language and mathematics examinations. Subjects meta memory was tested with a number of table and a figure table (16 items in each (4 by 4)) which were presented to subjects and time controlled for recall by the E. (2.min). Learning disabled subjects and non learning disabled subjects memory organization, memory monitoring, quantity of memory E-controlled or S-controlled time in number and figure memorization were studied with correlation analysis. Learning disabled subjects low level of memory organization presented as lack of effective organizational strategies and LD subjects inaccurate memory monitoring

presented as low self-consciousness indicative of LD subjects low level of meta memory.

Geary, Hamson and Hoard (2000) conducted a longitudinal study of process and concepts deficits in children with learning disability. Based on the stability and level of performance on standard achievement tests in first and second grade children with – IQ scores in the low average to high average range were classified as learning disabled in mathematics, reading or both. These children (n=42), a group of children who showed variable achievement test performance across grades (n=16), and a control group of academically normal peers (n=35) were administered a series of experimental and psychometric tasks. The task assessed number comprehension and production skills, counting knowledge, arithmetic skills, working memory, the ease of activation of phonetic representation of words and numbers and spatial abilities. The children with variable achievement test performance did not differ from the academically normal children in any cognitive domain, whereas the children in the LD groups showed specific pattern of cognitive deficits, above and beyond the influence of IQ.

Swanson (2000) investigated whether changes in the working memory (WM) performance of readers with learning disabilities (LD) is related to a general or domain-specific system. The study compared readers with LD, chronologically age-matched (CA-M), and reading level-matched (RL-M) children's WM performance for phonological, visual-spatial, and semantic information under initial, gain, and maintenance conditions. 84 children participated in the study, mean chronological age was 12.8 yrs for readers

with LD, 12.5 yrs for CA-M children, and 6.8 yrs for RL-M children. The main findings indicated that (a) CA-M children were superior in performance to readers with LD across initial, gain, and maintenance conditions; (b) readers with LD showed less change (as reflected in effect size scores, slopes for the quadratic curve) on both visual-spatial and verbal (phonological and semantic) WM tasks across gain and maintenance conditions than the CA-matched children; and (c) the performance of readers with LD was superior to the RL-M children's performance on initial conditions, but inferior on gain and maintenance conditions. Taken together, the results suggest that a general system moderated the changes in retrieval of phonological, visual-spatial, and semantic information in readers with LD.

Pennington, Cardoso-Martins, and Green (2001) compared the predictions of the phonological and double deficit hypotheses of developmental dyslexia (DD) by experimentally examining speech perception, phoneme awareness, lexical retrieval (serial and discrete), articulatory speed, and verbal short-term memory in 35 school age children and 36 adolescent dyslexics, and both chronological and reading age controls. Results favoured the phonological hypothesis over the double deficit hypothesis, confirming previous findings of a deficit in phoneme awareness (PHA) in DD. At both age levels, dyslexics performed significantly more poorly than control groups. Although deficits in other processes, particularly in rapid serial naming (RSN), were also apparent, they were not as clear-cut as the PHA deficit. Although RSN contributed independent variation to various literacy skills, its contribution was modest relative to the contribution of PHA,

regardless of whether the literacy skill relied more or less heavily on phonological or orthographic coding skills. Further analyses suggested that variation in RSN skill is particularly important for fluent reading of text, whereas PHA is important for development of reading ability by phonologically recoding letters or groups of letters in words into their phonological codes.

Henry (2001) examined in children aged 11-12 years who had borderline, mild, and moderate learning disabilities. Comparisons with children of average abilities were used to determine whether those with more severe learning disabilities had greater impairments in working memory. Seven measures of working memory span were used to assess temporary phonological short-term storage (digit span, word span), temporary visuospatial short-term storage (pattern span, spatial span), and temporary short-term storage with additional processing, or central executive, demands (listening span, odd one out span, reverse digit span). Children with mild and moderate learning disabilities were impaired on all measures of working memory compared to children of average abilities. Children with borderline learning disabilities were just as good as children with average abilities on visuo-spatial and complex span tasks, but showed an impairment on phonological span tasks. Children with moderate learning disabilities were indistinguishable from children with mild learning disabilities on simple span tasks, but were significantly poorer than the mild group on the more demanding complex span tasks. For the group as a whole, memory was strongly related to mental age.

Swanson and SachseLee (2001) explored the relationship between working Memory (WM) and Mathematical problem solving in children with learning disability (LD) (age 11.5 years) were compared to chronologically aged matched (CAM) and Younger comprehension/computation achievement matched children (age 8-9 years) on measures of verbal and visual spatial WM, phonological processing, components of problem solving and word problem solving accuracy. The result showed that children with LD were inferior on measures of word solution accuracy, components of problem solving. Phonological processing, Domain general WH, and verbal WM when compared to children who were CAM. Children with LD were comparable to younger children on all processing measures except measures of domain-general WM, Visual-spatial WM, Phonemic deletion and identifying problem goals.

Passolunghi and Siegel (2001) examined the relations between short term memory, working memory, inhibitory control and arithmetic word problem solution in children who were poor in arithmetic problem solving (n=23). The children were compared with group of good problem solvers (n=26) matched for vocabulary, age, gender. The results corroborate their hypothesis of poor problem solver's general deficit in inhibitory processes. They had lower scores and more intrusion errors in a series of working memory tasks.

Willcut et al (2001), conducted a study to evaluate the performance of individuals with reading disability (RD; n=93) attention deficit hyperactivity disorder (ADHD; n=52), RD and ADHD (n=48), and neither RD no ADHD

(n=121) on measures of phoneme awareness (PA) and executive functioning (EF). Exploratory factor analysis of the EF measures yielded underlying factors of working memory, inhibition and set shifting. Results revealed that RD was associated with significant deficit on measures of PA and verbal working memory. The RD+ADHD group was most impaired on virtually all measures.

Zhang, Sui and Fang (2002) assessed the retrieval capabilities of visual-spatial working memory of students with learning disability. 28 students with learning disability and 25 students with excellent learning ability in 2nd-, 4th-, and 6th-grades were tested in 2 visual-spatial working memory tasks with either high or low processing load. ANOVA and t test were used in analysis of the 3 indexes: visual-spatial working memory span, errors in retrieval, and retrieval speed in the performances between the learning disabled and excellent students. The results show that the students with learning disability had significantly lower scores than did those of the students with excellent learning ability in either high or low processing load; that under 2 processing load conditions, 3 indexes played different roles in assessing retrieval capabilities of visual-spatial working memory: under the low processing load condition, the working memory span and error rate were the good indexes; under the high processing load condition, the indexes of working memory span and retrieval speed were better than the index of error rates in retrieval.

Hoerig, David and D'Amato (2002) examined memory, or the ability to retain information, using the Test of Memory and Learning, a recently

released test that gives a comprehensive measure of global memory functioning. This, and the Wechsler Intelligence Scale for Children-Third Edition, used to assess intelligence, were given to 80 students (aged 6-12 yrs) with learning disabilities. The correlation between a global measure of memory and a global measure of intelligence was significant, indicating that memory should be viewed as an important component when evaluating children with learning disabilities.

Norrelgen, Lacerda and Forssberg (2002) investigated temporal resolution of auditory perception (TRAP), verbal working memory, and speech perception in 15 children (aged 5-7 yrs) with language impairment (LI) in comparison with a control group of 99 typical children. A computerized two-choice test was used to assess these three abilities. No deficits in TRAP were found in the LI group, and the thresholds were similar for both study groups. It was interesting that the variability was high for both groups and that the control group's performance was poorer than reported in some previously published studies. There were significant differences in the two groups' performance on speech perception and verbal working memory. Working memory was the most sensitive of these two measures.

Mati-Zissi and Zafiropoulou (2003). examined the visuo-spatial perception, short-term working memory, and motor skills of children with special reading difficulties, using the Rey-Osterrieth Complex Figure, which can record visuomotor and memory skills, observe drawing processes, and detect deficiencies in specific skills. 306 right- and left-handed boys and girls, aged 6.6 to 9.6 yrs. (102 with special reading difficulties, 102 normal

readers, and 102 with general learning difficulties) comprised one experimental and two control groups, respectively. The task was to depict the Rey-Osterrieth Complex Figure under two conditions, and drawing it from memory. Analysis indicated that (a) difficulty of the depiction of the Rey-Osterrieth Complex Figure, especially from memory, sharply affects children's performance and (b) the experimental group's performance was significantly poorer than that of controls in both conditions. The results are discussed in view of the predictive value of certain motor and cognitive skill deficiencies of children with special reading difficulties.

Vlachos and Karapetsas (2003) evaluated the performance of children with diagnosed dysgraphia and a control group on the Rey-Osterrieth Complex Figure test. A group of 48 Greek elementary school children aged 6.6 to 12.5 years who were in regular school placement participated. All had been diagnosed with dysgraphia, using the writing scale of the Luria-Nebraska Neuropsychological Battery and were matched with a control group of 48 for sex, age, grade, and handedness. Both groups were administered the test, and the children were examined during copying and mnemonic reproduction of the complex figure. Analysis indicated that there were no significant differences between dysgraphic and nondysgraphic groups during the copying task but the dysgraphic group performed significantly lower during mnemonic reproduction of the Rey-Osterrieth Complex Figure. These results suggest that children with dysgraphia possibly suffer from cognitive difficulties that influence visual memory more than visuo-motor skills.

Marton and Schwartz (2003) examined the interaction between working memory and language comprehension in children with specific language impairment (SLI), focusing on the function of the central executive component and its interaction with the phonological loop in complex working memory tasks. Thirteen children with SLI and 13 age-matched (age range=7;0 [years;months] to 10;0) children with typical language development participated. The tasks combined traditional nonword repetition tests and sentence comprehension by using sentences that differed in length and syntactic complexity. The children with SLI exhibited larger processing and attentional capacity limitations than their age-matched peers. Increased word length and syntactic complexity resulted in a large performance decrease in nonword repetition in both groups. There were some variations in the error pattern, which may indicate qualitative differences between the 2 groups. The performance of the children with SLI in nonword repetition, across the different tasks, indicated a limitation in simultaneous processing rather than difficulty in encoding and analyzing the phonological structure of the nonwords. Furthermore, syntactic complexity had a greater effect on performance accuracy than did sentence length.

McNamara and Wong (2003) compared students with and without learning disabilities (LD) on their recall of academic information and information encountered in the students' everyday lives. The academic recall measures included a sentence listening span test, a rhyming words working memory test, and a visual matrix working memory task. Students' cued recall of all the tasks was also measured. The everyday working memory tasks

included a dance episode event recall test; a library procedure recall test; and recall tests of commonly found objects, such as a coin, a telephone, and a McDonald's sign. Compared to students without LD, students with LD performed poorly on both the academic recall tasks and the everyday recall tasks. These results support the notion that some students with LD may have working memory problems that affect their performance on tasks other than reading. The results of the cued recall showed that the availability of cues significantly decreased the group differences on many of the academic and everyday tasks. This result replicates ability prior research findings that students with LD do not use retrieval strategies effectively and that some students with LD may have a production deficiency that affects their retrieval of previously encoded information.

Avis (2003) examined memory functioning among children with ADHD, children with LD in the area of reading comprehension (RLD), and controls using the Children's Memory Scale (Cohen, 1977). Both working memory and delayed memory measures were assessed. In addition, inhibition and selective attention were assessed using the Conners Continuous Performance Test (CCPT, Conners, 1995). Hypotheses for children with ADHD were based on a review of the literature and Barkley's (1997) theory of ADHD and self-control. Hypotheses for children with RLD were based on a review of the literature. One hundred, forty-eight children between the ages of 7 and 16 years participated. In general, hundred, forty-eight children between the ages of 7 and 16 years participated. In general, results indicated children with RLD scored lower than controls on most measures with the

exception of one measure of delayed memory. Memory problems were not found in children with ADHD, with the exception of one measure of working memory. Contrary to Barkley's (1997) theory, no differences in memory performance among subtypes of ADHD were found. No differences were found on measures of inhibition and selective attention.

Tijms (2004) examined whether two frequently reported causes of dyslexia, phonological processing problems and verbal memory impairments, represent a double-deficit or whether they are two expressions of the same deficit. Two-hundred-and-sixty-seven Dutch children aged 10-14 with dyslexia completed a list-learning task and several phonological tasks, together with a number of reading and spelling tests. The results indicate that phonological deficits and verbal memory impairments in dyslexia stem from the same root, which seemingly reflects an inaccurate encoding of the phonological characteristics of verbal information. This phonological encoding deficit is a negative predictor for both the reading and spelling skills of dyslexic children.

Swanson, Saez and Gerber (2004) examined the degree to which the phonological and executive components of memory reflect language-specific capacities in reading achievement. We tested whether the memory processes in a sample of English-language learners that played a major role in predicting second-language acquisition and risk for reading disability (RD) in Grade 1 (Swanson, Saez, Gerber and Leafstedt, 2004) also predicted reading performance in Grade 2. The present results showed that Spanish short-term

memory (STM) performance in Grade 1 predicted basic Spanish-reading skills and Spanish comprehension in Grade 2, whereas Grade 1 English STM performance predicted English vocabulary and English comprehension in Grade 2. More importantly, children at risk for RD in Grade 1 differed from the counterparts in Grade 2 on both English and Spanish measures of reading, whereas their memory deficits were isolated to Spanish STM and working memory (WM).

Reiter, Tucha and Lange (2005) investigated a variety of aspects of executive functioning in children with dyslexia. Forty-two children with dyslexia and 42 non-dyslexic children were examined using a neuropsychological test battery. The test battery consisted of standardised tests examining the assessment of working memory concept formation, inhibition, flexibility, problem solving and fluency functions. Comparison between the test performance of non-dyslexic children and children with dyslexia revealed obvious difficulties of children with dyslexia in tests measuring working memory. Inhibition of inappropriate reactions was impaired in children with dyslexia in more demanding tests, but not in simple ones. Furthermore, children with dyslexia displayed impairments of both verbal and figural fluency functions. While in comparison to non-dyslexic children no disturbances of concept formation were observed, problem solving seemed to be partially impaired. The present findings suggest that children with dyslexia demonstrate impairments in a variety of executive functions. This should be considered in the development of new concepts in the treatment of dyslexia.

Alloway, Gathercole and Adams (2005) investigated the distinctive working memory profiles of children with learning difficulties. A sample of 64 children aged 7 to 11 years with recognised special educational needs at varying stages participated in this study. They were tested on measures of the central executive, phonological loop and visuospatial skills. The children in all three special needs subgroups performed below the expected attainment levels for their age in central executive and visuo-spatial tasks, but not in measures of the phonological loop. Very low levels of working memory performance were many times more common in the special needs sample than in a large sample of children without special educational needs. Deficits in working memory performance were more marked in children with statements of special needs than those at earlier stages of recognition of the need for educational support, particularly in measures of the central executive. These children struggle to meet the demands of complex tasks that require them to process, maintain, and store information simultaneously. It is suggested that this difficulty may underpin their failures to make normal educational progress.



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Barnett, Maruff and Vance (2005) study investigated visuospatial memory impairment, in particular encoding and retrieval aspects, in children with ADHD-CT who are stimulant-medication naive and medicated with stimulant medication. A cross-sectional study of visuospatial memory in 6- to 12-year-old children with stimulant-medication-naive ADHD-CT ($n = 62$) and medicated ADHD-CT ($n = 58$) compared to an age- and gender-matched healthy control group ($n = 39$) was completed. Results: Both medication-

naive and medicated ADHD-CT groups demonstrated subtle yet significant impairment in visuospatial memory. The memory impairment was delay-independent, which, along with other factors, suggest dysfunction of the encoding rather than retrieval phase of visuospatial memory. Careful study of large ADHD-CT samples does detect deficits in a visuospatial memory task, but these reflect attentional deficits rather than being specifically due to dysfunction of the medial temporal lobe explicit memory system. Children with ADHD-CT may benefit from cognitive and behavioural strategies focused on improving encoding of relevant information rather than retrieval strategies.

Liddell and Rasmussen (2005) compared visual and verbal memory in children with non-verbal Learning Disability (NLD) using the children is memory scale and to identify the profile of strengths and weakness in visual memory abilities. Performance was significantly lower on measures of visual than verbal memory, indicating that children with Non-verbal Learning Disability (NLD) have deficits in visual memory despite adequate verbal memory. A unique pattern of performance emerged for the visual but not the verbal subtests. Performance on the Faces immediate subtest was well below average, although other measures of visual memory were within the average range. Hence it appears that children with Non-verbal Learning Disability (NLD) have a specific deficit on immediate memory for faces. This facial memory deficit may be linked to a deficit in right hemisphere functioning.

Martinussen and Tannock (2006) examined whether children with attention deficit hyperactivity disorder (ADHD) are impaired on one or more

components of working memory (WM) independent of comorbid language learning disorders, and whether WM impairments are more strongly related to symptoms of inattention than to hyperactivity impulsivity. Four groups of children participated. ADHD (n=62); ADHD + RD/LI (n=32); RD/LI (n=15); and a typically developing comparison group (n=34). Four simple and brief measures of WM were used that varied in modality (auditory verbal, visual-spatial) and processing demands (temporary storage versus manipulation of information). Children with ADHD without comorbid language learning disorders exhibited deficits in visual spatial storage and verbal and visual spatial central executive (CE) function that were independent of comorbid psychiatric disorders. Children with language learning disorders, regardless of comorbidity with ADHD exhibited impairments in both verbal and spatial storage as well as C.E domains of WM. Symptoms of inattention, but not symptoms of hyperactivity/ impulsivity predicted performance on verbal and visual spatial C.E measures independent of age, verbal cognitive ability and reading and language performance. The dimensional result reveals that the neuropsychological impairments are more strongly associated with the inattention symptom than with the hyperactive – impulsive dimension.

Rosselli, Matute and Pinto, (2006) examined (a) mathematical skills of 2 subgroups of children with developmental dyscalculia (DD)--1 group with DD only and a second group with DD plus reading disorders (RDD)--and (b) analyzed the memory skills of both groups of children. Fifty 11- and 12-year-old children were selected from public schools in Guadalajara, Mexico. Seventeen children had DD only, 13 had RDD, and 20 were normal controls.

Testing included 10 calculation and 6 memory subtests taken from the Evaluación Neuropsicológica Infantil (Matute, Rosselli, Ardila, & Ostrosky, in press). Results indicated that children with DD and children with RDD show a similar pattern of mathematical impairment. Both subgroups had significantly lower scores than the control group in working memory tasks. In addition, the RDD group had significantly lower scores than the control group in visual learning and semantic memory. Although the RDD group scored lower than the DD group in most memory tests, this difference did not reach significance. Working memory tests (digits backwards and sentence repetition) appeared to be the best predictors of mathematical test scores and may represent a major cognitive defect in children with specific defects in mathematics.

Gathercole, Alloway and Willis (2006) investigated associations between working memory (measured by complex memory tasks) and both reading and mathematics abilities, as well as the possible mediating factors of fluid intelligence, verbal abilities, short-term memory (STM), and phonological awareness, in a sample of 46 6- to 11-year-olds with reading disabilities. As a whole, the sample was characterized by deficits in complex memory and visuospatial STM and by low IQ scores; language, phonological STM, and phonological awareness abilities fell in the low average range. Severity of reading difficulties within the sample was significantly associated with complex memory, language, and phonological awareness abilities, whereas poor mathematics abilities were linked with complex memory, phonological STM, and phonological awareness scores. These findings suggest that

working memory skills indexed by complex memory tasks represent an important constraint on the acquisition of skill and knowledge in reading and mathematics. Possible mechanisms for the contribution of working memory to learning, and the implications for educational practice, are considered.

Marton, Schwartz and Farkas (2006) examined the effect of linguistic structure on working memory performance. It was examined whether syntactic complexity has a larger impact on working memory performance than sentence length in Hungarian-speaking children, similar to the findings in English speaking children. In Experiment 1, performance accuracy was measured with two linguistic span tasks that included stimuli with varying sentence length and syntactic complexity. Experiment 2 examined the impact of sentence length and morphological complexity on working memory performance. Children with SLI performed more poorly than their age-matched peers in all working memory tasks. Children with SLI produced a high number of interference errors that indicate poor executive functions. The findings were compared with previous results of English-speaking children. Complexity affected working memory performance accuracy differently across languages. In English, it was the increase of syntactic complexity that resulted in a decrease in performance accuracy, whereas in Hungarian, it was the morphological complexity that had a large impact on working memory performance. Working memory performance depends on the linguistic characteristics of the language tested. In both English- and Hungarian-speaking children, complexity has a larger effect on verbal working memory

performance than the length of the stimuli. However, complexity affects working memory performance accuracy differently across languages.

Archibald and Gathercole (2006) examined the extent to which deficits in immediate verbal short-term and working memory may co-occur in a group of children with SLI. Twenty children aged 7-11 years with SLI completed a comprehensive battery of short-term and working memory, as well as two phonological awareness tasks. The majority of the group had deficits in both verbal short-term and working memory, which persisted after the general language abilities of the children were taken into account.

Akshoomoff, Stiles and Wulfeck (2006) studied whether children with specific language impairment (LI) have deficits on some nonverbal tasks, but it is not clear if these are related to specific visuospatial deficits or to more general deficits in processing strategies. Children with LI were given two visuospatial tasks that we have shown to be sensitive to strategy use as well as specific processing deficits. In Study 1, children with LI (N=29, ages 6 to 12 years) performed significantly worse than typically developing children (N=26) on the Hierarchical Forms Memory task. In Study 2, children with LI (N=15; ages 9 to 12 years) performed significantly worse than typically developing children (N=40) on the Rey-Osterrieth Complex Figure task. Children with LI were less accurate and tended to use a fairly piecemeal (immature) strategy when copying the figure and were less likely to draw the core rectangle in a more integrated fashion during the immediate memory condition. These results suggest children with LI have subtle deficits on

visuospatial tasks that may be more indicative of limitations associated with processing load and planning than of specific visuospatial processing deficits.

Jambaqué, Hertz-Pannier and Mikaeloff (2006) studied neuropsychological profile of a female who had prolonged status epilepticus at 5 years of age, and then developed temporal lobe epilepsy. Brain magnetic resonance imaging 1 month after the onset of status epilepticus showed marked bilateral hippocampal atrophy that seemed disproportionate to the mild cortico-subcortical atrophy. At the age of 7 years, this child had cognitive impairment (an IQ of 62), which particularly affected her memory. This included short-term memory, and immediate and delayed memory deficits for verbal and visual materials that had a profound impact on everyday life. This observation demonstrates that severe status epilepticus can cause predominant bilateral hippocampal atrophy in childhood. In contrast with children who develop such damage after anoxia, this may result in general cognitive impairment but also in more severe episodic memory deficit.

Swanson and Jerman (2007) conducted 3-year longitudinal study determined whether (a) subgroups of children with reading disabilities (RD) (children with RD only, children with both reading and arithmetic deficits, and low verbal IQ readers) and skilled readers varied in working memory (WM) and short-term memory (STM) growth and (b) whether growth in an executive system and/ or a phonological storage system mediated growth in reading performance. A battery of memory and reading measures was administered to 84 children (11-17 years of age) across three testing waves

spaced 1 year apart. The results showed that skilled readers yielded higher WM growth estimates than did the RD groups. No significant differentiation among subgroups of children with RD on growth measures emerged. Hierarchical linear modeling showed that WM (controlled attention), rather than STM (phonological loop), was related to growth in reading comprehension and reading fluency. The results support the notion that deficient growth in the executive component of WM underlies RD.

The studies so far cited reveals that different categories of memory have been found to be poor in LD children as compared to normal and some other clinical groups.

ATTENTION AND LEARNING DISABILITIES

Deikal, Stuart and Morton (1982) studied selective attention in children with learning disabilities. They selected 49 samples of 11 to 13 years old comprising a learning disabled group and a normal group who performed a primary reading like card sorting task. After subjects completing the primary task, they were tested for memory of incidental materials presented during learning. While the normal showed better recall of incidental materials related to the primary task, the disabled subjects showed superior recall of material irrelevant to the primary task, Results are discussed in terms of alternative motivational and developmental lag interpretations.

Kershner and Micallef (1992) compared 30 dysphonemic dyslexics (aged 7-12 yrs) with 30 age-matched and 30 younger reading-matched normal readers to examine dyslexic children's superiority in forced left ear

dichotic recall with consonant-vowel (CV) combinations. Ss were tested in directed attention dichotic listening and in pseudoword decoding, word recognition, reading comprehension, spelling, arithmetic, and general intelligence. Laterality coefficients confirmed that the dyslexics were more weakly lateralized. CV lateralization may be associated inversely with reading comprehension and word decoding in the dyslexics and normal readers. Results support the hypothesis that weak attentional lateralization for CVs in dyslexia may result from the precocious development of posterior right hemisphere attentional systems in compensation for presumed posterior left hemisphere lesions.

Prasad (1995) conducted a study to compare the hypoxic characteristics of learning disabled and non learning disabled children. Vigilance, perceptual sensitivity and identification of a target object are the variables selected as hypoxic characteristics. All subjects were assessed on details of detection of stimulus, sensitivities and identification tasks. The results revealed that learning disabled had poorer levels of information processing and sensitivity as well as less efficient discriminating abilities than did their non-learning disabled counter parts.

Cossu, Da Prati and Marshall (1995) reported the case of a right-handed Italian boy who sustained extensive left hemisphere damage after a massive subarachnoid hemorrhage at age 12 yrs; the right hemisphere was fully intact. Two years later, the S had a residual anomic aphasia with good sentence construction and comprehension of speech. His reading aloud showed all the characteristics of deep dyslexia, although some minimal

ability to read pseudowords remained. Writing and spelling were severely impaired, but without clear qualitative signs of deep dysgraphia. The S's pattern of performance is discussed with regard to the written language capacity of the nondominant right hemisphere and its contribution to normal reading. It is concluded that the S's reading and writing may be mediated by a combination of left and right hemisphere sites.

Castles and Coltheart (1996) presented the case of a 9-year-old boy with a high IQ, no known history of neurological impairment, and developmental surface dyslexia. The S demonstrates extremely poor performance for his age and reading level on irregular word reading tasks, but performs normally on nonword and regular word tasks. His performance on a series of homophone selection tasks suggests an impairment at the orthographic input level. Results of the Recognition Memory Test, the Visual Retention Test, and the Visual Sequential Memory Test suggest that this impairment is not associated with phonological awareness deficits or with visual memory problems.

Hayduk, Bruck and Cavanagh (1996) conducted a study on the basis of the previous work by W. Lovegrove et al (1986) suggesting that dyslexic children show visual deficits specific to transient processing. The authors designed and examined a number of threshold and suprathreshold tasks to test the generality of their claims. 20 adults with childhood histories of dyslexia and 20 normal adult readers participated in the study. They first compared the performance of adult dyslexics and child dyslexics to the performance of age-matched normal readers on a series of threshold flicker

tasks. In contrast to the earlier results, dyslexics and normal readers did not differ in their contrast thresholds for flickering sinewave gratings. Dyslexic children and normal readers also showed similar performance on 2 suprathreshold visual search tasks that evaluated transient processing. The evidence suggests that a transient processing deficit is not a general characteristic of developmental dyslexia. Claims that visual factors play a role in dyslexia must address the confounding role of performance and attentional factors.

Wolfe (1996) investigated whether select neuropsychological measures commonly used to assess cognitive deficits associated with frontal pathology would discriminate learning-disabled from nonlearning-disabled children. 15 learning disabled children (aged 7-12 yrs) and 12 non-learning-disabled children (aged 7-12 yrs) participated in the study. ANOVA suggested that, as a group, the learning-disabled children scored lower on tasks with a high demand for selective attention, ability to inhibit interference, sequential reasoning, and integration and organization of new information, cognitive functions commonly attributed to the frontal lobes.

Lazar and Frank (1997) administered tests of attention, inhibition, working memory, motor learning and problem solving-functions associated with the brains frontal system to 26 children with attention deficit/hyper activity disorder and learning disabilities. (ADHD+LD), 22 children with LD only and 10 with ADHD only. Percentages of abnormal test results and significantly impaired scores were higher for the two groups with LD than for the ADHD only group. The groups differed significantly on some tests of

attention-inhibition-cueing, working memory and problem solving, with the ADHD + LD and LD groups performing worse than the ADHD only group.

Purvis and Tannock (1997) conducted study on the pragmatic and semantic language abilities of children with attention deficit hyperactivity disorder (ADHD) and examined the impact of concurrent reading disabilities (RD) on their performance. 50 males (aged 7-11 yrs) were divided into 4 groups: ADHD only, ADHD with RD (ADHDRD), RD only, and controls. Ss completed a task requiring recall of a lengthy narrative, and tests assessing knowledge of the semantic aspects of language. Findings reveal that ADHD Ss exhibited difficulties in organizing and monitoring their story retelling. Ss with RD only demonstrated deficits in receptive and expressive semantic language abilities on the language processing tests. The ADHDRD group exhibited deficits of both ADHD and RD children. The deficiencies of ADHD children are consistent with higher-order executive function deficits while the deficits of RD children are consistent with deficits in the basic semantics of language processing.

Johnson, Altmaier and Richman (1999) examined the interaction of Attention Deficits and Learning Disabilities on the immediate memory abilities of children. 40 children (aged 7 to 13 yrs) independently diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) by a pediatrician and a pediatric psychologist were matched according to Full Scale IQ, grade, and sex to 40 children who were independently diagnosed with Undifferentiated Attention Deficit Disorder (UADD). These children were further subgrouped based on the presence of an identified Learning Disability (LD) in reading.

Consequently, 4 groups of children were formed, ADHD+LD, ADHD-LD, UADD+LD, and UADD-LD. All children were administered the Color Span Test, a test of immediate visual and verbal memory. The findings revealed that, overall, children with attention deficits and a comorbid LD (ADHD + LD, UADD + LD) had greater memory deficits, suggesting that LD had an "additive effect." In addition, children with ADHD exhibited significantly more memory deficits than children with UADD.

Moors and Andrade (2000) conducted a study to investigate the nature of the attentional dysfunction in dyslexia. The sustained attention to Response Task (SART) was used to assess the attention. The subjects were dyslexics and control teenagers. The results reveal that teenagers with dyslexia made significantly more errors than controls on the SART.

Snider, Frankenberger and Aspenson (2000) explored the relationship between learning disabilities and attention deficit hyperactivity disorder. Teachers of students with learning disabilities from four states representing different geographical regions of the United States were surveyed about students diagnosed with attention deficit hyperactivity disorder (ADHD) on their caseloads. Results indicated that 22.7% of students with learning disabilities were also identified as having ADHD and that 14.2% were being treated with stimulant medication. Thirty five percent of identified students were described as having attention deficit without hyperactivity.

Zhu, Xu, and Kong (2000) studied attention., behaviour characteristics and peer relations in children with learning disabilities (LDS). 505 4th, 5th, and 6th grade students (aged 9-12 years) from an elementary school in

Beijing, China, were divided into a learning excellence group (186 ss), average learning group (290 Ss), and LDS (29 ss), based on their academic achievement. Subjects' attention and behaviour were assessed with an attention deficit hyperactivity disorder (ADHD) questionnaire and Rutter's children behaviour questionnaire (Rutter, 1967) which were completed by parents and teachers and subjects' relationships were assessed by peer review and teacher evaluation. Subjects' attention, hyperactivity impulsivity, and behaviour problems. Subjects' peer review results as the best loved, the least loved, the welcomed, the neglected and the rejected were compared among subjects with learning excellence, learning generality and LDS. The results of parent and teacher evaluation and peer review were also compared. The results show that subjects with LDs had more problems of attention and behaviour, hyperactivity impulsivity and poor relationships with peers.

Riccio, and Hynd (2000) report on 3 studies involving 12 normal controls, 19 children with reading disabilities and 23 with attention deficit hyperactivity disorder (ADHD) relating to hemispheric asymmetry, particularly asymmetry of the planum temporal in normal and reading disabled populations and possible implications with regard to the meaningfulness of IQ test results. A great deal of neurobiological research has examined this region of the brain because it has long been recognized for its role in linguistic processing. Specifically, the planum temporal has consistently been found to be associated with language comprehension and has been the focus of multiple clinical and experimental studies. This research suggests that both the Verbal IQ and Verbal Comprehension factors of the WISC-III are related to the

length of the left temporal bank of the planum temporal. Based on these studies, verbal performance differences may reflect the asymmetry of the planum.

Howes, Bigler and Lawson (2000) examined, in Study 1, 24 readers with dysphonetic dyslexia and 21 with dyseidetic dyslexia (aged 9-12 yrs), as compared to 90 control Ss (45 matched for age and 45 for reading level) on the Composite Memory Index (CMI) score from the Test of Memory and Learning (TOMAL). CMI scores were significantly lower for children with dyslexia ($p < .0001$). Plotting average subtest score profiles for all reader groups revealed auditory sequential memory impairments for both types of readers with dyslexia, and multiple strengths for good readers. Dysphonetic and dyseidetic dyslexia profiles were nearly identical. For Study 2 average linkage cluster analysis was performed using principal components derived from subtests of the TOMAL. Homogeneous clusters of normal readers and children with reading disabilities emerged. Results indicated that qualitatively distinct subtypes of readers with dyslexia exist.

Corina, Richards and Serafini (2001) examined the relationship between auditory language processing and reading disability. Functional magnetic resonance imaging (MRI) data were recorded as 8 male dyslexic children (aged 10-13 yrs) completed auditory tasks requiring phonological or lexical judgment. Results show that dyslexic Ss exhibited more activity than did normal-reading controls in the right compared with the left inferior temporal gyrus and the left precentral gyrus during completion of phonological judgment tasks. During lexical judgment tasks, dyslexic Ss were less active

than were controls in the bilateral middle frontal gyrus and more active than controls in left orbital frontal cortex. Individual dyslexics were reliably less active than were controls in the left insula and left inferior temporal gyrus. It is concluded that dyslexic and control Ss differ in brain activation during auditory language processing skills that do not require reading.

Solan, Larson and Shelley-Tremblay (2001) investigated eye movement (EM) therapy (stressing temporal processing) and reading comprehension (RC) therapy in 31 6th-grade Ss with reading disabilities (RDs). Both order of therapy and type of therapy were examined. Furthermore, the implications of visual attention (VA) in ameliorating RDs are discussed. RC and EM testing took place before the start of therapy (T1) and was repeated after 12 wks (T2) and 24 wks (T3) of therapy. At T1, mean reading grade was 2 yrs below grade level and EMs were at about Grade 2 level. Mean growth in RC for the total sample was 2.6 yrs at T3 ($p < .01$); equally significant improvement was measured in EMs. Learning rate in RC improved from 60% at T1 to 400% at T3. Although within-group differences were statistically significant, between-group differences were not significant for RC or EMs. Improvements in within-scores for RC and EMs were consistently significant at T2 and T3. EM therapy improved EMs and also resulted in significant gains in RC. RC therapy also produced improvements both in EM efficiency and in RC. Results support the notion of a cognitive link among VA, oculomotor readiness, and RC.

Zera and Lucian (2001) made a quantitative synthesis of 50 studies in which the relationship of self organization and learning disabilities was

studied. Reading and Math disabilities and the roles of language, attention, working memory and executive functioning as they relate to learning disabilities. Their quantitative synthesis showed that the mean correlation for attention and learning disabilities is 0.37.

Gibney et al. (2002) examined the attention disorders with measures of neuro-cognitive functioning. In their investigation findings show that there are more attentional difficulties in learning disabled subjects when compared to non-learning disabled children.

Breier et al. (2002) conducted a study on perceptual stimuli of speech and non-speech stimuli by children with and without reading disability and attention deficit hyperactivity disorder. The result shows that reading disabled children have attention deficiency than the non-reading disabled children. The attention on both stimuli of the reading disabled children is significantly different compared to non-reading disabled children.

Kitty, Wu and Vicki (2002) investigated multiple aspects of executive functioning in children with attention deficit hyperactivity disorder (ADHD). The areas of study includes attentional components, impulsiveness, planning and Problem Solving. The specific effect of comorbidity of learning disability (LD) was also investigated. A battery of neuro-psychological tests was utilized to evaluate specific deficits in speed of processing, selective attention, switching attention, sustained attention, attentional capacity, impulsiveness, planning and problem solving. Findings indicated that children with ADHD have slower verbal responses and sustained attention

deficit. Deficits in selective attention and attentional capacity observed were largely related to the presence of LD.

Hale, Hoepfner and Fiorello (2002) analyzed digit span components for assessment of attention processes. The Digit Span (DS) subtest of the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) is thought to be a measure of attention, concentration, sequencing, number facility and auditory short term memory. In this study of 195 children (aged 6-16 yrs); referred for comprehensive neuropsychological evaluations, Digit Forward (DF) and Digit backward (DB) component scores were found to be differentially predictive of attention, executive function, and behaviour rating measures. Results suggest that DB is associated with attention and executive function processes, not the short term route auditory memory processes tapped by DF.

Patnaik (2002) assessed the selective attention capacities of normal and learning disabled (LD) children. The sample consisted of 90 normal children and an equal number of LD children. The results showed that the LD children performed at lower levels on measures of selective attention at both receptive and expressive stages. Moreover, the LD children experienced greater interference in a Stroop Test compared to their normal counterparts. With increasing age the LD-normal difference on physical match and interference measures of selective attention decreased, indicating a developmental trend. The LD children were found to significantly lag behind their normal grade-mates in their general selective attention capacity.

Wu, Anderson and Castiello (2002) investigated multiple aspects of executive functioning in children with attention deficit/hyperactivity disorder (ADHD), including attentional components, impulsiveness, planning, and problem solving. The specific effect of comorbidity of learning disability (LD) was also investigated. 83 children with ADHD and 29 age-matched controls (age 7-13 yrs) participated in the study. A battery of neuropsychological tests was utilized to evaluate specific deficits in speed of processing, selective attention, switching attention, sustained attention, attentional capacity, impulsiveness, planning and problem solving. Findings indicate that children with ADHD have slower verbal responses and sustained attention deficit. Deficits in selective attention and attentional capacity observed were largely related to the presence of LD. No specific deficit associated with ADHD or the comorbidity of LD was identified in switching attention, impulsiveness, planning, and problem solving. These results reveal that ADHD is not associated with a general deficit in executive functioning. Instead, ADHD is related to a specific deficit in regulation for attentional resources.

Plaza, Cohen and Chevrie-Muller (2002) examined oral language abilities in 26 French-speaking dyslexic children (mean age 10.4 yrs), compared to 2 control groups (26 normally developing age-matched children and 26 normally developing younger children, mean age 8.7 yrs). The experimental procedure consisted of tasks involving immediate auditory memory skills (digit span, unfamiliar word repetition, sentence repetition), word retrieval (with semantic, phonological and grammatical criteria), and

sentence processing (with syntactic completion and act-out production). The major findings reveal that compared with their age-mates, the dyslexic children exhibited a significant deficit affecting all tasks, and the dyslexic children and the younger controls performed similarly on several tasks. The results are consistent with the processing limitation hypothesis and suggest that the core deficit is the formulation of cognitive plans from auditory input to verbal output.

Foster, Hynd and Morgan (2002) examined the relationship between planum temporal asymmetry and ear preference in dichotic listening performance in children (mean age 9 yrs) with Developmental Dyslexia and Attention Deficit Hyperactivity Disorder (ADHD). Ss included 19 children with dyslexia (10 of whom had a comorbid diagnosis of ADHD), 23 children with ADHD, and 12 diagnosed normal control children. Dichotic listening data were not collected for 8 of the 12 normal control children and for 3 of the 23 ADHD children. Results revealed no significant difference between ADHD and dyslexic Ss in regard to ear advantage on the free recall dichotic listening task. In addition, although the directed dichotic listening tasks were not related to degree of planum asymmetry, as predicted, results indicated that Ss who consistently displayed an a typical left ear advantage tended to have larger right bank lengths than those who consistently displayed a typical right ear advantage. These findings support the notion that some individuals with dyslexia or language deficits tend to have a larger right planum temporal and that performance on dichotic listening tasks may reflect this relatively unusual pattern.

Hooper, Swartz and Wakely (2002) examined the executive functioning of 55 elementary school children (aged 8.96-11.93 yrs) with and without problems in written expression. Ss were divided into 2 groups and did not differ in terms of chronological age, ethnicity, gender, socioeconomic status, special education status, or presence of attention problems or receptive vocabulary capabilities; however, they did differ in reading decoding ability. Dependent measures included tasks tapping an array of executive functions grouped conceptually in accordance with a model of executive functioning reflecting the following domains: initiate, sustain, set shifting, and inhibition/stopping. Children with writing problems performed more poorly in each of these domains, although the effect sizes were small. A multiple regression revealed a statistically significant regression function; however, reading decoding contributed most of the unique variance to the writing outcome. These findings point out the importance of executive functions in the written language process for elementary school students, but highlight the need to examine other variables when studying elementary school-age children with written expression problems.

Defort (2002) conducted a study on construction and validation of a test of writing competency. The purpose of this study was to: (1) attempt to develop a reliable and valid test of written expression, and (2) examine the differences between the written expression samples of students with and without learning disabilities. The Test of Writing Competency (TOWC) is a direct assessment of writing skills using an analytical format. Items on the TOWC included areas identified in the literature as writing skills deficits for

students with learning disabilities. The TOWC demonstrated evidence of content validity, with each item judged to be an adequate component of written expression by an expert panel. The TOWC's reliability and validity was further examined using a research sample consisting of 67 students from third through fifth grade. To examine group differences in written expression, students with and without learning disabilities were included in the sample. The TOWC demonstrated evidence of discriminant validity when compared to an indirect method for testing writing skills. The total score on the TOWC demonstrated moderate to low convergent validity and interscorer reliability. Higher validity and reliability was established for some individual items on the TOWC. The written expression skills of students with learning disabilities were examined using the total score on the TOWC, holistic scores, and the total number of words written. Students with learning disabilities did not demonstrate significantly different writing samples from non-disabled peers on the total TOWC. Examining specific items on the TOWC, participants with learning disabilities showed significantly more difficulty organizing sentences in a logical sequence than their non-disabled peers.

Richman and Wood (2002) examined 30 children (aged 6-13 yrs) with hyperlexic reading patterns and average intelligence to determine if established learning disability subtypes could be applied to these children with hyperlexia. Two groups emerged. One type showed language learning disorder patterns with good visual memory. This group also showed a high percentage of phonetic word errors. A second hyperlexic group showed signs

of nonverbal learning disorder with visual spatial deficits and impaired visual memory. This latter subgroup showed few phonetic errors with more sight word errors. These findings suggest subtypes of high functioning hyperlexia, one showing language deficits characteristic of dysphasia and one showing patterns similar to visual spatial dyslexia.

Brier, Simos and Fletcher (2003) conducted a study on event-related magnetic fields recorded using magnetoencephalography in children with (n=12) and without (n = 11) dyslexia while they discriminated between pairs of syllables from a voice onset time series (/ga/-/ka/). Nonimpaired readers exhibited left-hemisphere predominance of activity after the resolution of the N1m, whereas children with dyslexia experienced a sharp peak of relative activation in right temporo-parietal areas between 300 and 700 ms post-stimulus onset. Increased relative activation in right temporo-parietal areas was correlated with reduced performance on phonological processing measures. Results are consistent with the notion that deficits in appreciating the sound structure of both written and spoken language are associated with abnormal neurophysiological activity in temporo-parietal language areas in children with dyslexia.

Breier, Fletcher and Foorman's (2003) study on the auditory temporal deficit hypothesis predicts that children with specific reading disability (RD) will exhibit a deficit in the perception of auditory temporal cues in nonspeech stimuli. Tasks assessing perception of auditory temporal and nontemporal cues were administered to children with (a) RD without attention-deficit/hyperactivity disorder (RD/no-ADHD, n = 40), (b) ADHD alone (ADHD/

no-RD, $n = 33$), (c) RD and ADHD (RD/ADHD, $n = 36$), and (d) no impairment (NI, $n = 41$). The presence of RD was associated with a specific deficit in detection of a tone onset time asynchrony, but no reduction in performance on other tasks assessing perception of temporal or nontemporal acoustic cues. The presence of ADHD was associated with a general reduction in performance across tasks. The pattern of results did not indicate a pervasive deficit in auditory temporal function in children with RD, but did suggest a possible sensitivity to backward masking in this group. Results also indicated that the comorbid presence of ADHD is a significant factor in the performance of children with RD on psychoacoustic tasks.

Hugdahl, Heiervang and Ersland (2003) investigated differences between 23 dyslexic and 23 normal reading children (aged 10-12 yrs) in asymmetry of the planum temporal area in the upper posterior part of the temporal lobe and dichotic listening performance to consonant-vowel (C-V) syllables. The planum temporal area was measured in sagittal magnetic resonance (MR) images. Mean left and right area and asymmetry index were compared between the groups. Dichotic presentations of C-V syllables made it possible to separately probe left and right hemisphere phonological function, and to correlate this with planum temporal area. The results showed a significantly larger left than right planum temporal area for both groups. However, while the right planum temporal area was similar for the dyslexic and control Ss, the left planum temporal was significantly smaller in the dyslexic Ss. Both groups also showed a significant right ear advantage to the C-V syllables in the dichotic listening test. The relation between planum

temporal and dichotic listening asymmetry showed a significant correlation for the dyslexic group only, indicating a positive relation between brain structure and function in dyslexic children. Results are discussed in terms of important subject characteristics with regard to brain markers of dyslexia.

Chilosi, Larni and Pizzoli (2003) studied (1) whether phonological deficits are a common marker of all cases of dyslexia and (2) whether a link exists between the reading deficit and the neuropsychological profile. An extensive neuropsychological assessment was performed on 65 male and female school-age children and adolescents (aged 8-14 yrs) with developmental dyslexia in Italy. Results show that subjects who had presented delayed language acquisition in preschool performed significantly worse on several measures of verbal efficiency, working memory, and reading and writing tasks compared with dyslexics without previous language delay. The findings suggest that the "verbal deficit" hypothesis of dyslexia should not be generalized to all cases of developmental dyslexia.

Niemi, Gunderson and Leppasaari (2003) studied hemisphere lateralization for speech perception in a Finnish family with specific language impairment. We used dichotic presentations of consonant-vowel (CV) syllables, consisting of the 6 stop-consonants paired with the vowel /a/, under 3 different attentional instructions. Left hemisphere dominance for speech perception is assessed from a preference for the right ear stimulus. Response accuracy was compared in 5 members, over 3 generations, of a family with SLI with 5 healthy controls. The dichotic listening task was performed under 3 different instructions, to attend only to the right ear

stimulus, to attend only to the left ear stimulus, or with no instruction about attention. The Ss indicated orally which of the 6 CV-syllables they heard on each trial. There were 36 dichotic presentations of the CV syllables for each instruction. The CV syllables were played from a CD with digitized stimuli. The results showed no difference between the groups during the no instruction condition, indicating normal speech lateralization in the SLI group. However, the SLI group was deficient in modifying the ear advantage through focused attention to the left ear, thus indicating an attentional/executive deficit in addition to a deficit in left hemisphere lateralization.

Higuchi, Takahashi and Komatsu (2003) conducted a study on fifth graders (N = 45) and were given 11 cognitive tasks, so that an assessment battery for children with difficulties in reading and listening comprehension could be developed. Factor analysis was conducted with the data from the 11 tasks, and 6 factors were extracted: fluency of the mental lexicon, phonological awareness, intelligence, passive short-term memory, working memory, and kanji processing ability. Regression analyses revealed that kanji processing ability, intelligence, and fluency of the mental lexicon were associated with both reading and listening comprehension. Working memory was associated with reading comprehension, but not with listening comprehension.

Crowe (2003) in a study on twelve school-age children (aged 8-11 yrs) with language-learning disabilities (LLD) compared the effects of two reading feedback strategies for improving their oral and written language performance. Children were matched for age, disability, gender, and general

reading performance. Participants were assigned to one of the three study groups, Treatment 1 (T1), Treatment 2 (T2), or Control (C). Children were pre- and post-tested on standardized tests of reading and oral vocabulary. T1 and T2 participated in 6 weeks of reading intervention. T1 used traditional decoding-based feedback strategies, and T2 used meaning-based feedback strategies, termed Communicative Reading Strategies (CRS). Significant differences across groups were found for reading comprehension, oral reading, and expressive vocabulary measures. Pair-wise comparisons indicated that T2 performed significantly better than T1 and C on reading comprehension at posttest. Though not reaching levels of significance, T2 made greater gains than T1 and C on oral reading and expressive vocabulary measures.

Shin, Kim and Cho (2003) examined the performance of Korean children diagnosed with attention-deficit hyperactivity disorder (ADHD), learning disorder, ADHD with learning disorder, and tic disorder on the Rey-Osterreith Complex Figure. The clinical group consisted of 57 children between the ages of 6 and 13 years (15 with ADHD, 13 with learning disorder, 15 with ADHD + learning disorder, and 15 with tic disorder), and the control group included 20 children recruited from an elementary school. Rey-Osterreith Complex Figure productions were scored according to the Developmental Scoring System. The children in the control group showed a clear developmental trend-organization score increasing with age--that was similar to the performance of American children. No such age-related effect was found in the three clinical groups. The organization scores of the children with ADHD were lower than those of other groups, suggesting an

organizational deficit in ADHD. Performance on the immediate recall condition was poorest in the tic disorder and ADHD + learning disorder groups, suggesting the presence of nonverbal memory problems in those groups.

Greenham, Stelmack and Vander Vlugt (2003) examined the role of attention in the processing of pictures and words in a group of 10 normally achieving children and in groups of learning disability subtypes that were defined by deficient performance on tests of reading and spelling (Group RS; n=8) and of arithmetic (Group A; n=8). Ss were Dutch-speaking 7-12 year olds. An event-related potential (ERP) recording paradigm was employed in which the children were required to attend to and name either pictures or words that were presented individually or in superimposed picture-word arrays that varied in degree of semantic relation. For Group RS, the ERP waves to words, both presented individually or attended in the superimposed array, exhibited reduced N450 amplitude relative to controls, whereas their ERP waves to pictures were normal. This suggests that the word-naming deficiency for Group RS is not a selective attention deficit but rather a specific linguistic deficit that develops at a later stage of processing. In contrast to Group RS and controls, Group A did not exhibit reliable early frontal negative waves (N280) to the superimposed pictures and words, an effect that may reflect a selective attention deficit for these children that develops at an early stage of visuo-spatial processing.

SunWang and He Hua (2003) studied the alpha competitive structure of children with attention deficit hyperactivity disorder (ADHD) encompassed

within a learning disability (LD) and the neurobiological mechanism. 90 ADHD children without LD (aged 7-16 yrs) and 45 ADHD children with LD (aged 7-16 yrs) received EEG examination and their brainwaves measured in Hertz (Hz) in alpha frequency band were analyzed and compared between groups. The results show that (1) the LD group showed significantly more activity of 8 Hz than the non-LD group; (2) the LD group showed significantly less activity of 10 Hz than the non-LD group; (3) in the LD group, the main frequency of alpha band was 9 Hz and the energy distribution among alpha components was diffused, while in the non-LD group, the main frequency of alpha band was 10 Hz; (4) the entropy value of the LD group was higher than that of the non-LD group, especially at O2 and T6. The study concludes that comparing with the non-LD group, the LD group shows more immature alpha pattern and higher entropy value, indicating that the LD group has brain dysfunction syndrome.

Naglieri, Salter and Edwards (2004) evaluated the Planning, Attention, Simultaneous, and Successive (PASS) characteristics of children assessed for Attention Deficit/Hyperactivity Disorder (ADHD referred), children with a Reading Disability (RD), and children in Regular Education (RE). The Cognitive Assessment System (CAS) was used to assess PASS processes for the 119 children (48 in ADHDR; 23 in RD; and 48 in RE groups). The results showed that the ADHDR group had lower Planning scores than the RE group (effect size = 0.6). The RD group had lower Successive scores than the RE group (effect size = 1.1) and the ADHDR group (effect size = 1.2), and lower Simultaneous scores than the RE group (large effect size of 0.9). The

implications for using PASS theory to assist in the identification process as well as for the design of interventions for children with ADHD and children with RD are discussed.

Lorusso, Facoetti, Molteni (2004) analyzed the contributions of hemispheric, attentional, and processing speed factors to the effects of neuropsychological treatment of developmental dyslexia. Four groups of dyslexic children were treated over a period of four months. A first group (n=9) underwent Bakker's Hemisphere-Specific Stimulation, with presentation of words in the right and left visual field. A second group (n=7) received the same stimuli randomly in either visual hemifield. A third group (n=8) received the same words presented centrally at fixation point. A fourth group (n=6) received central stimuli with fixed presentation time (1500ms). The children were tested before and after treatment on reading and spelling measures. All groups improved significantly after treatment on all variables. A possible explanation is that rapid, simultaneous presentation to both hemispheres enhances interhemispheric exchange, which could produce an advantage in tasks requiring a high degree of integration between left and right hemispheric functions, such as spelling. The absence of significant differences in reading improvement may point to the role of memory functions or strategic factors characterizing all the treatment programs, possibly outweighing the effect of the other factors.

Fowler, and Swainson (2004) studied (1) whether imprecision in the phonological representations of lexical items underlies the impaired expressive naming abilities of disabled readers, and (2) whether weak verbal

memory might mediate the relationship between naming and reading skills. From samples of 93 first graders and 67 fourth graders, extreme groups of good and poor readers were identified and compared on measures of receptive vocabulary, expressive naming, acceptability judgments for variants of object names, imitation and correction of naming errors by another speaker, pseudoword repetition, and long-term memory. Performance was generally better by older than younger students and by good than poor readers at each age, with little interaction between grade and reader group. The results indicated that for both good and poor readers, imprecise phonological knowledge, especially about long words, contributed to children's difficulties on all naming tasks. Memory differences, however, appeared to play only a minor role in explaining the strong association between naming and reading.

Wilson (2004) conducted a study on fifty-three children aged 9 to 12 years old with a reading disability who were compared to two matched control groups on five tests of learning and memory. Three verbal memory tests included the Wechsler Memory Scale-Revised (WMS-R) Memory subtest (LM), the Selective Reminding Test (SRT), and the Consonant Trigrams Task (CTT). Two visual/spatial memory tests included the Wechsler Memory Scale - Revised (WMS-R) Visual Reproduction subtest (VR), and the Visual Memory Test (CVMT). Results revealed that children with a reading disability performed lower than control groups on most variables from the Selective Reminding Test and the Consonant Trigrams Task. The children with a reading disability also performed lower than controls on the delayed recall task

and the saving score variable of the WMS-R Visual Reproduction subtest. There was no significant differences noted between groups on the WMS-R Logical Memory subtest and the Continuous Visual Memory Test. As a whole, the data was thought to suggest that children with a reading disability have more difficulty processing verbal than visual information and that this difficulty is reduced when the material presented is meaningful.

Nation, Clarke and Marshall (2004) investigated the oral language skills of 8-year-old children with impaired reading comprehension. Despite fluent and accurate reading and normal nonverbal ability, these children are poor at understanding what they have read. Tasks tapping 3 domains of oral language, namely phonology, semantics, and morphosyntax, were administered, along with measures that reflect an interaction of language domains that we refer to as broader language skills. Relative to control children matched for age and decoding ability, poor comprehenders were impaired across all measures except those tapping phonological skills. In addition to low oral language ability characterizing the group as a whole, some individuals had marked language impairments; it is argued that a substantial minority can be classified as having specific language impairment. However, none of the children had been previously recognized as having a language or reading impairment. These findings demonstrate that serious reading and language impairments are not always obvious in children who have good phonological ability and appear, superficially at least, to read well.

Bezrukikh and Kreshchenko (2004) studied the mechanisms underlying writing and reading difficulties at elementary school. Assessment

of the actual level of speech development, language abilities, intellectual functions, visual memory, visuomotor coordination, and neuropsychological parameters of first- and third- or fourth-grade students were done. The leading mechanisms of writing and reading difficulties were identified for different stages of skill formation. The role of factors determining the efficiency of learning changed accordingly. From the first to the third (fourth) grade, a decrease was observed in the role of the factors of speech development, formation of motor skills, visual perception, and visual memory, while the voluntary organization of activity, working capacity, and fatigability became the most significant factors. At all stages of teaching writing and reading, the rate of teaching activity must correspond to the functional and adaptive capabilities of schoolchildren.

Swanson, Saez and Gerber (2004) examined whether the cognitive processes that underlie second-language acquisition difficulties are the same as those that underlie reading difficulties. First-grade (N = 101) bilingual and nonbilingual children were administered a battery of measures in Spanish and English. English word identification and vocabulary were predicted by a language-general working-memory (WM) factor, whereas English pseudoword reading was predicted by Spanish pseudoword reading and WM. The results also showed that (a) children proficient in language were better able to access resources from WM and (b) children with reading disabilities (RD) performed poorly on Spanish measures of short-term memory. In general, second-language difficulties are related to accessing a language-independent

WM system, whereas language-specific phonological memory deficits underlie RD.

Leikin, Share and Schwartz (2005) examined factors that influence the process of learning to read in a second language. The Hebrew reading comprehension skills of 68 Russian-speaking children (mean age 7 years 6 months) were screened at the start of Grade 2. From this sample, 40 participants were selected: 20 successful learners and 20 unsuccessful learners. These two groups were then tested on a wide range of language skills (e.g., phonological processing, vocabulary, syntactic and morphological awareness) in both languages (Hebrew and Russian) and reading skills in Hebrew (e.g., reading speed and accuracy). Two factors, level of spoken Hebrew and phonological awareness deficits in both languages, were significant. Phonological awareness difficulties constituted the key factor associated with poor decoding whereas insufficient mastery of spoken Hebrew was important in the case of reading comprehension. An interesting dissociation was also found in our poor readers between impaired phonological awareness and other unimpaired phonological processing abilities such as oral pseudoword repetition and working memory. These findings suggest that, in addition to poor spoken L2 proficiency, poor readers are characterized more by a metalinguistic rather than a linguistic deficit in their native tongue.

In a study Willcutt, Pennington and Olson (2005) examined the measures of component reading and language skills, executive functions, and processing speed were administered to groups of children with attention deficit hyperactivity disorder (ADHD; $n = 113$), reading disability (RD; $n =$

109), both RD and ADHD (n = 64), and neither RD nor ADHD (n = 151). Groups with RD exhibited pronounced deficits on all measures of component reading and language skills, as well as significant weaknesses on measures of verbal working memory, processing speed, and response inhibition. Groups with ADHD exhibited weaknesses on all response- inhibition and processing speed tasks and were impaired on some measures of component reading skills and verbal working memory. The group with comorbid RD and ADHD exhibited the combination of the deficits in the RD-only and ADHD-only groups, providing evidence against the phenocopy and cognitive subtype hypotheses as explanations for the co-occurrence of RD and ADHD. Slow and variable processing speed was characteristic of all 3 clinical groups, suggesting that measures of this domain may be useful for future studies that search for the common genes that increase susceptibility to RD and ADHD.

Barkley, Grodzinsky and Dupaul (2005) reviewed 22 neuropsychological studies of frontal lobe function in children with attention deficit disorder with and without hyperactivity (ADD/+H, ADD/-H). Some measures presumed to assess frontal lobe dysfunctions were not reliably sensitive to the deficits occurring in either form of ADD. Tests of response inhibition more reliably distinguished ADD/+H from normal children. Where impairments were found on other tests between ADD and normal subjects, they were highly inconsistent across studies and seemed strongly related to age of the subjects and possibly to the version of the test employed. The comorbidity of other disorders, such as learning disabilities (LD) and conduct problems, with ADD may be an additional confounding factor in some,

though not all, of these studies. In a separate study, children with ADD/+H (n=12) were then compared on frontal lobe tests to three other groups: ADD/-H (n=12), LD but no ADD (n = 11) and normal children (n = 12), statistically co-varying for differences in conduct problem across groups. Most measures did not distinguish among these groups. Both ADD groups made more omission errors on a Continuous Performance Test (CPT) than the normal group. All three clinical groups performed more poorly on the word and interference portion of the Stroop Test. Thus while both types of ADD share some apparent similarities in deficits on a few frontal tests in this study.

Stevens, Sanders and Neville (2006) used an event-related potential (ERP) paradigm to compare the earliest mechanisms of selective auditory attention in 12 children with specific language impairment (SLI) and 12 matched control children. Participants were cued to attend selectively to one of two simultaneously presented narrative stories. The stories differed in location (left/right speaker), narration voice (male/female), and content. ERPs were recorded to linguistic and nonlinguistic probe stimuli embedded in the attended and unattended story. By 100 ms, typically developing children showed an amplification of the sensorineural response to attended as compared to unattended stimuli. In contrast, children with SLI showed no evidence of sensorineural modulation with attention, despite behavioral performance indicating that they were performing the task as directed. These data are the first to show that SLI children have marked and specific deficits in the neural mechanisms of attention and, further, localize the timing of the attentional deficit to the earliest stages of sensory processing. Deficits in the

effects of selective attention on early sensorineural processing may give rise to the diverse set of sensory and linguistic impairments in SLI children.

Sutcliffe (2006) investigated the frequency discrimination performance of a 6-year-old boy (MH) with language and attentional difficulties. MH had been reported to have literacy problems not paralleling an advanced verbal ability, and he showed difficulties in discriminating non-verbal tones of different frequencies in comparison with children of his own age. A series of auditory training sessions were conducted to examine whether his frequency discrimination performance could be improved. Thresholds were shown to be inconsistent over six sessions. MH showed no improvement on a test of phonological short-term memory and his sustained attention level was comparable with a child with Attention Deficit Hyperactivity Disorder (ADHD). Clinical assessments confirmed a diagnosis of ADHD, and methylphenidate (Ritalin) was prescribed. Five weeks later, following the establishment of a medication regime, repeated assessment showed a significant improvement in frequency discrimination performance. Performance also improved on the test of sustained attention. A follow-up study 4 months later, while still medicated, confirmed MH had maintained his frequency discrimination performance.

Facoetti, Zorzi and Cestnick (2006) studied focused visuo-spatial attention in 10 developmental dyslexic children with impaired nonword reading, 10 dyslexic children with intact nonword reading, and 12 normally reading children. Reaction times to lateralized visual stimuli in a cued detection task showed that attentional facilitation of the target at the cued

location was symmetrical in the three groups. However, dyslexics with impaired nonword reading selectively showed a lack of attentional inhibition for targets at the uncued location in the right visual field. This result was replicated in a second group of 13 dyslexics with impaired nonword reading. Individual differences in the ability of right attentional inhibition across the entire sample of dyslexics accounted for 17% of unique variance in nonword reading accuracy after controlling for individual differences in age, IQ, and phonological skills. The results suggest that focused visuo-spatial attention may be crucial for nonword decoding.

De Salles and De Mattospimenta Parente (2006) studied about the relationship between reading and writing difficulties and neuropsychological associated factors. There are controversies around the hypotheses of a possible deviation or developmental delay. To analyze this, the present study compared the neuropsychological task performances of second grade children with reading and writing difficulties ($n = 14$) with two groups: one contrasting reading and writing competence, but not age ($n = 15$), and the other contrasting age, but not reading and writing competence (1st grade; $n = 9$). The results showed that the scores of the second grade group with reading and writing difficulties were statistically lower to second grade children competent in reading and writing in phonological awareness, oral language and phonological memory, not differing significantly from the first grade group. Such findings favour the developmental delay hypothesis of these neuropsychological functions in children with reading and writing difficulties.

Niogi and McCandliss (2006) used diffusion tensor imaging (DTI) to investigate the association between variation in white matter microstructure and individual differences in reading skill within children. Unlike previous DTI studies of reading, our sample examined children in both the average reading range as well as several children in the performance range of reading disability (RD). Results replicate previous findings of a strong correlation between fractional anisotropy (FA) values in a left temporo-parietal white matter region and standardized reading scores of typically developing children. Furthermore, FA values in this same region accounted for differences between children scoring in the average range and children scoring in the RD range, suggesting that the role of white matter tract microstructure is best characterized as an extreme range on a continuum of typical variation. Furthermore, significant correlations between working memory and frontal white matter tract regions were present in this same population, yet were demonstrated to be independent of the relationships found between reading and more posterior regions. Results form a "correlational double dissociation" that demonstrates domain specificity in the influence of white matter tract structures to individual differences in cognitive performance.

Im-Bolter, Johnson and Pascual-Leone (2006) revealed that children with specific language impairment (SLI) have processing limitations; however, the mechanisms involved have not been well defined or investigated in a theory-guided manner. The theory of constructive operators was used as a framework to explore processes underlying limited processing

capacity in children with SLI. Mental attentional capacity, mental attentional interruption, and 2 specific executive functions (shifting and updating) were examined in 45 children with SLI and 45 children with normally developing language, aged 7 to 12 years. The results revealed overall group differences in performance on measures of mental attention, interruption, and updating, but not shifting. The findings supported the premise that mental attention predicted language competence, but that this relationship was mediated partially by updating.

LANGUAGE AND LEARNING DISABILITIES

Jonathan, Geoffrey and David (1997) examined the relationship between brain activity and reading performance to test the hypothesis that dyslexia involves a deficit in a specific visual pathway known as the Magnocellular (M) pathway. Functional Magnetic Resonance Imaging (fMRI) was used to measure brain activity in dyslexic and control subjects in conditions designed to preferentially stimulate the M pathway. Dyslexics showed reduced activity compared with controls both in the primary visual cortex and in the Secondary cortical visual area (MT+) that is believed to receive a strong M pathway input. Most importantly significant correlations were found between individuals differences in reading rate and brain activity.

Diniz- et al (1997) conducted a study on a group of 16 children aged from 8 to 14 years, with learning disabilities by means of a series of conventional and sensitized audiological tests, including recording of the late cognitive electrical responses (p.300) They have no otolaryngological or neurological complaints but expressive language disorders (difficulties in

speaking and/or writing), receptive language disorders (difficulties in reading and text comprehension) and lack of concentration and/or restlessness. Their audiograms, speech discrimination and immitance tests were normal. The p 300 responses as compared with those found in 20 normal controls within the same age group, occurred at significantly longer latency periods.

Beverly and Steven (2004) revealed that language based learning disorder such as dyslexia affect millions of people, but there is little agreement as to their cause. New evidence from behavioral measures of the ability to hear tones in the presence of background noise indicates that the brains of affected individuals develop more slowly than those of their unaffected counterparts. In addition, it seems that brain changes occurring at 10 years of age, presumably associated with puberty, may prematurely halt this slower-than-normal development when improvements would normally continue in to adolescence. The combination of these ideas can account for a wide range of previous results suggesting that delayed brain development, and its interaction with puberty, may be key factor contributing to learning problems.

Petra. et al (2004) compared the language development profile of children at risk for dyslexia to that of age matched controls as well as of children who have been diagnosed with specific language impairment (SLI). The experiments described concern the perception and production of grammatical morphology, categorical perception of speech sounds, phonological processing (word repetition) mispronunciation detection and rhyme detection. The results of each of these indicate that the at risk children

as a group under perform in comparison to the controls and that in most cases, they approach the SLI group. It can be concluded that dyslexia most likely has precursors in language development.

Karen. et al(2004) compared the performance of four groups of adolescents (Reading disability (RD), Attention deficit Hyper activity Disorder (ADHD); comorbid ADHD and RD; and normal controls) on reading comprehension tasks as well as on reading rate and accuracy task. Adolescents with RD showed difficulties across most reading tasks, although their comprehension scores were average. Adolescents with ADHD exhibited adequate single word reading abilities. The comorbid group demonstrated similar difficulties to the RD group on word reading accuracy and on reading rate but experienced problems on only silent reading comprehension.

Haiying. et al. (2005) revealed that DYX2 on 6p 22 is the most replicated reading disability (RD) locus. By saturating a previously identified peak of association with single Nucleotide Polymorphism markers, they identified a large polymorphic deletion that encodes tandem repeats of putative brain related transcription factor binding sites in intron 2 of DCD₂. Alleles of this compound repeat are in significant dis-equilibrium with multiple reading traits. RT-PCR data show that DCDC₂ localizes to the region of the brain where fluent reading occurs and RNA interference studies show that down regulation alters neuronal migration. The statistical and functional studies are complementary and are consistent with latest clinical imaging data for RD.

Alloway and Gathercole (2005) explored the relationship between sentence recall, reading and language skill in a group of 7-11 year old children with learning difficulties. A sample of 72 children was tested on measures of verbal complex memory, verbal short term memory, sentence recall, expressive vocabulary, verbal and performance IQ reading and language skills. Both sentence recall and verbal complex memory shared unique links with reading skill and sentence recall was uniquely associated with language skill. The findings indicate that resources in long term memory also play an important diagnostic role in reading and language abilities.

Ferouhi (2007) conducted a study on written language difficulties in language-learning disabled (LLD) fourth and fifth graders. Forty students participated in the study. The participants were 21 males and 19 females, aged 9-11 years. They were tested using a battery of standardized measures compiled for the study, which assessed oral language, nonverbal IQ, reading, spelling and written expressions. Four groups were formed: Specific language impaired (SLI) Reading disabled (RD), specific language impaired with low reading performance (SLI-R), and typically developed (TD). Twelve (60%) of the LLD participants in this study were previously classified as language-learning disabled (LLD) by the school district's child study team (CST). Fifteen (75%) of the LLD Participants were classified as specific language impaired (SLI). Two (10%) of the LLD participants were classified as reading disabled (RD). Three (15%) of the LLD Participants were classified as specific language impaired with low reading performance (SLI-R). The TD group scored significantly higher than the participants in

the LLD group on all measures, indicating that developmental difference exist between the two groups. In spelling the SLI and RD group showed difficulty with letter sound correspondence and orthography. In writing all the four groups showed difficulty with contextual conventions and contextual language.

IMPULSIVITY AND LEARNING DISABILITY

Keogh and Donlon (1972) investigated the perceptual organization of 27 males with serious behavioural and learning disorders and 25 males with moderate LD's. The constructs of field dependence-independence and reflection impulsivity were assessed using a modified version of the Rod and Frame Test, a Pattern Walking Test, and the Matching Familiar Figure Test. Compared to available normative data for normal achieving children, LD males were found to be highly field dependent, extreme LD males were also impulsive. Field dependent associated with rapid response rate appears in compatible with success in most educational tasks. Analysis of childrens perceptual and cognitive style is proposed as a tentative but promising approach to understanding the educational problems of LD children.

Schworm and Birnbaum (1989) compared the behaviour of 19 students (aged 5.6-16.8 years) diagnosed as hyperactive or having attention deficit disorder with that of 17 students (aged 6.0-21.5 years) diagnosed as having learning disabilities. Symptoms associated with over activity, in attention and impulsivity were observed, using a direct diagnostic, procedure following a momentary time sampling technique. Analysis revealed that differences between the groups were often qualitative rather than quantitative

and only a few symptoms distinguished one diagnosis from the other. Hyperactive subjects demonstrated more talking, unsystematic searching and motor impersistence than non hyperactive subjects. Non hyperactive subjects demonstrated more upper extremity movement and displayed more attention when engaged in visual tasks than hyperactive subjects.

William, Richman and Yarbrough (1991) compared short term verbal memory, sustained attention and impulsivity in 13 children with Turner Syndrome and 13 female and 14 male with learning disability who had neuropsychological pattern similar to the Turner Syndrome children. Subjects were 7-14 year old. Similar pattern of short term memory deficits were found in all 3 groups. There was no significant differences among the groups on computer measures of sustained attention and impulsivity. However, extreme variability of attention and impulsivity scores in the Turner Syndrome group may reflect a typical attention deficit disorder in some of these children.

Willcut, Pennington and Defries (2000) examined a community sample of 278 (8 to 16 years) twin pairs in which at least one twin in each pair exhibited a history of learning difficulty was utilized to examine the etiology on inattention and hyperactivity/impulsivity (HYP/IMP) symptoms of attention-deficit /hyperactivity disorder (ADHD) were assessed by the DSM-III Diagnostic Interview for children and adolescents. Inattention and Hyp/Imp composite scores were almost entirely based on results of a factor analysis. Result indicated that extreme ADHD scores were almost entirely attributable to genetic influences across several increasingly extreme diagnostic cutoff scores. Extreme inattention scores were also highly

heritable whether or not the proband exhibited extreme Hyp/Emp. These findings suggest that extreme Hyp/Imp may be attributable to different etiological influences in individuals with and without extreme inattention.

Decker. et al (2001) examined the prevalence of comorbid 2nd and 3rd diagnoses of learning disorders. (LDS), disruptive behaviour disorders (DBDs), and affective disorders (AFFDs) in individuals with a primary diagnosis of attention deficit hyperactivity disorder ADHD. In experiment 1, comorbid 2nd and 3rd diagnoses for 287 individuals (aged 3.3-118.8 yrs) with a primary diagnosis of ADHD predominately inattentive type of predominately hyperactive-impulsive type, was compared to 290 individuals. (aged 3.3-19 yrs) not having a primary diagnosis of ADHD and the diagnosis of LDs and DBDs but not AFFDs. In experiment 2, the comorbid 2nd and 3rd diagnoses of 143 subjects with a primary ADHD subtype diagnosis of predominately inattentive was compared with 143 individuals having a primary ADHD subtype diagnosis of predominately hyperactive-impulsive. Results show that only conduct disorders were comorbid with certain ADHD subtype, with DSBDs being more likely to be diagnosed with ADHD hyperactive impulsive type than with ADHD inattentive type.

Kitty, Wu and Vicki (2002) investigated multiple aspects of executive functioning in children with attention deficit/hyperactivity disorder (ADHD). These areas include attentional components, impulsiveness, planning and problem solving. The rationale of the study is based on neuropsychological studies that suggest frontal lobe dysfunction in ADHD. As frontal lobe functioning is related to abilities in executive control, ADHD is hypothesized

to be associated with deficits in various areas of executive functioning. The specific effect of comorbidity of learning disability (LD) was also investigated. Eighty three children with ADHD and 29 age matched controls (age 7-13) participated in the study. A battery of neuropsychological tests was utilized to evaluate specific deficits in speed of processing, selective attention, switching attention, sustained attention, attentional capacity, impulsiveness, planning and problem solving. Findings indicated that ADHD have slower verbal responses and sustained attention deficit. Deficits in selective attention and attentional capacity were largely related to the presence of LD. The comorbidity of LD was identified in switching attention, impulsiveness, planning and problem solving.

Palacios (2003) conducted a study to explore the relationship between reading skills, specifically reading comprehension and phonological aware and externalizing behaviours-hyperactivity (ADHD) and Oppositional Defiant Disorder (ODD). Hyperactivity and impulsivity have been noted to be the most contributing factors in these studies. Children with only ADHD combined type of hyperactivity and inattentiveness, ODD only, a combination of ADHD and ODD, and children without either ADHD or ODD were invited to participate. 100 boys (age 11-15 yrs) were selected for this study. Results indicated that there was no significant differences among the four groups.

Toplak, Rucklidge and Hetherington (2003) examined time perception in Attention Deficit/Hyperactivity disorder (ADHD) with and without comorbid reading difficulties (RD) in child and adolescent participants. In

the study I, 50 children (aged 6-11 yrs) with ADHD and 50 age matched healthy controls completed three psychophysical tasks: duration discrimination, frequency discrimination and a duration estimation task using the method of reproduction for intervals of 400 ms, 200 ms and 600 ms. Study 2 used the same task with an adolescent sample (aged 13-16 yrs). In both studies children and adolescents with ADHD and ADHD+RD displayed some impairments in duration discrimination and the precision with which they reproduced the intervals on the estimation task, particularly the shorter 400 ms interval. The most severe impairments tended to occur in the comorbid ADHD + RD group. No impairments were found on the frequency discrimination task. Finally short term and working memory, estimated full-scale IQ and teacher report of hyperactivity/impulsivity were found to differentially predict performance on the time perception measures in the adolescent sample.

Donfrancesco, Mugnaini and Uomo (2005) investigated cognitive impulsivity in learning disabled children. A sample of 110 children (Second through eighth grade) were selected and administered 20 item Matching Familiar Figures Test (MFF20). In all 30 dyslexic children and 25 children with spelling disorder (all children without an ADHD comorbidity) were compared with 55 children of a control group. Results showed that the children with reading disorder were less accurate than the children with spelling disability. Both these groups performed less accurately than the control group. Subjects with dyslexia are faster than both the other groups in

response time ($P < 0.05$), clearly showing a significantly higher cognitive impulsivity than the other groups.

Crespo et al (2006). conducted studies on measures of sustained attention and impulsiveness control in children. In this study on children, the testing period was extended to 6 minute in order to measure sustained attention-number of correct answers (C) and impulse control inversely related to number of errors (E). The formula used to calculate the impulse control index (ICI) was $ICI = \frac{C-E}{C+E}$. The sample consist of 1090 children (72% males) stratified for ages between 6 and 10 years. The test was also given to a clinical series of 66 consecutive patients within the same age range, of which 36 had been diagnosed with attention deficit hyperactivity disorder (ADHD) and 30 with reading disability (RD). Results showed that the clinical group's performance as a whole was worse than that of the normative sample in both correct answer and ICI variable. Furthermore, children with ADHD had a lower ICI than the RD group. The ICI showed good discriminative power; 64% of participants with ADHD diagnosis had an ICI lower than -1.55 the incidence in the normative sample is only 3%. These results support the existence of an important inhibitory control deficit in ADHD.

PRESENT STUDY

Learning disability is an area that has contemporary interest both in psychologist, neurologist and educationalist (Wong, 1991). Learning is a complex cognitive process which involve many psychological functions like perception, attention, concentration, memory, language, reasoning, thinking,

problem solving etc. Literature reveals significant physiological and neuropsychological factors of perception, attention, memory, concentration, language and thinking.

Although the term learning disability has been used for the last 25 years, educationists were primarily working in this field. Initially learning disability was detected by school performance and educationists were primarily interested in helping the learning disabled through special training and teaching methods.

For the last 10 or 15 years, neurologists and neuropsychologists are also interested in working with the learning disabled. However methods of helping children with learning disability do not consider the neuropsychological aspect even now. A general pattern of helping is extended, to all the learning disabled, especially training them to improve their reading, writing, speaking and arithmetic skills.

The literature on neuropsychology indicates that there are individual differences among the learning disabled (Johnson and Myklebust, 1967, Wada and Colleagues, 1975 (cited by Vaughn and Bos, 1994); Sivadas (2006). Many studies also report that most of the LD children do not show a corresponding level of IQ deficiency. Therefore helping the learning disabled individually would be more effective.

Primarily effectiveness of any kind of helping depends up on accuracy of assessment and diagnosis. Vaughn and Bos (1994) also have stressed the need for neuropsychological assessment in general. Thus the individual characteristics and deficiencies in specific functions in each learning disabled

child need to be identified. So that individual therapy or helping is made more effective and appropriate for each child.

Gaddes (1980) found that the need for special training for learning disabilities range from 10% to 15% of the school age population in North America and Europe, although only about 2% are actually receiving special education. This reveals the need for further research in this area.

The literature so far cited indicate that learning disability is found across all ages and in all socio-economic classes. Most of the literature concentrate on neurological aspects of learning disability and a very few studies on psychological aspects are reported. Studies on western samples have repeatedly reported attention and memory as two defective psychological functions in LD children. Oflate impulsivity has also been studied in LD children with ADHD and other comorbid behavioural problems. However, the underlying neurological correlates have not been considered in these studies.

Moreover, the advancement of higher education in India, especially in Kerala learning disability creates a new and challenging problem before the parents and the educational system. The actual number of children who have a learning disability problem in India is difficult to assess because no national census has been taken.

In India, unlike other nations, this is made all the more difficult due to the multilingual population. No uniform screening or testing device could be used across the country.

In view of the theoretical and empirical literature reviewed and the extend of the Learning Disability in the native population the present study is planned with the following objectives.

Objectives

1. To develop a test for identifying learning disabled suitable for the native population.
2. Identify the significant neurological and psychological correlates of learning disability.
3. To compare the LD and Non LD children with regards to language function, attention, memory and impulsivity.
4. Improve the present system of helping the learning disabled emphasizing individualized attention.

Inorder to meet the above objectives the hypotheses formulated are:

Hypotheses

1. Learning disabled children differ from non learning disabled children in language skills.
2. Learning disabled children are deficient in attention compared to non learning disabled children.
3. Learning disabled children differ from non learning disabled children in memory.
4. Learning disabled children differ from non learning disabled children in impulsivity.

5. Attention as a neuropsychological function is related to language dysfunction.
6. Memory as a neuropsychological function is related to language dysfunction.
7. The two neuropsychological functions, Attention and Memory are interrelated.
8. Impulsivity is related to attention in LD children.
9. Impulsivity is related to memory in LD children.
10. Impulsivity is related to language variables.
11. Learning disability is related to certain socio demographic factors.
12. Neuropsychological functions are related to certain socio demographic factors.
13. Learning Disabled children differ among themselves in specific deficiencies.

Chapter III

METHODOLOGY

- ❖ *Research Design*
- ❖ *Sample*
- ❖ *Tools*
- ❖ *Administration and Scoring*
- ❖ *Analysis of the Data*

METHODOLOGY

According to dictionary definition, research means to engage in the systematic investigation in to and study of materials and sources in order to establish facts and reach new conclusion. Perhaps the words new conclusion could be replaced by valid conclusions to give the definition a little more teeth. (Mukherji, 2000)

When we speak about methodology it generally denotes a combination of:

- a) technology of data collection, namely tools and methods of research such as questionnaire, schedule, interview guide, case study, life history, survey and participant observation methods and content analysis.
- b) analytical tools such as statistical tests and methods and
- c) philosophy, theory and epistemology of social science guiding the conduct of research in the definition and understanding of the problem and the logic of enquiry (Mukherji, 2000).

The term methodology is at times used simply to refer to the procedures or techniques involved in the collection of data (Sjobery & Nett, 2002).

Ahuja (2005) says that methodology is concerned with techniques. It inquires into the potentialities and limitations of some technique or other. It is a plan and procedure for carrying out research. It refers to research

techniques and strategies for obtaining valid information. It is an approach to understanding a phenomenon. Thus methodology refers to the philosophy on which research is based. This philosophy includes assumptions and values that serves as basis (rationale) for research and are used for interviewing data and reaching conclusion.

The main purpose of this chapter is to provide details regarding the methodology adopted in this work with respect to the sample selected, tools used, mode of administration and statistical analysis.

Research Design

According to Kerlinger and Lee (2000) research design is the plan and structure of investigation, conceived so as to obtain answer to research question. The plan is the overall scheme or program of the research. It includes an outline of what the investigator will do, from writing the hypotheses and their operational implications to the final analysis of the data.

Research design is the systematic planning of research to permit valid conclusions. It involves the specification of the population to be studied, the treatments to be administered, and the dependent variable to be measured (Reis & Judd, 2000).

Ahuja (2005) says that research design is a process of making decisions or arranging details. It is a process of making decisions before the situation arises in which the decision has to be carried out.

The present study is designed as a diagnostic research study to explore certain psycho-neurological aspects of learning disability. Diagnostic

research studies determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. The aim is to obtain complete and accurate information in the said studies, the procedure used must be carefully planned. The research design must make enough provision for protection against bias and must maximise reliability with due concern for the economical completion of the research study (Kothari, 1985).

The Sample

Children from 9 years to 12 years constitute the population from which the sample is selected. Geographically Kerala includes three sub regions i.e., Malabar, Cochin and Travancore. In order to make the sample representative of the Kerala population, subjects were taken from all the three regions.

The sample of the study includes three categories of subjects, namely, two learning disabled groups and one learning abled group. The learning disabled subjects were selected from the clinics and special education centers where these children were studying. The normal control group was selected possibly from their blood relations of corresponding places. The total strength of the sample was 80. The learning disabled group consist of 40 subjects and the non learning disabled group consist of 40 subjects. Selection of the subjects to be included in the two groups was different. Subjects in the clinical group were selected following the purposive or judgemental sampling method. The basic assumption behind purposive or judgemental

sampling is that with the exercise of good judgement and appropriate strategy one can handpick the cases to be included in the sample and thus develop samples that are satisfactory in relation to one's research needs. A common strategy of purposive sampling is to pick cases that are judged to be typical of the population in which one is interested. The selection of elements proceeds under the assumption that errors of judgement in the selection will tend to counter balance each other (Wilkinson and Bhandarkar, 1982). Table. 3.1 gives the scatter of the sample

TABLE 3.1

Distribution of the Sample

| Sl. No. | Group | Girls | Boys | Total |
|---------|--|-----------|-----------|-----------|
| 1. | Learning Disabled (identified by the physician) | 8 | 19 | 27 |
| 2. | Learning Disabled (identified by the researcher) | 3 | 10 | 13 |
| 3 | Learning abled | 13 | 27 | 40 |
| | Total | 24 | 56 | 80 |

Inclusion and Exclusion Criteria

(a) Learning Disabled Group

The clinical group, consist of two kinds of samples. Selection of the subjects included in one of the group was based on the diagnosis made by the physician. Another group was selected by the researcher, according to the criterion of the DSM IV, and also with the help of the class teacher where the subject is studying. The researcher reaffirmed that this group did not receive

any professional help before. Children with average or better physical development and with average or above average intelligence were only included.

Children with sub normal intelligence, serious organic disorders, sub average overall physical development and drug consumers were excluded from the sample because learning deficit may be identified in children with these problems also.

(b) Learning Abled Group

Subjects in this group was selected by systematic random sampling. The selection was made from all the places from where the LD samples were taken, possibly from their blood relations. These samples are thus matched with those in the clinical groups with respect to age, sex and education. Before selecting each subject the researcher conducted an interview inorder to confirm that they did not have history of any major physical or psychological problems or brain injury. In order to make the interview more consistent a personal data sheet was used. The samples selected for the Non LD group was also based on the ratings of teachers and a standard intelligence test. Equal number of learning disabled and learning abled subjects were taken from every class inorder to control the effect of learning atmosphere in the institutions. Distribution of sample with respect to age is given in Table 3.2.

TABLE 3.2**Age Wise Distribution of the Sample**

| Sl. No. | Group | Age in Years | |
|---------|-------------------|--------------|------|
| | | Girls | Boys |
| 1. | Learning Disabled | 10-12 | 9-12 |
| 2. | Learning abled | 9-12 | 9-12 |

Educational level of the sample ranged from IVth standard to VIth standard. Educational distribution of the samples is given in Table 3.3

TABLE 3.3**Distribution of Education in the Sample**

| Sl. No. | Group | Education level | Boys | Girls | Total |
|---------|-------------------|---------------------|------|-------|-------|
| 1. | Learning Disabled | 4 th std | 7 | 1 | 8 |
| | | 5 th std | 12 | 5 | 17 |
| | | 6 th std | 10 | 5 | 15 |
| 2. | Learning abled | 4 th std | 1 | 5 | 6 |
| | | 5 th std | 19 | 6 | 25 |
| | | 6 th std | 7 | 2 | 9 |

Although no attempt to control the religious background of the subjects were made, distribution of this variable as represented in the sample is presented in Table 3.4.

TABLE 3.4
Distribution of Religion in the Sample

| Group | Hindu | Muslim | Christian | Total |
|-------------------|--------------|---------------|------------------|--------------|
| Learning Disabled | 30 | 5 | 5 | 40 |
| Learning abled | 25 | 9 | 6 | 40 |
| Total | 55 | 14 | 11 | 80 |

Thus the entries in Tables from 1 to 4 reveal that the Learning Disability groups and Non Learning Disability group are more or less matched in Age and Sex.

Variables in the Study

In the present study as the first step data was collected focusing on two set of variables:

- 1) Variables representing learning disability in Language function- Reading and Writing.
- 2) Variables representing neuropsychological functions-Attention, Memory and Impulsivity
- 3) As a second step a post-hoc categorization of the data was done to verify the role of socio demographic variables.

In the above LD variables are considered as the dependent variable, and other variables are considered as independent variables.

TOOLS

The following are the tools selected for assessing the variables under the study.

1. A personal data sheet- prepared by the researcher for collecting personal and family background.
2. For assessing intelligence Draw-A-Man-Test (Pramila Phatak-revised, 1987) is used.
3. For assessing attention Digit span- a subtest of Wechsler's Intelligence Scale for Children-Revised (WISC-R, Wechsler 1974) is used.
4. For assessing the impulsivity of children, Matching Familiar Figure Test (MMF) developed by Kagan and Co-worker (cited from Medinnus, 1976) is used.
5. For assessing memory, a test for children prepared by the researcher is used.
6. For assessing the language skill, a language test for children prepared by the researcher is used.

A brief description of each tool is followed:

1. Personal Data Sheet

The personal data sheet consist of personal details, family background and medical background of the subject. The personal details regarding the name, age, sex, education, academic performance etc... are included. The family history of the subject consist of type of family, education, nature of employment, socio-economic status, religion etc... of parents. In the medical

background, subjects history of any disease, health condition of parents during pregnancy, history of drug addiction, or alcoholism, marital problem etc... in the family are included. The informations are collected directly from the subjects, parents and teachers.

2. Draw-A-Man-Test

For the preliminary screening, Draw-A-Man test of intelligence is used. This is done to assure that the subject possess average intelligence which is one of the criteria for learning disabled. Here the researcher used revised and extended form of Draw-A man test by Pramila Phatak. The use of human figure to measure intelligence is based up on the development of human body. The original scale included scoring of the major body parts and their crude proportions. It was felt that in the advance concept of human figure the inter location of various body parts and the sex of the figure are inevitable. Hence a few more points were added to the original scale and a list of 25 points was made. The following are the list of the major 25 scoring points.

Reliability and Validity

Consistency of scores on repeated performance with different samples were reported to be around 0.9, indicating acceptable reliability of the scale.

The validity co-efficients have been calculated against different criteria in various studies. The correlation between the scale and the criterion varies according to the nature of the external criterion. However all of them

are in accordance with the expectation of accepting the validity of the scale. The rank order co-efficients (Rho) were calculated for 8 age groups consisting of 9-51 students. They ranged from 0.18 to 0.84. The average 'r' is calculated by using the Rho's. The Rho's were calculated for 10 groups consisting of 15 to 60 students. They ranged from 0.01 to 0.44.

3. Digit Span

Digit span is one of the subtests of Wechsler Intelligence Scale for Children (WISC-R, 1974), used to assess the span of attention. It consist of two categories, Digit Forward and Digit Backward. The present study selected this test in the year 2000. Hale, Hoepfner and Fiorello (2002) has also selected this tool for assessing attention which further ensures the validity of this method for this purpose.

4. Impulsivity Test

To assess the impulsivity of the subject, Matching Familiar Figures Test (MFF) was used. The original form consist of a series of twelve pictures, each on a separate sheet, along with six variants of that picture. For the present purpose a shorter form of Matching Familiar Figure Test was used. It was developed by Kagan and Coworkers (cited from Medinnus, 1976). The reflection-impulsivity dimension in children has received considerable attention in recent research. When faced with various problem solving task, the reflective children have been found to having longer attention span and are less distractable. On the other hand impulsive children spend little time in considering alternatives. They make quick and hasty

judgments that frequently result in incorrect responses (Medinnus, 1976). This test consist of six items of the matching familiar figure and two tasks involving motor control. All the items are drawing of figures and patterns. The child is asked to select the picture that is exactly like the one at the top of the sheet. The two measures obtained from this test are the time taken to respond (the amount of time the child takes to make his choice) and the number of errors.

Reliability and Validity

Studies using (MFF) has proved its validity by differentiating children of different levels in scholastic performance and intelligence (Joseph, 1994).

5. Memory

Memory refers to the mental processes that enable us to acquire, retain, and retrieve information (Hockenbury and Hockenbury, 1998). Although the present study was initially designed in 2000. Later in 2002, Hoerig, David and D' Amato also emphasized the need to assess memory of LD children. In order to assess the quality of memory of the subject, the investigator developed a test that is simple enough to be used with children of any literacy level. Twenty four common objects, made of wood, steel and plastics that are familiar to the children are selected. The objects are,

| | | | | | |
|-------|-----------|--------|----------|--------------|---------|
| Car | Carrot | Plate | Matchbox | Cow | Hen |
| Ball | Pineapple | Pencil | Torch | Hippopotamus | Parrot |
| Key | Mango | Bangle | Bulb | Goat | Sparrow |
| Watch | Grapes | Flower | Comb | Horse | Egg |

Reliability and Validity

As the scores for memory is likely to improve with passing of time in children Test retest reliability is not appropriate. Parallel form is an appropriate method which was not attempted in this work due to limitation of time.

The test could differentiate LD and Non LD children significantly with LD children scoring a significantly lower mean (LD mean = 5.03 and Non LD mean = 12.23) than the Non LD (Table 4.5). This result establishes the diagnostic validity of the test. Therefore this test is considered for use in the present study.

6. Language Test

Due to the non availability of language test in the native population, the investigator devised a test to asses the language ability of the learning disabled children. The test consists of two areas i.e., Reading and Writing. The criteria used for the selection of the words, numbers and letters are given below:

- 1) The possible words that are interchangeable with other letters were identified.
- 2) Simple words with two or three letters, numbers and alphabets including the letters and numbers that are often miswritten or misread by learning disabled children were selected.
- 3) 25 Malayalam words which were correctly spelled (read and written) by all the students in the class were selected from the Malayalam

textbook for the 3rd standard students. As the present sample is selected from 4th standard, it is assumed that children who pass class 3 have acquired the language at the average level.

Reading:

One of the most critical problems faced by a significant number of learning disabled children is their difficulty with reading. For assessing reading, the investigator first prepared the following:

(1) List of Malayalam and English alphabets

| | | | | | | | | | | | | |
|---|----|----|---|---|---|---|---|---|---|---|---|---|
| അ | ആ | ഇ | ഈ | ഉ | ഊ | ഋ | ൠ | എ | ഏ | ഐ | ഓ | ഔ |
| ഓ | അം | അഃ | | | | | | | | | | |
| A | B | C | D | E | F | G | H | I | J | K | L | M |
| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

(2) Identified a list of Malayalam and English words (9 each) that are commonly miss spelt by the learning disabled including words and alphabets.

| | |
|------|------|
| തല | Play |
| പീലി | home |
| ന | on |
| ധ | cold |
| സ | step |
| ഗ | belt |
| ലത | was |
| ഡ | top |
| ലിപി | Saw |

(3) A list of nine numbers also selected which are given below

| | |
|----|----|
| 12 | 14 |
| 10 | 51 |
| 6 | 61 |
| 31 | 17 |
| 9 | |

Writing: In order to identify the writing skill of learning disabled children, the researcher identified 25 common Malayalam words from Malayalam textbook prescribed for standard three, the previous standard from which the subjects in the sample were promoted. This was done based on certain criteria. Before identifying the words, the investigator conducted a dictation of 35 Malayalam words based on their textbook among the 3rd standard Non LD children. Among the 35 Malayalam words, 25 words which were correctly written by all of them were selected. The words are given below.

| | |
|----------------|-------------------|
| മാന്ത്രികപ്പുഴ | പ്രാണൻ |
| ആഹാരം | കൗശലം |
| മാർഗം | സ്വകാര്യം |
| ആലോചിച്ചു | മേലം |
| മൃഗരാജാവ് | നിയന്ത്രണമില്ലാതെ |
| ആനന്ദം | സമാധാനം |
| സുന്ദരി | കുടുംബക്കാർ |
| മനോഹരം | വേദന |
| സംഭവം | സങ്കടം |
| ഉല്ലാസം | മധുരം |
| ഉദിച്ചു | ഭാവം |
| അങ്കവാൽ | ക്ഷണിച്ചു |
| | ഘോരവനാന്തരം |

Reliability Validity

As the scores for language is likely to improve with passing of time in children test-retest reliability is not appropriate. Parallel form is an appropriate method which was not attempted in this work due to limitation of time.

However, the test could differentiate LD and Non LD children significantly with LD children scoring a significantly lower mean score (LD Reading mean = 12.88 and Writing mean = 12.49; NLD Reading mean=1.80 and Writing mean = 2.17) than the Non LD children (Table 4.3).

ADMINISTRATION AND SCORING

1) PERSONAL DATA SHEET

Administration

The subject was seated comfortably in front of the table. After making proper rapport, the personal data sheet was given to the subject and were asked to write the personal, educational, family, social and health background of the subject.

Scoring

The informations collected are used for the post hoc subgrouping of the sample with regard to certain socio demographic factors and also for initial screening of subjects.

2) DRAW – A – MAN TEST

Administration

The subject was seated comfortably at the table. After establishing proper rapport, a blank sheet of paper was given to the subject and the investigator gave the following instructions. “This is a blank space and I want you to draw a picture of a full human figure in the space. I want to see how nicely you can draw it. You can take as much time as you like, but if you want to turn the sheet and use the backside, you have to tell me. When you finish put the pencil down and raise your hand to indicate that you have finished”.

Scoring

The scoring of the human figure is simple for anyone who is capable of following the instructions faithfully. The illustration of each body part is given in the manual along with their weightages and description of scoring points. Thus the directions in the manual is followed.

3) DIGIT SPAN

Administration

The subject is seated comfortably and proper rapport is established. The two parts of the test is administered one after the other.

Digit Forward: The instruction for the subject was as follows; “ I am going to say some numbers. Listen carefully and when I have finished, repeat them after me” (Wechsler, 1974). The digits were read out one per second with clarity. If the subject repeated trial ‘I’ of a series successfully, then the next

higher number in the same trial is used. If he/she failed then a second chance is given in the same series of trial II. If he/she failed on both the trials of a given series then the testing was discontinued.

Digit Backward: The instruction for the subject was as follows. “Now I am going to say some more numbers, but this time I want you to say them backwards” (Wechsler, 1974). An example was given and let the subject try. If the subject failed in the trial I, trial II of the same series is given to him/her. If he/she succeeded, testing proceeded to the higher series. If he/she failed in the trial II, the test was discontinued.

Scoring

The subject’s score in the Digit Forward is the highest number of digits repeated without error. Maximum score is 9.

Scoring in Digit Backward is the maximum number of digits repeated in backward series with out error in trial I or II. The highest score in digit backward is ‘8’.

The total score for the Digit span is the sum of scores on digit forward and digit backward. The maximum possible score is ‘17’.

4) IMPULSIVITY TEST

Administration

Each child is individually tested using the picture materials. Seated the subject comfortably in front of the table. After making proper rapport the child is instructed, “find the picture that is exactly like the one at the top of the page”. The time take to make his selection and errors are recorded.

The two tasks, involving fine motor control were used to assess motor behaviour. For the first task the child is instructed to connect the dots in order to make a umbrella. For the second task the child is to draw a path for the dog to run over to get his bone. A broken line has been drawn to show where the path is, but the subject has to connect the dashes so that the dog can run along the path.

Scoring

The recorded time taken to complete each task is the index. In addition a general or global assessment of the child's performance in terms of some of the following criteria is also made.

1. Accuracy of performance
2. Did the child appear to map out a plan of action before beginning or did he proceed immediately with the task.
3. Did the child exhibit good motor control or was he somewhat poorly co-ordinated in performing the task.
4. To what extent did the child appear tense and anxious. Combine the children's performance on the two tasks.

5) MEMORY

Administration

The subject was seated comfortably in front of a table and rapport was established. After establishing rapport all the 24 objects were presented together by placing them for 60 seconds. Then subjects were instructed to recall the names of objects from memory.

Scoring

The number of items correctly recalled represent the score. The maximum score thus possible is '24' and minimum is '0'.

6) LANGUAGE TEST

Administration

Seated each individual subject comfortably at the table. After making proper rapport the subject is instructed as follows: "I am going to show a list of Malayalam alphabets, your task is to read the alphabet I have shown specifically". This procedure was repeated in the case of English alphabets, Malayalam and English words and the numbers.

In the second session, the subject is instructed to write the Malayalam words one by one in the order in which they were presented verbally.

Scoring

For the assessment of reading, the investigator shows the list already prepared to each individual subject and asked them to read them aloud. The number of miss spelled words or errors are taken as the score. As cited by Reddy, Rmar and Kusuma (2002), Thomas et al, 1987; and Adams, 1990 found students with learning disabilities have been found to display a substantially greater number of error responses in certain academic subjects than their non handicapped peers and have suggested that error analysis can be effectively made use of by the teacher to identify the learning disabled students and also to measure the degree of disability.

In the case of writing the investigator conducted a dictation of the already prepared 25 Malayalam words individually. Each wrong word is considered as one score.

ANALYSIS OF THE DATA

The present study intended to explore certain psycho-neurological aspects of learning disability in school going children. The tenability of the hypotheses formulated to meet these objectives was tested using simple statistical methods as follows:

The first four hypotheses suggesting a difference between the Learning Disabled children and Non Learning Disabled children in terms of language learning and three neuropsychological functions, viz., attention, memory and impulsivity. The mean differences were tested using 't' test.

For hypotheses five to the tenth inter relationship between the studied variables were verified by computing Pearson's Correlation Coefficient between the scores of the respective variables. The scores were also subjected to Multiple Regression Analysis. But the results were not significant enough.

Hypotheses 11th and 12th intend to explore the role of certain socio-demographic factors on LD. For verifying this, 't'-test was computed between the mean score of the different subgroups categorized according to their socio-demographic characteristics.

The last hypothesis, to study individual differences among the LD

children with respect to the studied language and neuropsychological variables, was verified by graphical analysis.

The results of the analysis are presented and discussed in the next chapter.

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Chapter IV

RESULTS AND DISCUSSION

- ❖ *Hypothesis I*
- ❖ *Hypothesis II*
- ❖ *Hypothesis III*
- ❖ *Hypothesis IV*
- ❖ *Hypothesis V*
- ❖ *Hypothesis VI*
- ❖ *Hypothesis VII*
- ❖ *Hypothesis VIII*
- ❖ *Hypothesis IX*
- ❖ *Hypothesis X*
- ❖ *Hypothesis XI*
- ❖ *Hypothesis XII*
- ❖ *Hypothesis XIII*

RESULTS AND DISCUSSION

To test the hypotheses formulated for the present study certain statistical analyses were carried out. The details of the results are presented in this chapter.

Before using the specific statistical methods for testing the hypotheses, the descriptive statistics of LD and NLD groups was worked out. Table 4.1 shows the mean, median, mode, standard deviation, range, minimum and maximum of the Learning Disabled (LD).

TABLE 4.1
Descriptive Statistics
of the Variables in the L.D. Group

| Variable | N | Mean | Median | Mode | SD | Range | Minimum | Maximum |
|------------------|----|-------|--------|------|-------|-------|---------|---------|
| Attention | 40 | 5.28 | 5.00 | 6 | 1.012 | 4 | 3 | 7 |
| Memory | 40 | 5.03 | 5.00 | 5 | 1.074 | 4 | 3 | 7 |
| Impulsivity | 40 | 2.367 | 2.255 | 2.2 | 0.813 | 4.8 | 1.2 | 6 |
| Language Reading | 40 | 12.88 | 12.50 | 15 | 3.006 | 11 | 8 | 19 |
| Language writing | 40 | 12.45 | 12.00 | 9 | 2.900 | 10 | 8 | 18 |

Similarly the computation were done for the Non Learning Disabled group (NLD) as shown in Table 4.2.

TABLE 4.2
Descriptive Statistics
of the Variables in the NLD Group

| Variable | N | Mean | Median | Mode | SD | Range | Minimum | Maximum |
|------------------|----|-------|--------|------|-------|-------|---------|---------|
| Attention | 40 | 12.35 | 12.00 | 12 | 1.610 | 6 | 9 | 15 |
| Memory | 40 | 12.23 | 12.00 | 12 | 2.567 | 12 | 6 | 18 |
| Impulsivity | 40 | 4.534 | 4.310 | 3.5 | 1.397 | 6.9 | 2.4 | 9.2 |
| Language Reading | 40 | 1.80 | 1.00 | 1 | 1.667 | 9 | 0 | 9 |
| Language writing | 40 | 2.17 | 2.00 | 1 | 1.767 | 7 | 0 | 7 |

A close examination of the SD values in Table 4.1. and 4.2 reveals that SDs for the language variables are relatively larger indicating more individual differences in the LD group whereas in the NLD group they are more language means on these variables which is also supported by the ranges .

The testing of hypotheses and discussion of results are presented in two sections:

- A. Comparative analysis of the LD and Non LD groups with respect to the studied psychological variables.
- B. The relationship between the variables in the two groups

Hypothesis I

The first hypothesis of the study was that there is significant difference in language ability of learning disabled children and Normal Children. For testing this hypothesis 't' was computed and the result is given below

TABLE 4.3
Means, Df, SDs and 't' value for Language

| | | N | df | M | SD | 't' |
|------------------|-----|----|----|-------|-------|----------|
| Language Reading | LD | 40 | 39 | 12.88 | 3.006 | 20.378** |
| | NLD | 40 | 39 | 1.80 | 1.667 | |
| Language Writing | LD | 40 | 39 | 12.45 | 2.900 | 19.138** |
| | NLD | 40 | 39 | 2.17 | 1.767 | |

** Significant at 0.01 level (two tailed)

The 't' values in Table 4.3 indicate that there is considerable difference in language ability between normals and learning disabled, especially in reading and writing. The findings clearly say that LD children are inferior in reading and writing ability compared to normal children.

These results also reveals that the sampling of LD and NLD children is correctly done.

Hypothesis II

The second hypothesis of the present study is that learning disabled children are deficient in attention compared to Non LD children. For testing this hypothesis 't' was computed between scores of LD and Non LD children for attention. The details is given in Table 4.4.

TABLE 4.4
Means, Df, SDs and 't' value for
Attention Scores of LD and Non LD Children

| | Group | N | df | M | SD | 't' |
|-----------|--------|----|----|-------|-------|----------|
| Attention | LD | 40 | 39 | 5.28 | 1.012 | 23.527** |
| | Non LD | 40 | 39 | 12.35 | 1.610 | |

** Significant at 0.01 level (two tailed)

The attention span of LD and Non LD children is significantly different. It shows that there is significant difference between Non Learning Disabled and Learning Disabled children in attention span. From the findings it is observed that the Learning Disabled are deficient in attention compared to normal children. Attention is one of the cognitive function necessary for learning. Without attention one cannot concentrate on any task. In the case of learning disabled their deficiency in attention may be one among the reasons for their poor learning. Similar finding was also reported by Tarnowski. et al (1986), Richard. et al (1990), Keogh and Margolis (1976) and Hallahan and Reev (1980).

Analyzing the reason for attention deficit in Learning Disabled children, we can assume that attention as a psychological variable is related to neurological functions. That is the parietal cortex of human being is primarily controlling the process of attention with other neural circuits. This was evident from PET studies and Electro-physiological studies (Kolb and Whishaw, 1996). According to them, damage to the posterior parietal cortex impairs performance on any task that require the ability to select objects. This was also supportive evidences by Luria in 1973; Corbetta in 1991 and Naatanen in 1992. These experimental evidences suggest that attention problem of Learning Disabled children are due to the damage or structural deficit in parietal cortex.

Hypothesis III

The third hypothesis is that learning disabled children differ from normal children in memory. For verifying this hypothesis 't' test was

computed between mean scores of the two groups and the findings are given in Table 4.5.

TABLE 4.5
Means, Df, SDs and 't' value for
Memory Scores of LD and Non LD Children

| | Group | N | Df | M | SD | 't' |
|--------|--------------|----------|-----------|----------|-----------|------------|
| Memory | LD | 40 | 39 | 5.02 | 1.074 | 16.365** |
| | Non LD | 40 | 39 | 12.23 | 2.567 | |

** Significant at 0.01 level (two-tailed)

The values in Table 4.5 shows that there is significant difference among Non LD and LD children on memory task. From the mean scores we can infer that LD children are poor in memory task compared to Non LD children. Similar findings were reported by Bauer, 1977; Tarver. et al, 1976; Torgesen and Goldman, 1977; Worden, 1986 (cited by Wong, 1991). According to them LD children's long term memory is deficient when compared with that of Non LD Peers. The present result also suggest that their short term memory is also impaired. Table 4.4 reveal that LD children are deficient in attention which is a prerequisite for memory. When a child is deficient in attention, naturally it will reflect the memory process of that child. So attention and memory are interconnected.

When analyzing the neurological networks of memory it can be seen that the hippocampus play a significant role in the process of memory. This is evident from the animal ablation studies by Morgan, Squire, Amaral, Suzuki, 1981; human lesion studies by Kartsounis, Rudge and Stevens, 1995;

Rempel-clower. et al, 1996; Functional imaging by Grasby. et al 1994; Kapoor. et al 1994; Shallice. et al, 1994 (cited from Nilsson and Markowits, 1999). Recently Kandel. et al (2000) also identified the role of hippocampus in memory formation. All of these say that hippocampus mediates the representation of spatial and temporal memories. From the above findings it can be inferred that deficit in hippocampus formation may lead to severe memory problem. And it leads to poor attention and language function in children. Attention problem and language dysfunction are the two major problems found in almost all the learning disabled group.

Hypothesis IV

The fourth hypothesis is that Learning Disabled children differ from Non Learning Disabled children in impulsivity. Inorder to test this hypothesis ‘t’ was computed between the mean score of the two groups for impulsivity. And the results are given in Table 4.6.

TABLE 4.6

Means, Df, SDs and ‘t’ value for Impulsivity

| | Group | N | Df | M | SD | ‘t’ |
|-------------|--------------|----------|-----------|----------|-----------|------------|
| Impulsivity | LD | 40 | 39 | 2.367 | 0.8134 | 8.480** |
| | Non LD | 40 | 39 | 4.534 | 1.3971 | |

** Significant at 0.01 level (two tailed)

The t value in Table 4.6 show that impulsivity of LD and Non LD children is significantly different. The mean values indicate that LD children have scored lower than the Non LD children. Lower score means that LD

children takes significantly lesser time to respond as compared to Non LD children. This indicates that the LD children are more impulsive than the Non LD children. The studies of Clements, 1996; Conte, 1991; Blackman and Goldstein, 1982; etc also have reported similar findings. According to them learning disabled children are more impulsive decision makers. Due to the difficulty in awaiting turn and blurts out answers before questions have been completed , they often fail to attend the material before. it naturally leads to their academic backwardness.

When analyzing neurological correlates of impulsivity it is seen that damage to frontal lobe may cause problems in stopping, that are often described as impulsivity, over activity and difficulty in holding back a wrong and unwanted response (Lezak, 1995). This finding was also supported by Syndulko (1978) and Popkin, (1989).

Hypothesis V

The fifth hypothesis of the present investigation was to study the relationship of attention as a neuropsychological function with language dysfunction. This was estimated by computing Pearson's Correlation Coefficient between scores of attention and language. The details of the analysis is given in Table 4.7.

TABLE 4.7
Correlation Co-efficient between the Scores of
Attention and Language among LD and NLD children

| Variable | N | 'r' | |
|----------------------------|----|----------|----------|
| | | LD | NLD |
| Attention Vs Reading | 40 | -0.427** | -0.403** |
| Attention Vs Writing | 40 | -0.323* | -0.301* |

** Significant at 0.01 level (two tailed)

* Significant at 0.05 level (one tailed)

Table 4.7 reveals that the scores of attention and language, reading and writing, are statistically significant in both LD and NLD groups. There is a negative correlation among the scores of attention and language. Here the negative correlation indicates that as the scores in attention decreases the scores of language increases, i.e., error of language increases. This shows that when a persons attention improves the ability for language also increases and vice versa. This was also supported by the studies of Walker and Roberts (2001). According to them childhood attention deficits, behavioural problems and anxiety may be related to subtle speech or language disorders. The following studies by Facoetti, Zorzi and Cestnick (2006); Breier, Fletcher and Foorman (2003); Im-Botter, Johnson and Pascual-Leone (2006); Stevens, Sanders and Neville (2006) confirmed the relationship of attention and

language. Marton and Schwartz (2003) also found attention deficit in children with specific language impairment.

The learning of language depends on attentional capacity of the individual. If the person is weak in attentional process it naturally reflects the process of learning language. This is supported by the results in Table 4.4 and 4.5.

Hypothesis VI

In the present investigation the sixth hypothesis is that memory as a neuropsychological function is related to language dysfunction. This was estimated by computing Pearson's Correlation Coefficient among the variables, memory and language. The values of the analysis is given in Table 4.8.

TABLE 4.8
Correlation Coefficient between
the Scores of Memory and Language Categories

| Variable | N | 'r' | |
|-------------------------|----|----------|----------|
| | | LD | NLD |
| Memory Vs Reading | 40 | -0.460** | -0.415** |
| Memory Vs Writing | 40 | -0.300* | -0.224 |

** Significant at 0.01 level (two-tailed)

* Significant at 0.05 level (one-tailed)

Table 4.8 reveals that the scores of memory and language-reading and writing are significantly related in a negative direction. In the Non LD group memory and writing is related but not significant. Here the negative correlation means as the scores of memory decreases the errors of language increases, (errors is considered as score) that is the right answer decreases. This shows that when a persons memory increases, the language ability also increases.

This was supported by the studies of Tijms, (2004); Mati-Zissi and Zafiropoulou (2003); Plaza, Cohen and Chevrie-Muller (2002); Kramer, Knee and Delis (2000). All of the above studies report that dyslexics have less efficient rehearsal and encoding mechanisms, resulting in deficient encoding of new information.

Apart from this, the process of attention and memory are closely interrelated. Failure in one of these processes may contribute to failure in language ability. Arden (2002) has clearly stated the relationship of memory and attention with supportive empirical evidence. The neurological processes underlying these psychological functions are also to be considered as important. Attention and memory are related to two distinct brain centres but they are also interconnected by neural circuits. So problems in one or more of these areas or neural circuits may contribute to language functions.

Hypothesis VII

The seventh hypothesis of the present study is that attention as a neuropsychological function is related to memory. This was estimated by

computing Pearson's Correlation Coefficient among variables attention and memory. The values of the analysis is given in Table 4.9.

TABLE 4.9
Correlation Coefficient between
the Scores of Attention and Memory

| Variable | N | 'r' | |
|---------------------------|----|---------|---------|
| | | LD | NLD |
| Attention Vs Memory | 40 | 0.677** | 0.502** |

** Significant at 0.01 level (tw-tailed)

The 'r' value in Table 4.9 reveals that the scores of attention and memory are positively related in both the groups. This means that when attention increases the ability for memory also increases. The value of LD group is greater than the NLD group. A similar finding was also recorded by Johnson, Altmaier and Richman (1999); Martinussen and Tannock (2006). They argued that children with attention deficit and a comorbid LD had greater memory deficits.

This relation could also be explored interms of the underlying neurological processes.

Wagner et al as cited by Rosenzweig, Breedlove, Leiman (2002) also stated that in the case of words, the critical area showing greater activation to correctly recalled sentence were left prefrontal cortex and the left parahippocampal cortex. The neural networking between the prefrontal

cortex and parahippocampal cortex could also be associated with the deficit in attention of the LD children.

Hypothesis VIII

The eighth hypothesis of this investigation is to study the relationship between impulsivity and attention among learning disabled and non learning disabled children. This was estimated by computing correlation coefficients between the scores of the subjects on the two variables. Table 4.10 shows the details.

TABLE 4.10

Correlation Coefficient between the Scores of

Impulsivity and Attention Among LD and NLD Children

| Variable | N | 'r' | |
|--------------------------------|----|--------|-------|
| | | LD | NLD |
| Impulsivity Vs Attention | 40 | 0.325* | 0.136 |

* Significant at 0.05 level (two-tailed)

The correlation values in Table 4.10 reveal that among LD children impulsivity and attention are significantly positively related while among NLD children the relation is not significant though the nature of relation is positive. This is not intune with the commonsense assumption that when impulsivity increases attention is likely to be decrease. Here the results suggest that as attention increases impulsivity also is likely to increase or vice versa. That is, a learning disabled child who can focus attention better is

more likely to become restless and tends to hurry doing a task. For a non learning disabled child this relation is not so strong. This phenomena can be observed in children with superior IQ that they become frequently restless and may be making more errors in task during childhood. However, no supportive study could be traced. Therefore, the finding needs further evidences for confirmation.

Hypothesis IX

The ninth hypothesis of the present investigation is to study the relationship between impulsivity and memory. This is estimated by computing correlation coefficient between the scores on impulsivity and memory of the subjects. The result of the analysis is given in the Table 4.11.

TABLE 4.11
Correlation Coefficient between the Scores of
Impulsivity and Memory Among LD and NLD Children

| Variable | N | 'r' | |
|-----------------------------|----|--------|-------|
| | | LD | NLD |
| Impulsivity Vs Memory | 40 | -0.031 | 0.113 |

The r-value in Table 4.11 reveals that the scores of impulsivity and memory are negatively related in LD group. Where as in the Non-LD it is positively related. This means that memory improves when impulsivity decreases in LD children. It again strengthens the notion that reflective

children respond more slowly and make few errors whereas impulsive children respond quickly but make many errors (Hallahan, Kauffman and Llyod, 1996). Lorschach, Wilson and Reimer (1996) reported that suppression of irrelevant information is difficult in learning disabled children. It is one of the reason for their poor memory. From this result we can infer that when a child is impulsive naturally he/she cannot concentrate on any task and make responses to non target stimuli, and it leads to deficient attention and this deficient attention adversely affect the memory process. So the process of impulsivity and memory are interconnected. From the Tables 4.5 and 4.6 we can observe that LD children are deficient in memory, attention and impulsivity as compared to Non LD peers. It is interesting to note that the nature of correlation between memory and impulsivity in LD and Non LD groups are different. This suggest that impulsivity as indicated by the test is not an unhealthy characteristics. Probably the score indicates the rate of activity. Thus the overactive/ hyperactiveness in LD children is contributing to their poor memory. This is also supported by the results in Table 4.12 that as impulsivity decreases language also improves.

Hypothesis X

The tenth hypothesis of the present investigation is to study the relationship between impulsivity and language variables. This is estimated by computing Pearson's Correlation Coefficients between the scores on impulsivity and language variables of the subjects. The results of the analysis is given in the Table 4.12.

TABLE 4.12
Correlation Co-efficient between
the Scores of Impulsivity and Language
Reading and Writing Among LD and NLD Children

| Variable | N | 'r' | |
|------------------------------|----|--------|--------|
| | | LD | NLD |
| Impulsivity Vs Reading | 40 | -0.123 | -0.156 |
| Impulsivity Vs Writing | 40 | -0.197 | -0.267 |

The 'r' values in Table 4.12 reveal that the scores of impulsivity and language variables are negatively related in both the groups but not significant. This suggests that as the score on impulsivity increases the scores in language decreases. High scores on impulsivity (more time) indicate less impulsivity and less number of errors in language means better performance. Therefore as the impulsivity reduces learning of language improves and vice versa. However for confirmation this has to be repeated in larger stratified samples.

The findings of Gaddes (1989) reveal that the brain centres are damaged, diseased or structurally malformed, the child will have difficulty in acquiring language skills and also he says that the dysfunction is in language area in the brain, the child is said to have a specific learning disability involving reading and language arts. Today the researchers clearly identified

the area for language, that is the planum temporal in left hemisphere. The majority of the nondyslexic brain's a section of the left temporal lobe is larger than the same areas in the right hemisphere. This area include a large portion of Wernicke's area, that is referred to as planum temporal. The result for those who were dyslexics are dramatically different-in the majority of the cases the planum temporal in the left and right hemisphere are the same size (cited by Hallahan, Kauffman and Lloyd, 1996). So the above result may be attributed to the structural or functional asymmetry of planum temporal.

Galaburda in the year 1994, stated various pathological features in the brain of patients with dyslexia. The anomalies consisted of unusual grouping of cells in outer layers of the cerebral cortex that distorted the normal layered arrangements and columnar organization. Some cells were disoriented and excessive cortical folding (micropolygyria) was observed. Nests of extra cells (ectopias) were seen. The result of these deficits might be the production of unusual pattern of connectivity in language related region of the temporal cortex (cited by Rosenzweig, Breedlove and Leiman, 2002).

Apart from this the process of reading is related to attention and memory. Therefore any defect in the process of attention and memory may result in language dysfunction.

In addition to the primary objectives of the study, a post hoc analysis of the data was also done to test the role of certain socio-demographic factors in learning disability among the studied subjects. Mean differences between the different subgroups with respect to age, gender, religion and socio-economic status were found. The following section gives the details:

Hypothesis XI

The eleventh hypothesis of the present study is that learning disability is related to certain socio-demographic factors. For testing this hypothesis t-value is computed for language variables between scores of pairs of sub groups based on socio demographic variables such as age, sex, religion, and socio-economic status. The result of the calculation is given in Table 4.13.

TABLE 4.13**Means, SDs and t-values for****Reading and Writing of the Socio-Demographic Groups**

| Socio- Demographic Variables | | N | Reading | | | Writing | | |
|------------------------------|---------------|----|---------|-------|----------------|---------|-------|----------------|
| | | | Mean | SD | 't' | Mean | SD | 't' |
| Sex | Boys | 29 | 12.72 | 2.576 | 0.510 | 12.72 | 2.576 | 0.970 |
| | Girls | 11 | 13.27 | 4.052 | | 11.73 | 3.663 | |
| Age | 9-10 yrs | 20 | 12.45 | 2.982 | 0.892 | 12.30 | 3.080 | 0.323 |
| | 11-12 yrs | 20 | 13.30 | 3.045 | | 12.60 | 2.780 | |
| Religion | Hindu | 30 | 12.53 | 3.267 | 0.695 (1&2) | 11.97 | 3.057 | 1.133 (1&2) |
| | Muslim | 5 | 13.60 | 2.408 | 1.118 (1&3) | 13.60 | 2.408 | 1.599 (1&3) |
| | Christian | 5 | 14.20 | 1.095 | 0.507 (2&3) | 14.20 | 1.095 | 0.507 (2&3) |
| Socio Economic Status | Above Average | 7 | 13.29 | 3.450 | 0.035 (1&2) | 13.29 | 3.450 | 0.568 (1&2) |
| | Average | 17 | 13.24 | 3.093 | 0.712 (1&3) | 12.53 | 2.764 | 0.925 (1&3) |
| | Below Average | 16 | 12.31 | 2.822 | 0.894 (2&3) | 12.00 | 2.898 | 0.537 (2&3) |

The entries in Table 4.13 reveal that learning disabilities in both reading and writing do not differ with respect to any of the selected socio-demographic variables. However, as the sample was not originally selected based on this stratification and do not have equal number of subjects in each group. So this result cannot be taken as confirmatory.

Hypothesis XII

The twelfth hypothesis of the present study is that neuropsychological functions are related to certain socio demographic factors. For testing this hypothesis 't' was computed with each neuropsychological variables of the present study and certain socio-demographic variables such as sex, age, religion and socio economic status. The result of the calculation is given in Table 4.14.

TABLE 4.14

Means, SDs and t-values

for Attention, Memory and Impulsivity of the Socio-Demographic Groups

| Socio Demographic Variables | | N | Attention | | | Memory | | | Impulsivity | | |
|-----------------------------|---------------|----|-----------|-------|----------------|--------|-------|----------------|-------------|-------|----------------|
| | | | Mean | SD | 't' | Mean | SD | 't' | Mean | SD | 't' |
| Sex | Boys | 29 | 5.28 | 0.960 | 0.009 | 5.21 | 0.978 | 1.788* | 2.303 | 0.510 | 0.797 |
| | Girls | 11 | 5.27 | 1.191 | | 4.55 | 1.214 | | 2.534 | 1.345 | |
| Age | 9-10yrs | 20 | 5.25 | 1.020 | 0.154 | 5.00 | 1.026 | 0.145 | 2.558 | 0.957 | 1.509 |
| | 11-12yrs | 20 | 5.30 | 1.031 | | 5.05 | 1.146 | | 2.175 | 0.605 | |
| Religion | Hindu | 30 | 5.37 | 0.999 | 1.160 (1&2) | 5.03 | 1.098 | 0.440 (1&2) | 2.383 | 0.912 | 0.273 (1&2) |
| | Muslim | 5 | 4.80 | 1.095 | 0.341 (1&3) | 4.80 | 1.095 | 0.314 (1&3) | 2.498 | 0.457 | 0.598 (1&3) |
| | Christian | 5 | 5.20 | 1.095 | 0.577 (2&3) | 5.20 | 1.095 | 0.577 (2&3) | 2.134 | 0.358 | 1.403 (2&3) |
| Socio Economic Status | Above Average | 7 | 5.14 | 1.069 | 0.049 (1&2) | 5.14 | 1.069 | 0.596 (1&2) | 2.207 | 0.655 | 0.012 (1&2) |
| | Average | 17 | 5.12 | 1.166 | 0.880 (1&3) | 4.82 | 1.237 | 0.103 (1&3) | 2.204 | 0.513 | 0.907 (1&3) |
| | Below Average | 16 | 5.50 | 0.816 | 1.084 (2&3) | 5.19 | 0.911 | 0.958 (2&3) | 2.609 | 1.079 | 1.390 (2&3) |

* Significant at 0.05 level (one tailed)

The values in Table 4.14 reveal that psychological functions of learning disability do not differ with respect to selected socio demographic variables except the variable memory. Here the score indicates that there is significant difference among girls and boys in memory processing with boys performing better than girls.

Hypothesis XIII

In order to meet the 4th objective suggesting individualized helping for the learning disabled children and to verify the last hypothesis that, LD children differ in specific deficiencies among themselves. A detailed qualitative and comparative analysis of the learning disabled, with respect to their IQ, age, gender and language ability was done in four steps. The details of the analysis is given in the forthcoming pages.

First the entire sample was checked for identifying LD children with same IQ. It was found that only 5 subjects had an IQ of 97. From this group four subjects (2 boys and 2 girls) were selected and their scores in reading and writing were compared. A graphic representation is presented in Figure 3 where the alphabet represents each subject.

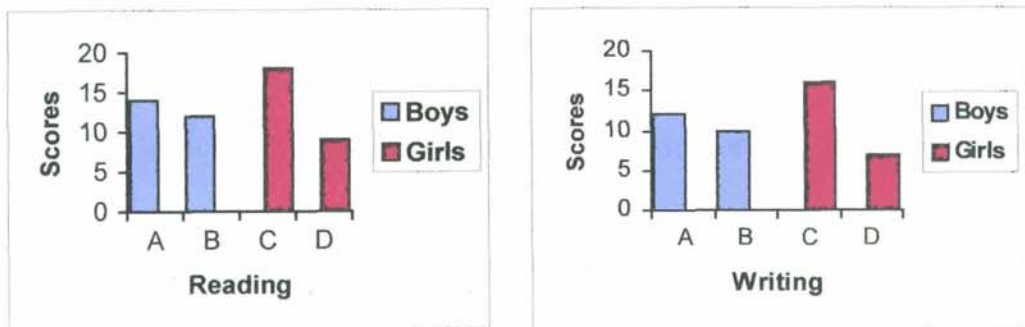


Figure 3

An examination of the graphs for both reading and writing clearly reveal that while boys differ for 2 points the girls differ for 10 points. This indicates that IQ does not ensure the exact rate of performance in reading or writing. Further it also suggests that individual difference among girls is more prominent than in boys.

Similarly it was assumed that, each learning disabled child could be unique in his/her cognitive and psychological abilities/deficits. Therefore as the next step subjects with same score for both reading and writing were identified. From the total of 9 such subjects 6 were selected (3 boys and 3 girls) and their scores in attention, memory and impulsivity were compared. The comparison is shown graphically in Figures 4, 5 and 6. The alphabets represent each subject.

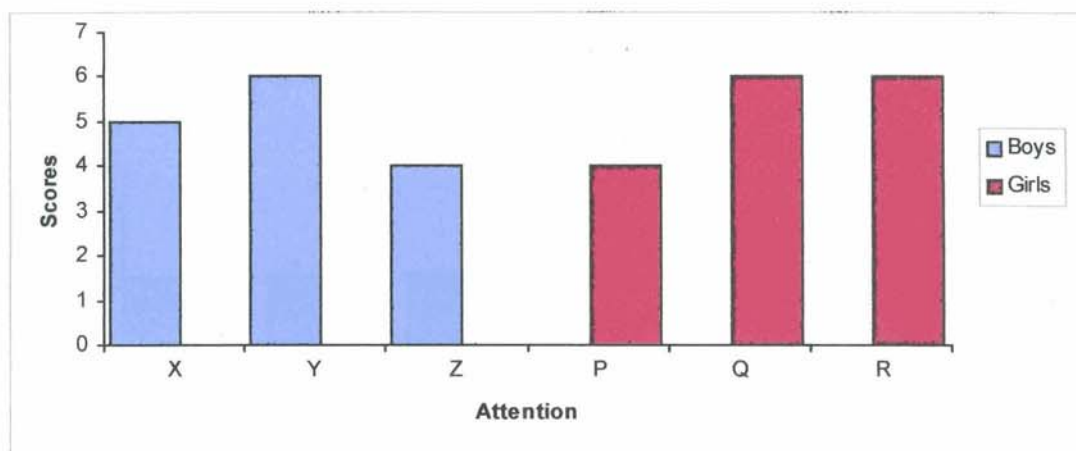


Figure 4

The individual scores in attention plotted do not reveal much variation between girls and boys but in each group the homogeneity of score is not indicated.

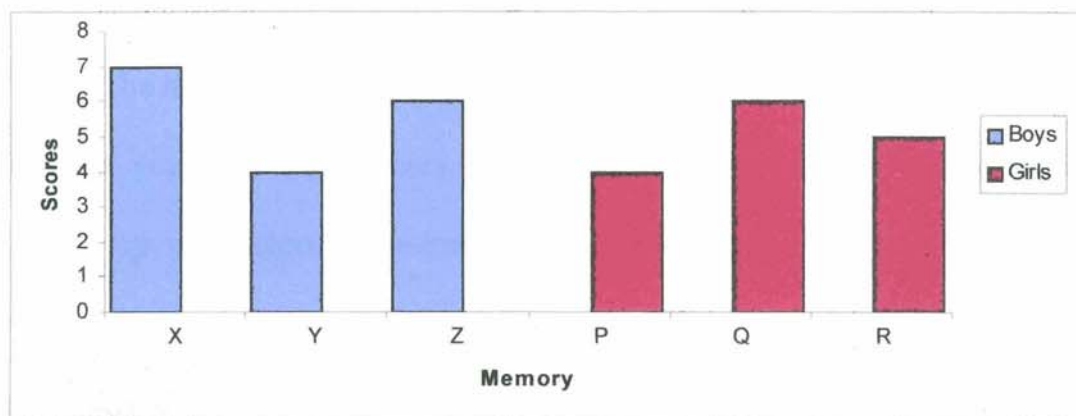


Figure 5

The graphs in Figure 5, like Figure 4, also suggest no clear pattern of difference between boys and girls for scores in memory. However, unpredictability of homogeneity of scores among both the groups is evident with each subject differing in memory.

Thus result indicated in Figures 4 and 5 suggest that deficits in attention and memory as two major psychological processes significant in learning are not comparable even in LD children with similar performance in language ie., reading and writing.

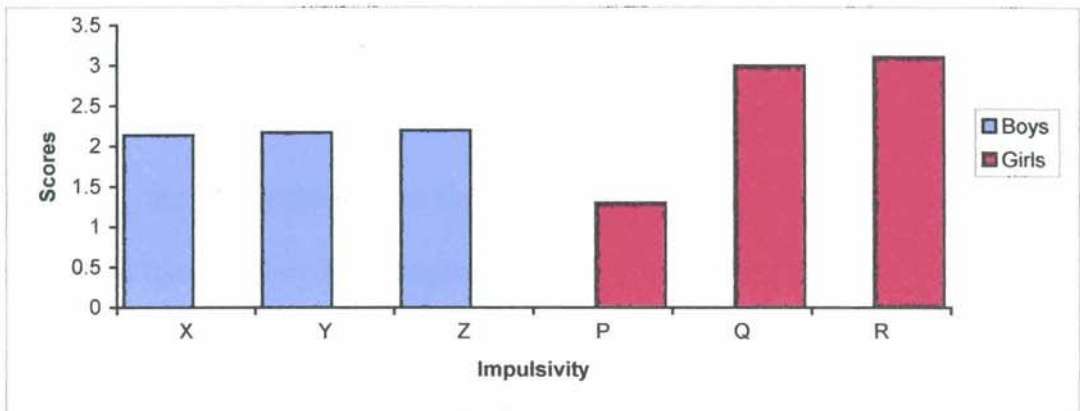


Figure 6

A comparison of impulsivity shown in Figure 6 reveals that girls show more inter individual differences as compared to boys.

The next step was to make an age wise analysis of the two age groups ie., 9-10 years and 11-12 years. Six subjects (3 boys and 3 girls) from each age group was selected randomly from these groups and their scores in reading and writing were compared graphically as represented in Figures 7 and 8.



Figure 7 – Reading

A comparison of reading scores of boys and girls for the two age groups shown in Figure 7 suggests that in younger age boys show more homogeneity while girls become more homogeneous as they become older. This may be attributed to the reason that boys catch up learning language at a later stage that contribute to more individual difference while girls start early reflecting the difference more during the 10-11 year period and once when they have learned they became comparable.

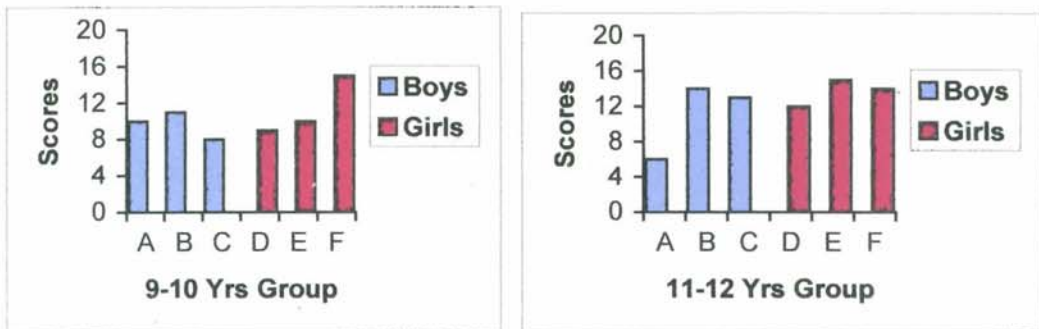


Figure 8 – Writing

The graphs on writing for the two age groups in Figure 8 show that one girl in the 9-10 year group and one boy in the 11-12 group differ from others considerably. This could be because generally in schools more attention is paid to the written word than spoken word or to the reading and

hence the error in writing gets marginalized or are levelled among most of the children except for those with very severe problems.

Thus from the graphical representations in figures from 3-8 it is evident that each child is distinct in their cognitive and psychological functions irrespective of their age, gender, acquisition of language or even IQ. And a similar trend was reported in the study of Howes, Bigler and Lawson (2000). They found (homogeneous clusters of normal and LD children in memory) qualitatively distinct subtypes of readers with dyslexia.

Therefore the results of the present study strengthens the need for individual evaluation of each LD child for the language learning and other relevant psychological functions for designing and implementing the most suitable modes of interventions at the earliest so that each LD child could be brought to the mainstream at the earliest.

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Chapter V

SUMMARY AND CONCLUSIONS

- ❖ *Objectives*
- ❖ *Hypotheses*
- ❖ *Method*
- ❖ *Tools*
- ❖ *Administration*
- ❖ *Analysis*
- ❖ *Results and Tenability of the Hypotheses*
- ❖ *Conclusion*
- ❖ *Limitation of the Study*
- ❖ *Suggestion for Further Research*
- ❖ *Scope of the Study*

SUMMARY AND CONCLUSION

A major topic for discussion today is the extent to which a learning disability is a reality independent of social context versus a socially constructed phenomenon that depends, for its existence, on the demands, perception, values and judgements of persons in position of authority over students. One view is that students with learning disability are different from most people in ways that are relatively constant across social contexts. This idea is associated with assumption that the primary causes of learning disabilities are biological-that is neurological. Another perspective is that learning disabilities are mostly created by social demands and expectations; that is, learning disabilities are phenomena constructed by social contexts.

Today people from nearly every walk of life recognize the term learning disability, which is often used generically by the general public to indicate that someone's behaviour is highly unusual or inadequate for the circumstances.

The assessment and identification of children with LD has been another major area of debate and disagreement, given the lack of equivocal acceptance of a definition/description of LD. For this reason the present study is intended to focus on the psycho-neurological aspects of learning disability taking the specific variables; Attention, Memory, Language and Impulsivity.

OBJECTIVES

The following are the objectives framed for the present investigation,

1. To develop a test for identifying learning disabled suitable for the native population.
2. Identify the significant neurological and psychological correlates of learning disability.
3. To compare the LD and Non LD children with regards to language function, attention, memory and impulsivity.
4. Improve the present system of helping the learning disabled emphasizing individualized attention.

Based on the above said objectives and the available literature, following hypotheses are formed.

HYPOTHESES

1. Learning disabled children differ from normal children in language ability.
2. Learning disabled children are deficient in attention compared to normal children.
3. Learning disabled children differ from normal children in memory.
4. Learning disabled children differ from normal children in impulsivity.
5. Attention as a neuropsychological function is related to language dysfunction.

6. Memory as a neuropsychological function is related to language dysfunction.
7. The neuropsychological functions- attention and memory are related.
8. Impulsivity is related to attention in Learning Disabled children.
9. Impulsivity is related to memory in Learning Disabled children
10. Impulsivity is related to language learning in Learning Disabled children.
11. Learning disability is related to certain socio-demographic factors.
12. Neuropsychological functions are related to certain socio-demographic factors.
13. Learning Disabled children differ among themselves in specific deficiencies.

METHOD

The study includes subjects selected from the three major sub regions of Kerala; Travancore, Cochin and Malabar. 40 subjects are learning disabled and another 40 represents the non learning disabled group. The subjects were selected following certain inclusion and exclusion criteria.

TOOLS

The following are the tools used for this investigation.

1. A personal data sheet is used to collect personal and family background of the subject.

2. Draw-A-Man-Test (Pramila Phatak-revised, 1987) is used to assess the intelligence.
3. Digit Span (WISC-R, 1974) of Wechsler is used to assess the attentional ability of the subject.
4. Matching Familiar Figure Test (MMF) by Kagan and co-worker (Medinnus, 1976) is used to assess the impulsivity.
5. For measuring memory, a test prepared by the researcher is used.
6. For assessing language ability (reading and writing) of the subject, a test prepared by the researcher is used.

ADMINISTRATION

All the tests used for this investigation is individually administered to the subjects after making proper rapport. The responses were recorded and scored strictly according to the authors instructions.

ANALYSIS

Inorder to quantify the collected data certain statistical analyses were carried out. For verifying the 1st hypothesis to 4th hypothesis, 't' test was used. From hypothesis 5 to 10 Pearson's correlation co-efficient is used. To verify 11th and 12th hypothesis 't' test was again used. The last hypothesis is verified graphically.

RESULTS AND TENABILITY OF THE HYPOTHESES

1. The first hypothesis of the study was that there is significant difference in language ability of learning disabled and normal children. The mean difference being significant the first hypothesis is

accepted. The LD children are found to be deficient in reading and writing compared to normal children.

2. The second hypothesis is that learning disabled children are deficient in attention compared to normal children. The result shows that LD children are deficient in attention. So the hypothesis is accepted.
3. The third hypothesis is that LD children differ from normal children in memory. The findings support the hypothesis.
4. The fourth hypothesis is that learning disabled children differ from non learning disabled on impulsivity. The analysis reveal that LD children are more impulsive than their Non LD peers. So the hypothesis is accepted.
5. The fifth hypothesis of the investigation is that there is a relationship between attention and language dysfunction. The results show a significant correlation among the variables in both LD and Non LD group. So the hypothesis is accepted.
6. The sixth hypothesis is that memory as a neuropsychological function is related to language dysfunction. The analysis shows a significant correlation among the variables in LD and Non LD children accepting the hypothesis.
7. The seventh hypothesis of the study is that attention is related to memory in LD children. The result shows a positive correlation among the variables in both, the LD and Non LD groups. So the hypothesis is accepted.

8. The eighth hypothesis is to study the relationship between impulsivity and attention in LD children. The result shows that, in the LD group the relation is significantly positive whereas in the Non LD group, the relation is positive but not significant. The hypothesis is accepted.
9. The ninth hypothesis is to study the relationship between impulsivity and memory in LD children. Here in the LD group the relationship is negative whereas in the Non LD group the relation is positive. So the hypothesis is accepted.
10. The tenth hypothesis is to study the relationship between impulsivity and language variables. The result shows that in both groups the variables are found to be negatively correlated. So the hypothesis stands accepted.
11. The eleventh hypothesis was that learning disability is related to certain socio demographic factors. The findings show no significant relationship between the variables. So the hypothesis is rejected.
12. The twelfth hypothesis is that neuropsychological functions are related to certain socio demographic factors. The findings do not support the hypothesis and hence rejected.
13. The last hypothesis that LD children differ in specific deficiencies is accepted as the graphic analysis indicate heterogeneity of scores.

CONCLUSIONS

- 1) The tests that were constructed in the study for detecting children with Learning Disability among the native population are found to be valid.

- 2) The results of the study clearly indicate the relationship between psychological and neurological functions and learning disability.
- 3) Learning Disabled children are deficient in attention and memory.
- 4) Learning Disabled children are overactive or more impulsive than Non Learning Disabled children.
- 5) Neuropsychological functions - Attention, Memory are related to language disability.
- 6) Impulsivity as an indicator of activity is related to learning disability.
- 7) Based on the above findings the results suggest individualized psychologically oriented helping for the LD children along with educational training.

LIMITATION OF THE STUDY

- ❖ Sample was not selected to include the different socio-demographic characteristics in the initial state of sampling.
- ❖ Sample does not include children with different types of LD's as a separate group.

SUGGESTION FOR FURTHER RESEARCH

- ❖ The study on a large sample selected by stratified sampling techniques including children from different geographical areas and socio-demographic characteristics.

SCOPE OF THE STUDY

In spite of having sufficient intelligence children perform poorly in their academic pursuits. And these children are facing difficulties in one or many areas of their studies, such as writing, reading, arithmetic, spelling, etc. Clinically, they are known by many labels like, dyslexics, slow learners, scholastically backward, dysgraphia, learning disabled and minimally brain damaged.

In India the LD children are getting help from different professionals such as clinical psychologists, psychiatrists, neurologists, teachers, etc. However, generally most of the children are helped only as part of the educational training. New teaching strategies for training learning disabled groups are developed and applied. Studies have shown that LD children differ among themselves with respect to ability and performance manifested in different neuropsychological capacities, which tend to reduce the efficiency of the teaching strategies used in a group set up.

The result of the present study clearly indicates the need for assessing each LD child separately identifying the deficiency in specific psychological function underlying the learning process. The study suggests the need for planning and extending individual based interventions to improve the learning ability of each LD child.

According to researchers in the field of learning disability, 10% of the school going population is observed as learning disabled. Studies have also reported the possibility of their improvement provided the problem is

detected as early as possible during the school years and appropriate intervention is extended.

In view of the findings of the present study

- (i) A system for compulsory earlier assessment of children with relatively poor academic skills can be introduced at the primary schooling stage.
- (ii) Detailed psychological assessment for the detected LD children can be done by the school psychologist or may be referred for extensive psychological help.
- (iii) Due to the inter individual differences among the learning disabled, individual psychological intervention could be extended, which would be more effective in improving the learning skills of these children and they could be brought to the mainstream at the earliest.
- (iv) Rectification of learning difficulties at a very early stage will be complimentary to the development of overall personal skills.

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APPENDICES

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**PERSONAL PERFORMA FOR
LEARNING ABLED /LEARNING DISABLED**

PERSONAL DETAILS

Name : Address:
Age :
Sex :
Education (Std) : Acad. performance :
Oral :
Written :
Medium : Malayalam/English
Birth order :
History of any disease : Yes/No. If yes, name of the disease :

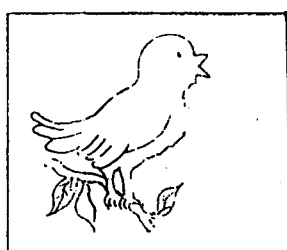
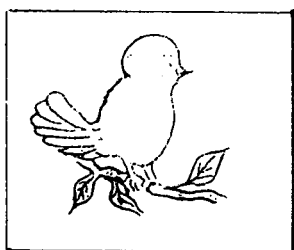
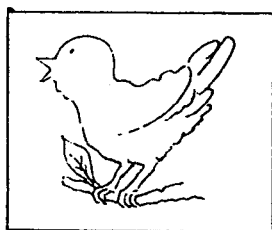
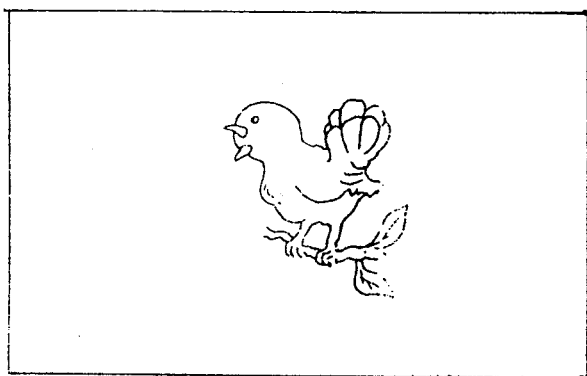
FAMILY HISTORY

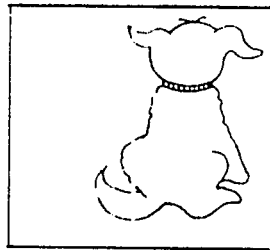
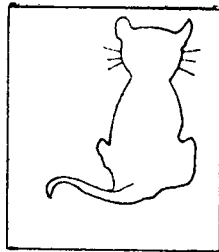
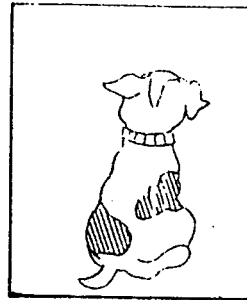
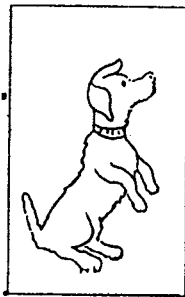
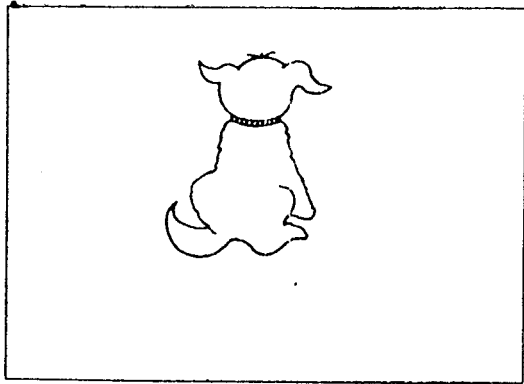
Type of family : Joint/Nuclear/Single parent/Orphan
Name of mother :
Age :
Education :
Employment :
Name of father :
Age :
Education :
Employment :
Religion : Hindu/Muslim/Christian/Others
Socio economic status : Low/Medium/High
Family history of MR : Yes/No
Family history of epilepsy : Yes/No
Any diseases/infection of mother in prenatal period:
Treatment/drugs taken :
Disease :
Emotional shock :
Marital problems among spouses : Parents-separated/divorced/widowed
Parental history of drug addiction/ alcoholism : Yes/No
Age at which the problem was detected :

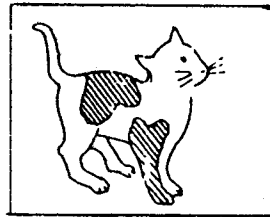
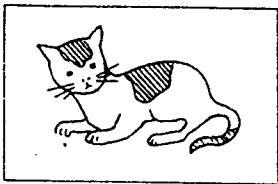
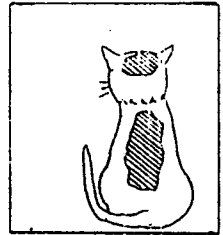
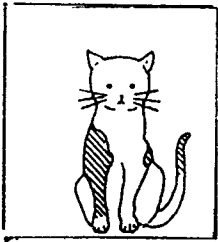
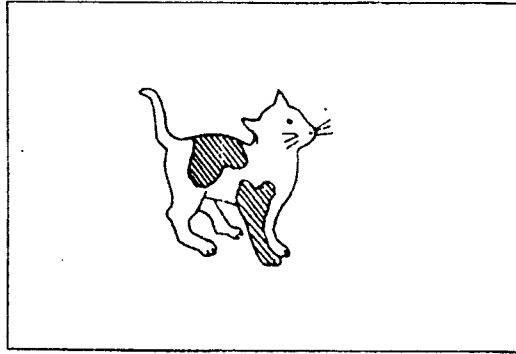
Treatment taken-

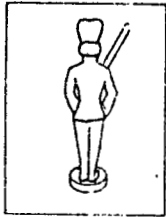
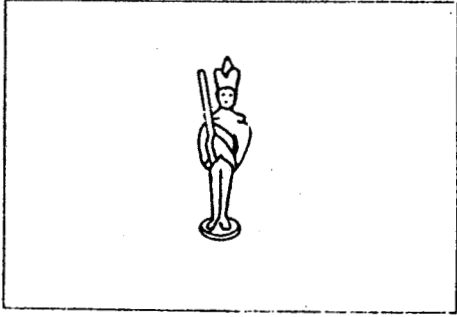
Duration :
Nature :

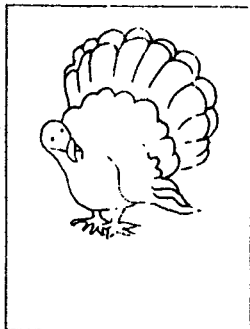
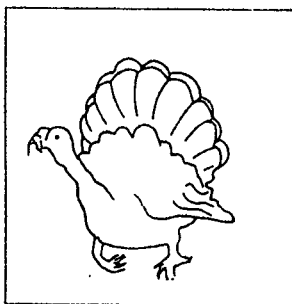
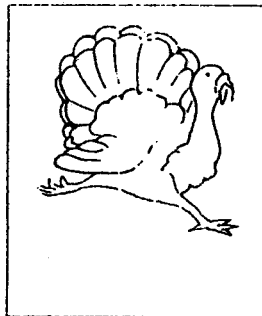
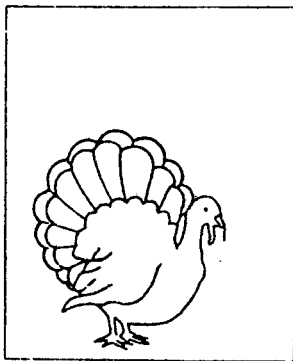
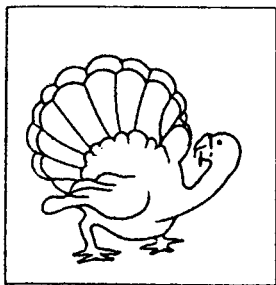
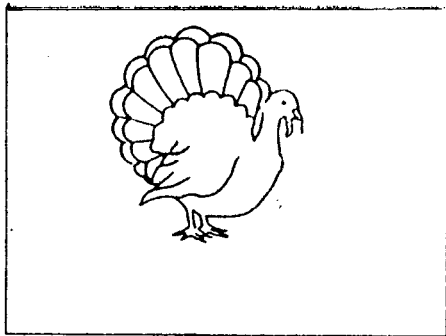
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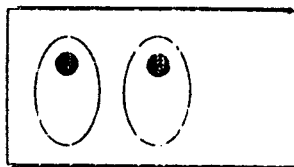
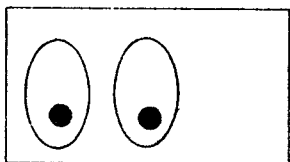
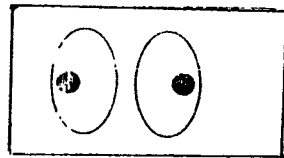
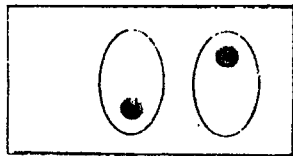
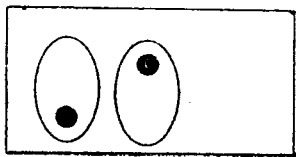
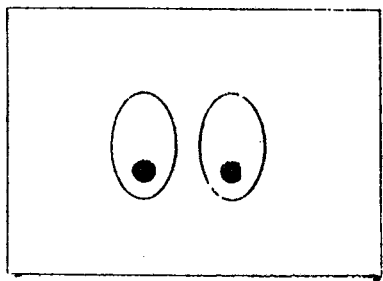


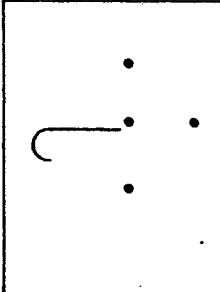
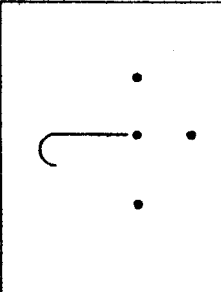
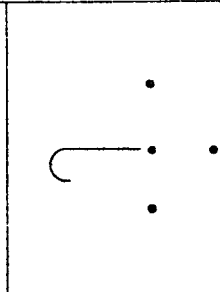
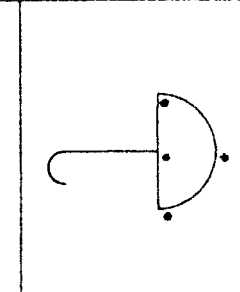
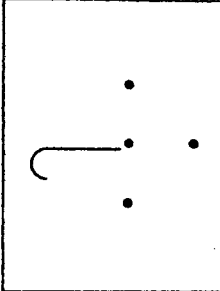
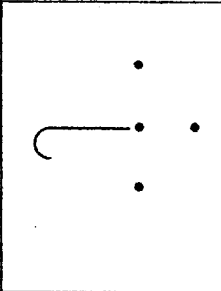
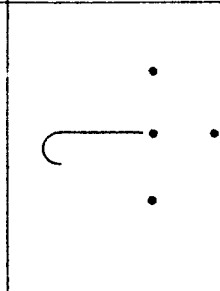
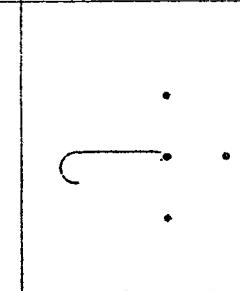
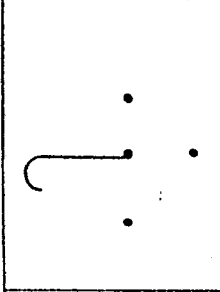
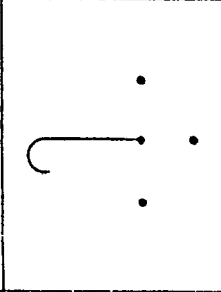
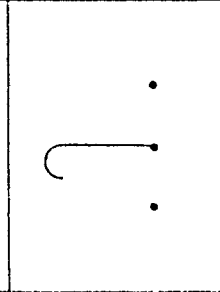
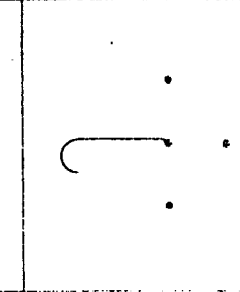
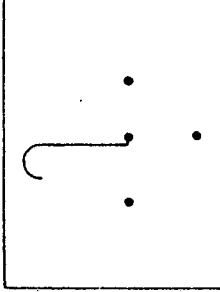
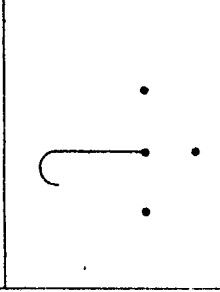
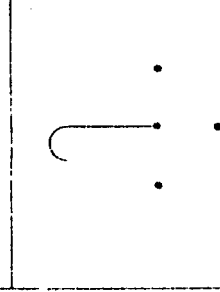
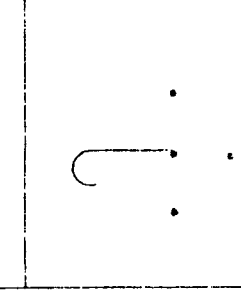


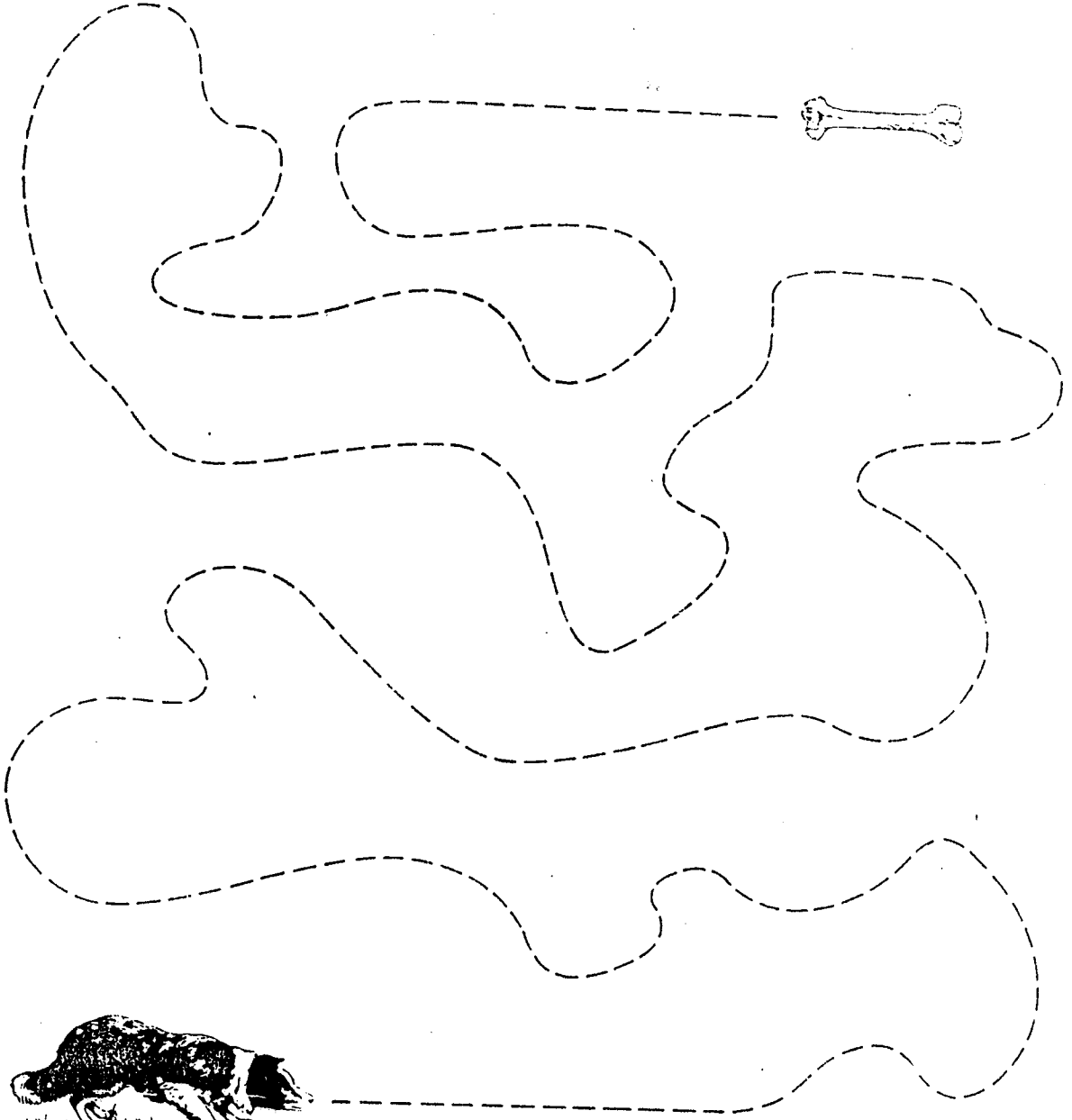








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