CHAPTER II
METHODOLOGY I

2.0 Phase I

This phase consisted of identifying the tools existing tools, check their utility, adapt or construct a new measure.

2.1 Development of the tool

2.1.1 Assessment and Review of the Existing Measures to Identify Learning Difficulty

After identifying existing tools to check their utility in the Indian context, the adaptation or construction of the diagnostic tool is undertaken. Some of the tools looked at before construction of our tool in the Indian context:

2.1.1.1 The Stanford-Binet Intelligence Scale Fourth Edition (SB: FE)

It is a standardized test that measures intelligence and cognitive abilities in children and adults, from age two through mature adulthood.

Purpose

The Stanford-Binet Intelligence Scale is originally developed to help place children in appropriate educational settings. It can help determine the level of intellectual and cognitive functioning in preschoolers, children, adolescents and adults, and assist in the diagnosis of a learning difficulty, developmental delay, mental retardation, or giftedness. It is used to provide educational planning and placement, neuropsychological assessment, and research. The Stanford-Binet Intelligence Scale is generally administered in a school or clinical setting.

The Stanford-Binet Intelligence Scale is considered to be one of the best and most widely used intelligence tests available. It is especially useful in providing intellectual assessment in young children, adolescents, and young adults. The test has been criticized for

not being comparable for all age ranges. This is because different age ranges are administered different subtests. Additionally, for very young preschoolers, it is not uncommon to receive a score of zero due to test difficulty or the child's unwillingness to cooperate. Consequently, it is difficult to discriminate abilities in this age group among the lower scorers.

Administration and interpretation of results of the Stanford-Binet Intelligence Scale requires a competent examiner who is trained in psychology and individual intellectual assessment, preferably a psychologist.

Description

The Stanford-Binet Intelligence Scale has a rich history. It is a descendant of the Binet-Simon scale which is developed in 1905 and became the first intelligence test. The Stanford-Binet Intelligence Scale is developed in 1916 and is revised in 1937, 1960, and 1986. The present edition is published in 1986. The Stanford Binet Intelligence Scale is currently being revised and the Fifth Edition is expected to be available in the spring of 2003.

Administration of the Stanford-Binet Intelligence Scale typically takes between 45 to 90 minutes, but can take as long as two hours, 30 minutes. The older the child - more subtests administered, the longer the test generally takes to complete. The Stanford-Binet Intelligence Scale is comprised of four cognitive area scores which together determine the composite score and factor scores. These area scores include: Verbal Reasoning, Abstract/Visual Reasoning, Quantitative Reasoning, and Short-Term Memory. The composite score is considered to be what the authors call the best estimate of "g" or "general reasoning ability" and is the sum of all of subtest scores. General reasoning ability or "g" is considered to represent a person's ability to solve novel problems. The composite score is a global estimate of a person's intellectual functioning.

The test consists of 15 subtests, which are grouped into the four area scores. Not all subtests are administered to each age group; but six subtests are administered to all age levels. These subtests are: Vocabulary, Comprehension, Pattern Analysis, Quantitative, Bead Memory, and Memory for Sentences. The number of tests administered and general test difficulty is adjusted based on the test taker's age and performance on the sub-test that measures word knowledge. The subtest measuring word knowledge is given to all test takers and is the first subtest administered.

The following is a review of the specific cognitive abilities that the four area scores measure. The Verbal Reasoning area score measures verbal knowledge and understanding

obtained from the school and home learning environment and reflects the ability to apply verbal skills to new situations. Examples of subtests comprising this factor measure skills which include: word knowledge, social judgment and awareness, ability to isolate the inappropriate feature in visual material and social intelligence, and the ability to differentiate essential from non-essential detail.

The Abstract/Visual Reasoning area score examines the ability to interpret and perform mathematic operations, the ability to visualize patterns, visual/motor skills, and problem-solving skills through the use of reasoning. An example of a subtest which determines the Abstract/Visual Reasoning score is a timed test that involves tasks such as completing a basic puzzle and replicating black and white cube designs.

The Quantitative Reasoning area score measures: numerical reasoning, concentration, and knowledge and application of numerical concepts. The Quantitative Reasoning area is combined with the Abstract/Visual Reasoning area score to create an Abstract/Visual Reasoning Factor Score.

The Short-Term Memory score measures concentration skills, short-term memory, and sequencing skills. Subtests comprising this area score measure visual short-term memory and auditory short term memory involving both sentences and number sequences. In one subtest that measures visual short-term memory, the participant is presented with pictures of a bead design, and asked to replicate it from memory.

Results

The Stanford-Binet Intelligence Scale is a standardized test, which means that a large sample of children and adults were administered the exam as a means of developing test norms. The population in the sample is representative of the population of the United States based on age, gender, race or ethnic group, geographic region, community size, parental education, educational placement (normal versus special classes) etc. From this sample, norms were established. Norms are the performance of a comparison group of subjects—that nature of the group should be specified, and this usually constitutes a normal group so that the performance of the tested individual can be compared to this group and thus evaluated.

The numbers of correct responses on the given subtests are converted to a SAS score or Standard Age Score which is based on the chronological age of the test subject. This score is similar to an I.Q. score. Based on these norms, the Area Scores and Test Composite on the Stanford-Binet Intelligence Scale each have a mean or average score of 100 and a standard

deviation of 16. For this test, as with most measures of intelligence, a score of 100 is in the normal or average range. The standard deviation indicates how above or below the norm a child's score is. For example, a score of 84 is one standard deviation below the norm score of 100. Based on the number of correct responses on a given subtest, an age-equivalent is available to help interpret the person's level of functioning.

Test scores provide an estimate of the level at which a child is functioning based on a combination of many different subtests or measures of skills. A trained psychologist is needed to evaluate and interpret the results, determine strengths and weaknesses, and make overall recommendations based on the findings and observed behavioral observations.

2.1.1.2 WISC (Indian adaptation)

Malin's Intelligence Scale for Indian Children, Indian adaptation of WISC [MISIC] (1955) Includes both verbal and performance scales. Age - 6 to 15.11 years. Administration time is 2-2½ hours. The Indian adaptation covers only 10 years from 6 to 15.11.

Verbal - 5

Information; Arithmetic; Similarity; Vocabulary; Digit Span.

Performance -7

Picture completion; Block design; Object assembly; Coding; Mazes.

The Indian adaptation omits the picture arrangement of the performance scale as it proved to be culturally biased both as to content as well to form. These sub tests may be administered in any order convenient for rapport. Only 10 tests - 5 from each group -are required for complete for complete scoring. In case more or fewer tests are taken appropriate score pro rating is called for. For safe validity however not less than four sub tests of each group should be taken. The verbal group has an alternate in Digit Span test in case of spoilage or when the regional vernacular test drops the vocabulary test in the upper age levels. The alternate should not be taken just to improve a score.

POINT SCALE The original WISC as well as its Indian adaptation works on the point scale and all items of a given type are grouped together and arranged in increasing order of difficulty. Thus, for example, all information items are in the subtest for "information"

The points or raw scores of each test are totaled and then converted on the principle of the "Deviation IQ" into derived scores. In the original WISC these derived scores and standard scores called "scaled scores" which in turn must be converted into IQ's by means of table each for Verbal, Performance and Total Full Scale IQ's.

The adapted MISC for reasons to be explained later avoids the use of "Scaled Score" and by means of Table converts the raw scores directly into "Test Quotients" (TQ) which are actually IQ's. The Subtest TQ's are then added and group averaged (Verbal, Performance) and the Total or Full Scale of both groups is similarly obtained without the use of a Table.

Abandoning Mental Age Norms

Wechsler made much ado over his abandonment of the Mental Age norms in favor of his "Scaled Score" deviation IQ technique. True, a Global M.A. suffers the same disadvantages of a Global IQ but Wechsler seems not to realize that his criticism leveled against the M.A. can be equally turned against the IQ's he uses in his tests. He fails to distinguish between a Global M.A. and a specific function or factorial M.A. This latter M.A. is very useful for education and guidance purposes. Moreover with all his criticism of the M.A. one wonders why he substituted another and even at that a meaningless "Scaled Score" intermediary between his raw scores and the final IQ's.

Vocabulary Test Rationale

Vocabulary tests in intelligence scales perform a dual role – one as a test of "Verbal Comprehension" and another as a test of "Verbal Information". This dual role however is never given a specific discriminating analysis. Most of the time as Wechsler explains:

"Only knowledge of the *number of words* and their minimum content" is expected from this test. Correlation table moreover show that in the upper age levels (10+) there is a very close correlation between Information and vocabulary tests and the memory factor of the digit span test, but not so on the lower age levels (5-10)

From various other data it is clear that the Verbal Comprehension factor of the Vocabulary Test operate on the lower age levels and the verbal Information factor on the upper age levels. The question then poses itself whether a vocabulary test is actually needed at the upper age levels if Information test sufficiently assesses that factor.

For the obvious reasons then the Indian Adaptation has dropped the Vocabulary test for the ages 10 to 16 in the regional vernaculars and offers the digit span alternate to complete the 5th test required for the scoring. It should be noted however when administrating the Vocabulary test in the regional languages that the scoring criteria for the lower age levels are as follows:

1. Definitions in "terms of use" or functional levels, e.g. knife cuts; are scored 1 point.
2. Definitions in "terms of superior to use"- or concrete and descriptive levels, e.g. knife has sharp edge; are scored 2 points.

Standardization Statistics

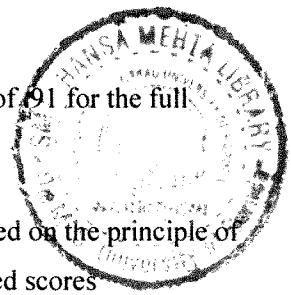
Sample size- for the Indian adaptation over 1200 children were given full individual test during the past 6 years and over 3000 were sampled in subtest trail runs. An average of about 90 samples is used for each age level including boys and girls in a 20- 30 ratio. Age norms were based on a twelve month interval 4 months before and seven months after a birthday. Closer approximations are not possible due to the unreliability of Indian birth data. Comparisons with WISC birth data were made on the middle third of the WISC tables e.g. 6yrs.4months through 6yrs. 7 months.

Regional Norms-Fortunately for English speaking children regional differences are at a minimum since the English medium schools follow fairly uniform standards in textbooks and literature content throughout the length and breadth of India. The English version samplings were taken in Nagpur, Mumbai, Shimla, Mangalore and New Delhi. The samples from the Hill boarding schools covered generally the whole northern portion of India.

For the Marathi and Hindi version samples were drawn from Nagpur alone which due to its centrally located position provides an ideal meeting place for the two above mentioned vernaculars.

Coefficients of Reliability and Validity

The original WISC reliability established subtest wise by the Split-half method with appropriate correction for full length of test by the Spearman- Brown formula and yielded a total coefficient of 91.The Indian adaptation established its reliability with the Test-Retest



method and yielded a Pearson's product moment correlation coefficient of .91 for the full scale IQ results.

The points or raw scores of each test are totaled and then converted on the principle of the "Deviation I.Q" in to derive scores. In the original WISC these derived scores are standard scores called "scaled scores." which in turn must be converted into I.O'S by means of a table each for verbal performance and total full scale I.Q's.

2.1.1.3 Comprehensive Test of Non Verbal Intelligence (C-TONI-2)

(Hammill, Pearson & Wiederholt, 1997)

It is a completely nonverbal assessment that's ideal for children and adults whose performance on traditional intelligence tests might be adversely affected by language or motor impairments. The CTONI-2 is particularly appropriate for use with people who are bilingual, non-English speaking, socially or economically disadvantaged, deaf, language disordered, or physically limited. The test requires no oral responses, no reading or writing, and no object manipulation. All the examinee has to do is point to his or her selected response. Individually administered in 60 minutes, the CTONI-2 measures analogical reasoning, categorical classification, and sequential reasoning. Easy to administer and free of gender and racial bias, the CTONI-2 allows one to assess the reasoning ability of individuals who would otherwise be difficult to test. Its six subtests assess these abilities in two ways--first using pictures of familiar objects and then using geometric designs:

- Pictorial Analogies
- Geometric Analogies
- Pictorial Categories
- Geometric Categories
- Pictorial Sequences
- Geometric Sequences

Pictorial analogies and geometric analogies (McCallum, 2003)

The examiner points to the picture on top of the page and says "this is to (points to the second picture) this (pause) as this (point to the third picture) is to which one of these (run your finger over the pictures at the bottom of the page). Point to your answer"

Pictorial categories and geometrical categories (McCallum, 2003)

In these subtests the examiner points to each of the two pictures at the top of the page and says- these two are alike in some way. Which one of these (run your finger over the alternatives at the bottom of the page) is most like these two and should go in the empty box (point back to the empty box between the top two pictures). Point your answer

Pictorial sequence and geometric sequence (McCallum, 2003)

This measures the ability to select from a set of geometric designs the one that sequence of action shown in three designs. The examiner points to each of the picture at the top of the page and says, "Which one of these (run your finger over the boxes at the bottom of the page) goes in this box (point to the empty box at the top of the page)?"

Examinee has to just point to the answers, no manipulation of objects, reading or writing or oral responses are required to take the test.

The three principles on which the test is based

1) The tests instructions were given orally or in pantomime, depending on which the examiner considers most appropriate.
2) The test should measure three kinds of intellectual abilities: analogical thinking, categorical formulation and sequential reasoning
3) The abilities should be measured in both pictured object and geometric design contexts.

Six subsets were used

- Pictorial Analogies
- Geometric Analogies
- Pictorial Categories
- Geometric Categories
- Pictorial Sequences
- Geometric Sequences

The standard score from the subsets are combined to form three composite quotients: Pictorial Nonverbal Intelligence Quotient, Geometric Nonverbal Intelligence Quotient and an overall Nonverbal Intelligence Quotient.

The CTONI is normed on a sample of 2,901 persons over a period of 2 years in 1995 (N=2,129) and 1996(N=772). The sample is stratified by age.

Test Reliability: For this the following were tested

The study of test's reliability is done by using Cronbach coefficient alpha. All but two of the coefficients for the subtests round to or exceed 0.80; coefficients for the composites are all greater than 0.90.The alphas for the 10 selected subgroup s within the school aged sample were examined. The subgroups studied were Caucasoids, African Americans, American Indians, speakers of English as a second language (ESL, mostly Hispanics),students with diagnosed learning disabilities, persons who are deaf or hard of hearing, Panamanians, males, females and Asians. Again, all of the coefficients for the subtests round to or exceed 0.80; composite scores are all greater than0.90.

Time Sampling

The stability of the test is studied using test-retest method and the coefficient is found to be greater than 0.80, with a single exception, those for the composites rounded to or exceeded 0.90.

Scorer differences

This is the amount of test error due to examiner variability in scoring. The coefficient is found to be greater than or equal to 0.95, those for the composites rounded to or exceeded 0.98.

Standard Score of each CTONI composite is constructed to have a mean of 100 and a standard deviation of 15.

The subtests and the specific abilities that they measure:

Pictorial analogies – Measures the ability to recognize the relationship between two objects to each other and to find the same relationship between two different objects.

Geometric analogies – Measure the ability to recognize the relationship between two geometric designs to each other and to find the same relationship between two different geometric designs.

Pictorial categories– Measures the ability to select from a set of different pictures the one that is the most similar to the two other related objects.

Geometric categories – Measures the ability to select from a set of different geometric designs the one that is the most similar to the two other related geometric designs.
Pictorial sequence– Measures the ability to select from a set of pictures the one that completes a sequence of actions shown in three pictures.
Geometric sequences– Measures the ability to select from a set of geometric designs the one that completes a sequence of actions shown in three designs.

The pictorial Nonverbal Intelligence Quotient is an index of problem solving and reasoning for which representational pictures of familiar objects are used in the test formats The Geometric Nonverbal Intelligence Quotient is an index of problem solving and reasoning for which unfamiliar designs are used as a stimuli. In the vast majority of cases, these two quotients will be approximately equal.

2.1.1.4 Comprehensive Test of Phonological Processing (C-TOPP)

Comprehensive Test of Phonological Processing (CTOPP- Wagner, Torgensen & Rashotte, 1999) is a measure of phonological awareness, phonological memory, and naming. It helps in identifying children in the age group of 5-24 years whose phonological abilities are below par with their age level peers. Because of the age span it has two test levels age 5-6 has seven subtests and one supplemental test and 7-24 has six subtests and eight supplemental tests. The supplemental tests help in assessing the phonological strengths and weaknesses. The subtests included rapid letter naming, blending words, rapid object naming, sound matching, blending non words, memory for digits, phoneme reversal, non word repetition, segmenting words, rapid color naming, segmenting non words, rapid digit naming. Phonological coding consists of the analysis and synthesis of phonemes (the smallest unit of recognized sounds). Beginning readers who have deficits in phonological coding seem to have difficulty naming letters of the alphabet, identifying sounds for alphabet letters, segmenting words into phonemes and syllables, and applying knowledge of letter-sound correspondence to decode words (Vellutino, et al.1996).
The following tests were used (Reading Assessment Database: Search Results - SEDL Reading Resources).

Elision - The student must repeat a word with one phoneme omitted (when the phoneme is omitted, the remaining word is always a real word).

Blending Words --Words are spoken aloud to the student with a clear pause between each phoneme, and the student must correctly identify each word.

Initial Sound Matching - The student must match two words that begin with the same sound (phoneme).

Final Sound Matching - The student must match two words that end with the same sound (phoneme).

Nonword Repetition - Non-words are read aloud to the student, and the student must repeat them verbatim. Some of the non-words are very long, so this is a test of phonological memory span.

Rapid Color Naming - The student must identify colors by name as quickly as possible (for ages 7 and older only).

Rapid Digit Naming - The student must identify numerals from a list as quickly as possible (for ages 7 and older only).

Rapid Letter Naming - The student must identify letters of the alphabet as quickly as possible (for ages 7 and older only).

Rapid Object Naming - The student must identify objects (from pictures) as quickly as possible.

Blending Nonwords - Nonsense words are spoken aloud to the student with a clear pause between each phoneme, and the student must correctly identify each nonsense word.

Phoneme Reversal - Real words are read backwards to the student. The student must identify the word (for ages 7 and older only).

Segmenting Words - A word is spoken aloud to the student, and the student repeats the word, placing a clear pause between each phoneme (for ages 7 and older only).

Segmenting Nonwords - A nonsense word is spoken aloud to the student, and the student repeats the nonsense word, placing a clear pause between each phoneme (for ages 7 and older only).

Memory for Digits - Random digits are read aloud to the student, and the student must repeat them in the same order.

Scores from subtests can be combined to derive three composite scores: the Phonological Awareness Quotient, the Phonological Memory Quotient, and the Rapid Naming Quotient. Scores can be converted into percentiles, standard scores, and age- and grade-equivalent scores. Normed on a representative nationwide sample of more than 1,600 students. Reliability coefficients were in the .70 to .90 range, and validity measures are available from the publisher. This is a collection of assessments designed to assess verbal memory, rapid automatized naming (RAN), and phonological processing (PP). RAN and PP have been shown to make separate contributions to reading success, and are the two components of the double-deficit hypothesis.

2.1.1.5 Test of Phonological Awareness (TOPAS)

Test of Phonological Awareness Skills (Newcomer & Barenbaum, 2003) The TOPAS is helpful in identifying children, ages 5 through 10, who have problems in phonological awareness. It has four subtests (Rhyming, Incomplete Words, Sound Sequencing, and Sound Deletion) that measure three areas of phonological awareness: sound comparison, phoneme blending, and phoneme segmentation (Newcomer & Barenbaum, 2003)

Rhyming -- The student must complete a sentence with a word that is both semantically appropriate and which rhymes with a previous target word in the sentence (e.g. "I hurt my KNEE falling out of a _____.").

Incomplete Words -- The teacher says a word aloud, deleting a certain phoneme. The student must correctly identify the missing phoneme.

Sound Sequencing -- A set of colored blocks is used in this task. The student is told that each colored block represents a speech sound (phoneme), and the student must represent speech sounds in words by arranging the colored blocks appropriately.

Phoneme Deletion -- The student must repeat a word out loud, and then must say the word with a certain phoneme missing (e.g. say "cat" without the /k/).The TOPAS is untimed, requires approximately 15-30 minutes to administer, and is administered individually. It is a well standardized norm – referenced instrument.

The test is normed on a sample size of 926 children and the sample is matched to those of US according to the updated 2001 census. On the basis of age, gender, race and ethnic group and

geographical relationship the normative data is stratified.

Percentile ranks, age equivalents, standard scores, and a composite score are provided. These performance indices facilitate test interpretation, including conducting discrepancy analyses between TOPAS subtests.

The reliability coefficients for the test are high, ranging from .87 to .97. Average reliability coefficients range from .91 to .96 and all averaged coefficients for the composites exceed .90. Test/retest studies show that the TOPAS is stable over time.

A variety of validity studies attest to construct-identification, content-description, and criterion-predictive validity. The test's relationship to the Comprehensive Test of Phonological Processing, Diagnostic Achievement Battery-Third Edition, Lindamood Auditory Conceptualization Test-Second Edition, Iowa Test of Basic Skills, California Achievement Tests-Fifth Edition, Test of Early Reading Ability-Second Edition, Wechsler Preschool Primary Scales of Intelligence-Revised, and the Test of Language Development-Primary: Third Edition has been established. The possibility of gender and ethnic test bias is investigated. Most of the potentially biased items were eliminated from the final version of the test. Two items showing Differential Item Functioning remain, both have negligible effect sizes (Reading Assessment Database: Search Results - SEDL Reading Resources).

2.1.1.6 Lindamood Auditory Conceptualization Test (LAC-3)

This test is individually administered test of auditory- conceptual skill. This means that the ability to judge the order of sounds that appear in a word. The subtests present are phonemic counting, phoneme sequencing, phoneme substitution, phoneme deletion and a judgment task (same or different). For speech sound pattern, the students had to move colored blocks which did not require them to know grapheme- phoneme correspondence (Kenny, 2004). The authors of the test claim that the items in the two categories" parallel the two skills basic to spelling and reading. These are a) conceptualization of isolated phonemic units and b) conceptualization of contrasts within and between syllables in respect to identity, number and sequences of the phonemes involved," (Lindamood & Lindamood,1979). It can be tested in the age group of 5 to 18. This test takes around 20-30 minutes. LAC tests an individual's ability to perceive and conceptualize speech sounds using a visual medium. It also measures an individual's cognitive ability to differentiate and manipulate sounds. The test consists of 28 items divided into 2 categories. In the first category (I-A, 10 items) one

needs to discriminate how many sounds (to a maximum of 3) have been heard and if they are same or different. The child uses colored blocks to represent sounds. In second item (1-B, 12 items) the child is asked track and represent changes that occur within a syllable pattern as one sound is added, /op/to/pap/ substituted , ap/to/op/, omitted,/pap/to/ap, shifted, /ap/ to/ pa or repeated /pap/. Nonsense syllables are used to minimize the influence of familiarity of meaningful words.

Isolated Phoneme Patterns -- A set of colored blocks is used in this task. The student is told that each colored block represents a speech sound (phoneme), and the student must represent speech sounds by moving the appropriate block forward. So, if the teacher says "Show me /f/ /a/," the student would push forward the blocks representing those phonemes.

Tracking Phonemes - Students use the blocks from the Isolated Phoneme Patterns task to construct and modify nonsense words. For example, the teacher might arrange the appropriate blocks and say, "If this says "sasp," move the blocks around to show me "slasp."

Counting Syllables - Colored felt pads are placed in front of the student, and the student is told that each pad represents a syllable. The student is told to point to a pad with each syllable in a nonsense word. So, for example, if the teacher says "bifter," the student should point to two different felt pads to indicate that there are two syllables in the nonsense word "bifter."

Tracking Syllables -- This task is the same as the Tracking Phonemes task, except with syllables. Each colored felt pad is assigned a syllable, and the student must move and manipulate the pads to change one nonsense word into another nonsense word. So for example, the teacher may arrange the pads and say, "If this says "pretive," then show me "intive."

Tracking Syllables and Phonemes -- This is a culmination of the other tasks. The student must appropriately arrange the phoneme blocks on top of the felt pads to represent changes in phonemes and syllables (Reading Assessment Database: Search Results - SEDL Reading Resources).

There are two forms of the test-forms-A and B. Lindamood and Lindamood (1979) stated that the two forms are equivalent and reported a test-retest reliability of .96 between the forms.

2.1.1.7 NIMHANS Index of SLD TEST (NIMHANS -SLD)

The battery is initially developed for the purpose of doctoral thesis (John, 1989) and is routinely used in the NIMHANS centre of child and adolescent mental health unit for confirmation of LD. Initially, the battery consisted of Bender Gestalt test, Minnesota Percepto-Diagnostic test, tests of reading, writing, comprehension, spelling and tests of arithmetic. This battery is administered on 50 children (8-12 yrs) who presented with difficulties in scholastic performance and is compared with a control group of 50 children who were average and above average performers. The results showed that the profile of children who were learning disabled is significantly different as compared to the controls. In the year 1992 Kapur and her colleagues compiled the following tests into a battery and named it as NIMHANS Index for SLD.

The index comprises of the following tests.

a) Attention (number cancellation)
b) Language Test (reading, writing, spelling and comprehension)
c) Arithmetic (Addition, Subtraction, Multiplication, Division and Fractions)
d) Visuo motor skills (The Bender Gestalt test and the developmental test of Visuo-Motor Integration)
e) Memory(Auditory and Visual)

Interpretation:

If a child on any performance on any of the academic skills is more than two standards below the standard he is studying in currently, it indicates presence of a learning difficulty. If the child's performance is just one standard or two below, it indicates a learning difficulty.

Reliability of the NIMHANS Index is 0.53 which is adequate on a sample of forty children diagnosed as having learning difficulty and criterion validity with teacher's and clinician's assessment is found to be satisfactory 0.75 and 0.61 respectively (John, Rozario, Oommen, & Uma, 2002)

Considering all the existing tools and tests it is realized that each test has something to contribute in identifying LD in early preschoolers. Thus, the researcher has adapted,

modified, incorporated and conceptualized parts of these tests in the new measure which is discussed in details in the later section.

2.2 Item Development

After identification of the available tests, their utility in the Indian context was looked at and adaptation and construction of items was done. For the development of items the following tests were looked at considering the age of the children and their age appropriate developmental capacities. We under took the following dimensions in our test.

Broadly they can be divided into:
Phonemic decoding skills (adapted from CTOPP, TOPAS, LAC-3)
Auditory processing skills (adapted from LAC-3, NIMHANS index of SLD)
Visual-spatial motor skills (adapted from NIMHANS index of SLD, CTONI 2, MISIC)
Dimensions Adapted from existing Tests (as they are):

2.2.1 Phonemic decoding skills-

Phonemic awareness (adapted from CTOPP, TOPAS, LAC-3)
Adapted from TOPAS (examples modified)
Sound Sequencing: "Let's match blocks with sounds. Remember what we learned before; the blue block makes the /m/ sound and the red block the /a/ sound. When I say the word, make the blocks match the sounds you hear. Here's the word: *May*."
Adapted from LAC -3
The student is required to discriminate how many sounds s/he heard and whether they were same or different. The student uses colored blocks to represent the sounds. The student is required to determine in addition to number and sameness, the sequential order of the same and different sounds, placing blocks in the order indicated by the sound pattern.
Adapted from CTOPP
Phonological awareness comprised of Elision, Blending Words and Sound Matching for 5 and 6 year-olds and Elision and Blending Words for persons 7 to 24-years-old;

Rhyming word (adapted from CTOPP, TOPAS, LAC-3)

Adapted from TOPAS (example modified) (Margolis & Brannigan, 2009).

Rhyming:" Finish the sentence with a word that rhymes with *hat*: The dog chased the _____."

Adapted from LAC3

The student uses colored blocks to represent the sounds. The student is required to determine in addition to number and sameness, the sequential order of the same and different sounds, placing blocks in the order indicated by the sound pattern.

Blending (adapted from CTOPP, TOPAS, LAC-3)

Adapted from TOPAS (modified examples) (Margolis & Brannigan 2009).

Deletion of Small Sounds (phonemes): "Say the word *horse*. Now say it without the /h/ sound."

Blending or Incomplete Words: "I will say a word with a missing sound. What word am I saying? Bath___oom."

Adapted from LAC-3.

The category II items (12 items) measure most consonant – vowel contrasts possible in simple syllables. The student is required to track and represent changes that occur within a syllable pattern as one sound is added /op / to /pap/ substituted /ap/ to /op/ omitted pap to ap, shifted ap to pa or repeated pap. Nonsense syllables are used to minimize the influence of familiarity of meaningful words.

Adapted from CTOPP

Elision and Blending Words are core subtests for phonological awareness. Elision requires breaking down sounds of a spoken word. Blending Word (in reverse) requires squeezing sounds together to make a word.

Rapid naming objects (CTOPP)

Rapid Naming is the ability to name phonemes, words, word chunks, or objects in a quick and automatic manner. Almost three decades of research with the Rapid Automatized Naming Test (RAN) have demonstrated that the majority of children and adults with reading difficulties have pronounced difficulties when asked to name rapidly the most familiar symbols and stimuli in the language: letters, numbers, colors, and similar objects.

Adapted from CTOPP

Rapid naming comprised of Rapid Color Naming and Rapid Object Naming, and Rapid Digit Naming and Rapid Letter Naming, for younger and older students respectively (Wagner, Torgesen, & Rashotte, 1999).

2.2.2 Auditory processing skill

Auditory discrimination (adapted from LAC-3, NIMHANS index of SLD)

Adapted from NIMHANS INDEX of SLD

The child should not see the examiner's face. This is to avoid guessing from lip reading. "I am going to tell you some words and you tell me if they are same or different." If the child makes a mistake, a second presentation could be made of the same words. If he fails again it can be counted as an error. Five or more uncorrected errors by children age 6 or older suggests difficulty with auditory discrimination and possible problems with learning through phonetic approach.

Adapted from LAC-3

The student is required to discriminate how many sounds s/he heard and whether they were same or different. The student uses colored blocks to represent the sounds.

Auditory memory (adapted from LAC-3, NIMHANS index of SLD)

Adapted from NIMHANS Index of SLD

The examiner says I am going to read some sentences to you. When I finish, just repeat what I said. Eight such sentences are read. One or more errors in each of the eight sentences suggest difficulty with auditory memory in children of 5 years of age.

Adapted from LAC3

The student is required to discriminate how many sounds s/he heard and whether they were same or different. The student uses colored blocks to represent the sounds. In addition to number and sameness, the sequential order of the same and different sounds, placing blocks in the order indicated by the sound pattern.

2.2.3 Visual-spatial motor skills

Visual discrimination test

(Adapted from NIMHANS index of SLD, MISIC, CTONI 2)

Adapted from NIMHANS SLD

The examiner shows five pictures and asks the child to mark the one that looks the same as the first one. Three or more errors suggest difficulty with visual discrimination.

Adapted from CTONI2

Pictorial analogies and geometric analogies (McCallum, 2003)

The examiner points to the picture on top of the page and says "this is to (points to the second picture) this (pause) as this (point to the third picture) is to which one of these (run your finger over the pictures at the bottom of the page). Point to your answer"

Pictorial categories and geometrical categories (McCallum, 2003)

In these subtests the examiner points to each of the two pictures at the top of the page and says- these two are alike in some way. Which one of these (run your finger over the alternatives at the bottom of the page) is most like these two and should go in the empty box (point back to the empty box between the top two pictures). Point your answer

Spatial orientation test (adapted from C-TONI 2)

Adapted from C-TONI 2

Geometric sequence this measures the ability to select from a set of geometric designs the one that sequence of action shown in three designs (McCallum, 2003).The examiner points to each of the picture at the top of the page and says, "Which one of these (run your finger over the boxes at the bottom of the page) goes in this box (point to the empty box at the top of the page)?" Point your answer.

Visual organization (adapted from NIMHANS index of SLD, C-TONI2)

Adapted from NIMHANS SLD

Very similar to visual organization

The examiner shows five pictures and asks the child to mark the one that looks the same as the first one. Three or more errors suggest difficulty with visual discrimination.

Adapted from CTONI2

Pictorial categories and geometrical categories (McCallum, 2003)

In these subtests the examiner points to each of the two pictures at the top of the page and says- these two are alike in some way. Which one of these (run your finger over the alternatives at the bottom of the page) is most like these two and should go in the empty box (point back to the empty box between the top two pictures). Point your answer

Visual motor skills (adapted from NIMHANS index of SLD which is adapted from Brigance, 1977)

Adapted from Brigance AH 1977

(Asked to draw some drawings) record performance (John, Rozario, Oommen & Hirsave, 1992) Adapted from NIMHANS SLD

Visual-motor skills the child is asked to copy design exactly

the way he or she sees it. The child is given three chances, but only the best effort is counted. Difficulty with these designs after age seven indicates a need for a programme of comprehensive visual-motor activities to develop eye hand readiness.

Picture sequence

Adapted from C-TONI 2

Pictorial sequence and geometric sequence (McCallum, 2003)

The examiner points to each of the picture at the top of the page and says, "Which one of these (run your finger over the boxes at the bottom of the page) goes in this box (point to the empty box at the top of the page)?" Point your answer.

Story sequence

Adapted from C-TONI 2

Pictorial sequence and geometric sequence (McCallum, 2003)

The examiner points to each of the picture at the top of the page and says, "Which one of these (run your finger over the boxes at the bottom of the page) goes in this box (point to the empty box at the top of the page)?" Point your answer. This measures the ability to select from a set of different pictures that one that completes a sequence of actions in three pictures (Naglieri & Goldstein, 2009)

Literacy readiness

Adapted from CTONI2

Pictorial categories and geometrical categories (McCallum, 2003)

In these subtests the examiner points to each of the two pictures at the top of the page and says- these two are alike in some way. Which one of these (run your finger over the alternatives at the bottom of the page) is most like these two and should go in the empty box (point back to the empty box between the top two pictures). Point your answer. Here the child has to point to the best made geometric design or the best drawn letter.

2.2.4 Attention (adapted from NIMHANS index SLD)

Adapted from NIMHANS index SLD

The ability of the child to focus his attention on a given job can be tested by using

1. Simple color cancellation test – request the child to cancel out any one color from the color cancellation sheet, within the time limit of one minute.
2. Double color cancellation test- request the child to cancel out any two colors.

2.3 Dimensions of the Newly Developed Tool (including the adaptation and modification)

Tool developed in this research study (Biwas and Kaul) after looking at quite a few tests as mentioned above, this test is formulated keeping in mind the Indian child and their age.

Broadly the testing is done for-

i) Phonemic decoding skills -

Phonemic awareness, rhyming words, blending, and rapid naming objects.

ii) Auditory processing skills -

Auditory discrimination, Auditory memory,

iii) Visual-spatial motor skills -

Visual discrimination test, Spatial orientation test, Visual organization, visuomotor skills, picture sequence, story sequence, literacy readiness.

iv) Attention

These tests were further divided into smaller subtests so that a detailed testing in all these three fields could be done. Attention too is tested for supportive and secondary identification. Total number of tests is 29.The broad categories that the test is divided into were :

2.3.1 Attention and concentration

Principle: Attention is the ability to stay focused on an activity. Maintaining attention helps the child in learning and sequential information processing.

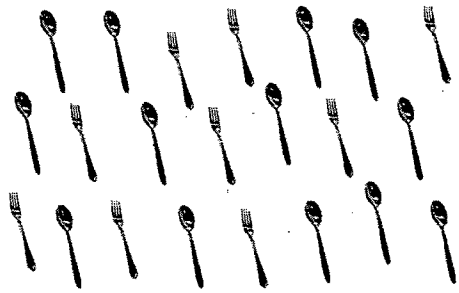


Fig 2.1

Test used- Object cancellation test.

A black and white picture of spoons and forks given to the children. They were asked to cancel only the spoons. Altogether there were 21 spoons and forks. Children were given 1 minute to complete the test (refer manual pg no 1)

2.3.2 Visual discrimination

Principle-Visual discrimination skills are skills that permit a person to accurately compare and contrast visual images. Children who have difficulties in this area may be unable to identify shades of color and texture in pictures, confuse shapes and symbols in math, confuse letters, words and objects that look similar, reverse numbers and letters when writing, have problems with learning sight vocabulary.

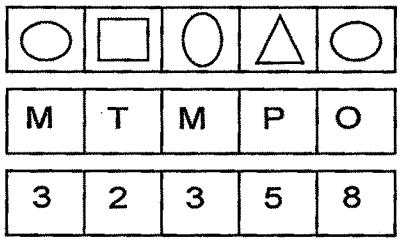


Fig 2.2

Test- In the first test where the first three subtests from NIMHANS Index were used. Children were asked to circle similar looking pictures or similar looking alphabets and words. The first picture in the first row is pointed at and the child is asked to point to or circle similar

looking picture. Similar procedure is followed with the next two rows. Only one row is shown at a time. Exposure time per row is 1 min.

The next subtest had three nearly similar looking pictures with one picture having a part missing. The children had to identify the picture with the missing part. (refer manual pg no 2)

Example 

Fig 2.3

2.3.3 Spatial orientation

Principle- The ability to perceive the location of objects in relationship to other objects is a critical skill in reading, math, and handwriting, where a child must be able to recognize the different symbols, perceive their direction, tell the difference between similar shapes, and determine where these are located in relationship to each other. Individuals who have difficulty with spatial relationships may seem unusually clumsy or accident prone, may have difficulty reading or may refuse to read, or may have poor handwriting (dysgraphia).

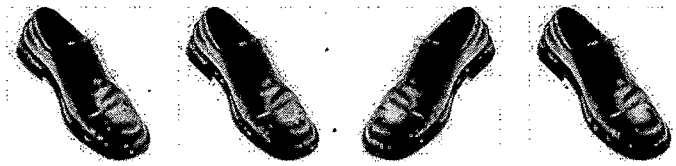
Example 

Fig 2.4

Test - The first and second subset is tested with one object aligned in a different way and the other three aligned in the same direction. Child had to identify the picture that is aligned in different direction from the other three pictures. The third subset of spatial orientation involved showing a small part of a picture separately and then child is asked to identify the small part in the bigger picture (refer manual pg no 3)

Exposure time per row is 1 min.

2.3.4 Left and right recognition

Principle –this test is based on spatial orientation.

Example

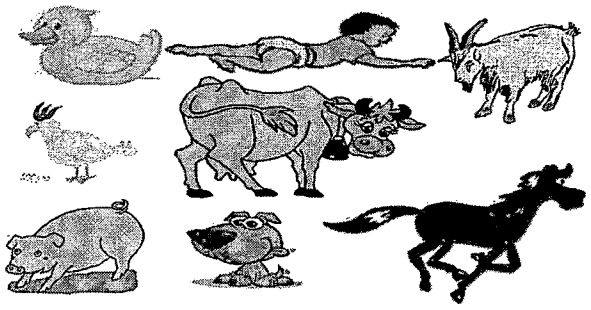


Fig 2.5

Test-Picture is shown which had animals looking in the two directions and the child is asked to point to all animals looking to the left and then all animals looking to the right. (refer manual pg no 5).

Exposure time in this picture 2 min.

2.3.5 Top and bottom recognition

Principle- Based on spatial orientation and visual integration

Example

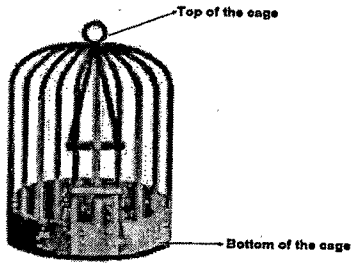


Fig 2.6

Test- The child is asked to point to the top and bottom of the picture.

Exposure time per picture is 1 min.

2.3.6 Visual organization

Principle-When an individual is confronted by any (abstract or symbolic) visual image, we seem to separate a dominant shape (a 'figure' with definite contours) from the background. This is found difficult by the dyslexics.
Testing involved (refer manual pg no 7)

i) *Proximity*- Children were asked to identify the objects which were placed closest out of three pictures. Exposure time per picture -1 minute

Example

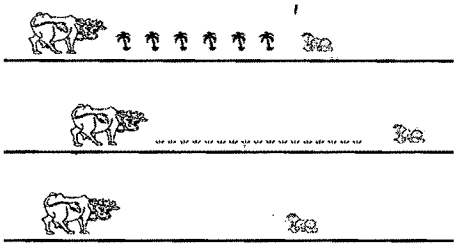


Fig 2.7

ii) *Similarity*- Children had to identify the two shapes that were similar in that picture. Exposure time per picture -1 minute.

Example ⟶

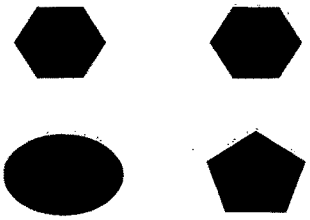


Fig 2.8

iii) *Closure*- Children had to identify pictures of alphabets and were asked to recognize the alphabet. Exposure time per picture -1 minute

Example

Fig 2.9

iv) *Synthesis and Analysis* -children had to identify missing objects in the second picture of two similar looking pictures (refer manual pg no 9). Exposure time per picture -1 minute.

Example

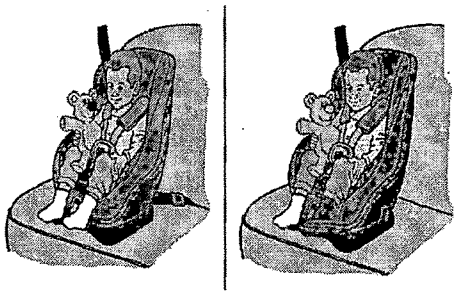


Fig 2.10

2.3.7 Visual motor skills

Principle- Dyslexic subjects are found to be less efficient at recognizing structure-from-motion and less accurate at grasping objects precisely. They also show a mild impairment in stereo acuity. Dyslexic individuals should show deficiencies on tasks dependent on dorsal stream processing of visual information

Example

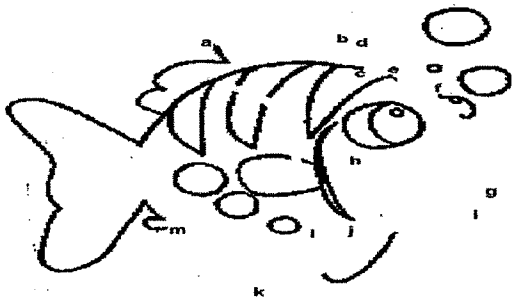


Fig 2.11

Test- There are three subtests which involved joining alphabets in sequence to complete a picture, drawing pictures from memory, arranging beads in a sequence (refer manual pg no 10). Exposure time 4 minutes.

2.3.8 Visual memory

Principle -Children with learning difficulty have difficulty remembering familiar items such as letters, words, and numbers, and unfamiliar items such as abstract shapes that can be named.

Test- children had to name the pictures in the same order that they were viewed. (refer manual pg no 12). Exposure time per picture as shown below.

VISUAL MEMORY

ROW	TIME TAKEN
DOG	2 SEC
CLOCK ,	2 SEC
CAT , SCISSOR	3 SEC
MAN , KEY, FISH	3 SEC
COW , TREE , PEN	3 SEC

Fig 2.12

2.3.9 Auditory discrimination

Principle -some children have special difficulties processing rapidly changing or rapidly sequential auditory stimuli. This difficulty arises because these children's brains do not sample acoustic signals sufficiently rapidly to note changes of short temporal duration. Thus, the children perceive some speech contrasts, or other rapid temporal events, inaccurately. Children had to differentiate if the two words were similar or different.

- Bat bat
- Bad bat
- Dog hog

Test- children were given two words said in slow succession one after the other with the child having his back towards the tester and he had to say whether the words pronounced were same or different (refer manual pg no 13).

2.3.10 Auditory memory

Principle-Dyslexics have a specific speech processing deficit at the sensory level which could be used to identify children at risk at an early age.

Example: It is hot

I am a girl/boy

Test- children had to repeat sentences in the same order (refer manual pg no 14).

2.3.11 Receptive language

Principle- Receptive language or auditory processing disorder describes children whose brain has an abnormal way of processing information and sound they hear from their surroundings. He is unable to follow adequately the language of others. It may be associated with conditions such as dyslexia

Test- The child is asked to identify the object by pointing with their index finger (refer manual pg no 14). Exposure time per picture half minute.

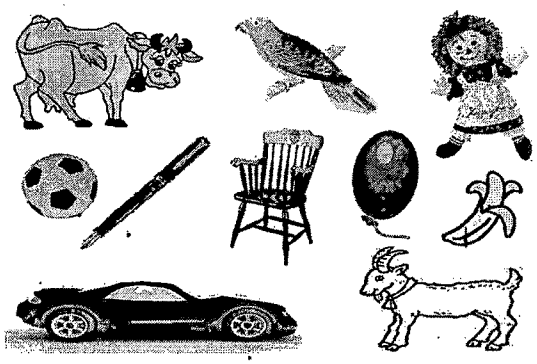


Fig 2.13

2.3.12 Expressive language

Principle- Individuals have problems putting thoughts into words. Children may have a markedly limited vocabulary, making errors in tense, or having difficulty recalling words or producing sentences with developmentally appropriate length or complexity.
Test-children were asked to speak few sentences on common objects (refer manual pg no 15).

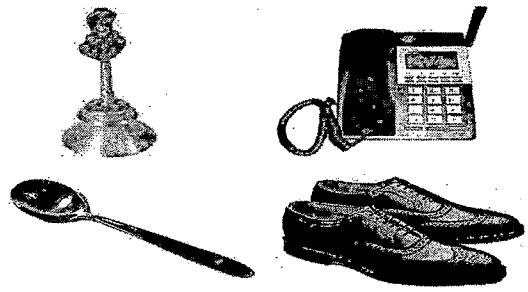


Fig 2.14

2.3.13 Picture sequence

Principle- The most common difficulty that comes with dyslexia is the inability to or difficulty with, a concept called sequencing, the step-by-step way in which most people solve problems and organize their lives

Test- Children were shown some pictures and objects that were arranged in a particular sequence or order. One picture is missing in the sequence. The child had to identify the missing picture. The first picture is shown as an example. The first two subtests had only one picture missing. The third subtest had two pictures missing in the sequence (refer manual pg no 16). Exposure time per picture -1 minute.

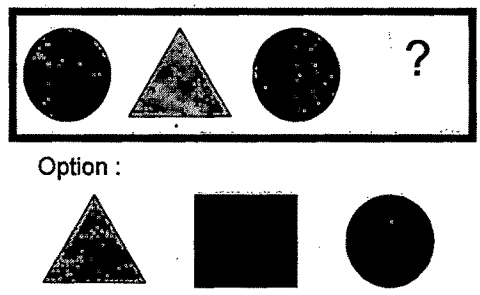


Fig 2.15

2.3.14 Story sequence

Principle- The most common difficulty that comes with dyslexia is the inability to or difficulty with, a concept called sequencing, the step-by-step way in which most people solve problems and organize their lives.

Example: Sowing seed---watering the seed---big plant

Test- The ability to sequence a story in an orderly manner after seeing the pictures is tested. Children were shown three pictures. They were showing small actions to complete a small activity. The child had to arrange the pictures in a sequential order to complete the activity. One example is shown (refer manual pg no 17). Exposure time per picture -1 minute.

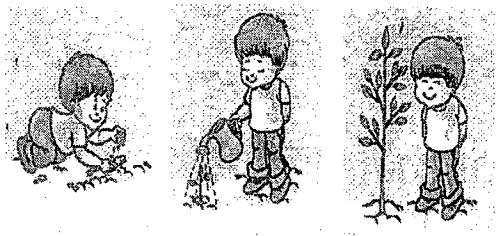


Fig 2.16

2.3.15 Literacy readiness

Principle- children at risk of developing dyslexia are delayed in literacy development.
Test-children were told to identify the best written/draw letter/shape. Children were shown four triangles and had to identify the best drawn triangle. Children were shown four alphabets (all capital A) and had to identify the best written capital A (refer manual pg no 18). Exposure time per picture -1 minute.

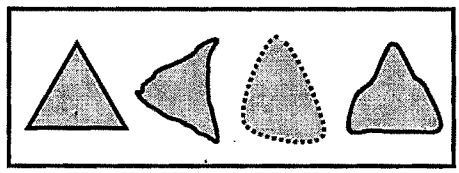


Fig 2.17

2.3.16 Phonemic awareness

Principle - Phonological awareness provides individuals with the ability to break words into syllables and component phonemes, to synthesize words from discrete sounds, and to learn about the distinctive features of words. This seems difficult in dyslexics.

Test- Children were tested using pictures. Three subtests were used where (refer manual pg no 18).

i) They were asked to name two pictures starting with the same phoneme

Bat starts with buh. Find another picture which starts with buh

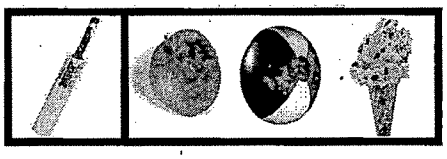


Fig 2.18

ii) Match the beginning sound letter with the picture

Hh	Cc	Pp

Fig 2.19

iii) Match the phoneme with the letter

Find the letter that makes a tuh sound

P	Q	T	M

Fig 2.20

Exposure time per picture -1 minute.

2.3.17 Rhyming words

Principle- Dyslexia is a problem with phonological coding. One of the early symptoms may be the child's inability to learn or understand rhyming words.

Test-children were asked to identify two pictures ending with the same sound (Refer manual pg no 21). Exposure time per picture -1 minute.
Example: Match the word that rhymes with bat

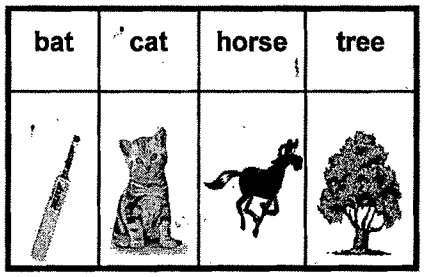
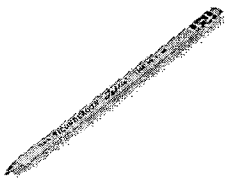


Fig 2.21

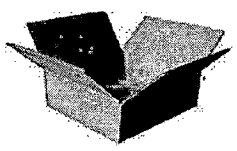
2.3.18 Blending

Principle- Phonological awareness provides individuals with the ability to synthesize words from discrete sounds, and to learn about the distinctive features of words. This seems difficult in dyslexics.

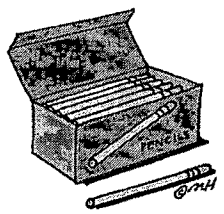
Test-Children were shown pictures of two objects and those objects were named aloud. They were asked to join the two words together to make a compound word. Similarly, blending of simple picture to form compound words is done, blending of phonemes with morphemes to form words is tested, and removal of morpheme to form simple word is tested (refer manual pg no 22). Exposure time per picture -1 minute



Pencil



Box



Pencilbox

Fig No 2.22

2.3.19 Rapid naming object

Principle- Efficient retrieval of a series of names of objects, colors, digits, or letters from long-term memory. Rapid naming of verbal material is a measure of the fluid access to verbal names, in isolation or as part of a series, and related efficiency in activating name codes from memory. This is impaired in dyslexics.

Test-Children were asked to name pictures seen on the paper as quickly as possible (refer manual pg no 24). Exposure time per picture -1 minute.

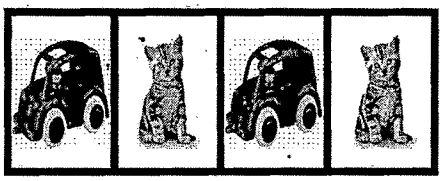


Fig 2.23