ANALYSIS OF NEUROPSYCHOLOGICAL FUNCTIONS IN A GROUP OF MENTALL.Y HANDICAPPED ADULTS

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CERTIFICATE

This is to certify that Shri S. Venkatesan has completed his dissertation titled "Analysis of Neuropsychological Functions in a Group of Mentally Handicapped Adults" in fulfillment of the requirements for award of Doctor in Philosophy in Psychology under my guidance.

This research work. either in part or full, has not previously formed a basis for award of any degree, diploma and other similar titles.

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DECLARATION

This is to declare that the dissertation titled 'Analysis of Neuropsychological Functions in a Group of Mentally Handicapped Adults' does not constitute to be part of any other thesis/dissertation/monograph submitted by the candidate to any other university/ institution

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PREFACE

Pychological assessment is a crucial step in the diagnosis, training and rehabilitation of individuals with mental handicap. Psychological assessment enables several decisions at various levels of planning, programming and evaluation of these individuals. There are several approaches to psychological assessment as there are several purposes for which they maybe required to be used. Traditionally, the role of psychologists have been viewed as a diagnostician of individuals with mental handicap. Indeed, such a role is crucial. However, the question that arises subsequently is: What is achieved after the diagnosis is made and the label of "mental retardation" has been affixed on a given individual? In fact, this is when psychological assessment for programme planning or intervention must begin.

An initial breakthough in the area of psychological assessment for curriculum programming in our country has led to the development and standardisation of Behavioural Assessment Scales for Indian Children with Mental Retardation (BASIC-MR). This Scale is currently proving useful in answering the question about what to teach children with mental handicap.

The next question that arises in the context of teaching or training individuals with mental handicap is: How to teach these children? Of course, behavioural technologies are providing a satisfactory answer in this context. But, one may explore alternative ways of answering this question too.

Neuropsychology appears to show promise in this direction with its fair degree of success in the rehabilitation of neurologically (structurally) brain damaged individuals by attempting to anlyse behavioural phenomena at a deeper level than as done by a behaviourist. Although more research is required in this area, tentatively, it appears that neuropsychological functional preferences and patterns exist variedly in different individuals with mental handicap as with all normal individuals. Therefore, it calls for more research in this direction. However, it is believed that a humble beginning has been made in this study to explore these avenues for psychological assessment in individuals with mental handicap. Possibly, it may go a long way in the development of neuropsychoeducation for individuals with mental handicap.

The presentation of this thesis has been classified into five chapters. Chapter one gives an introductory overview of the historical and contemporary scenario within the framework of the various approaches to psychological assessment in individuals with mental handicap. A tenor of suggestive criticism is deliberately maintained in this chapter to facilitate and highlight the need for work in this area particularly in our country. Chapter two narrows down to an overview of idiometric approaches to neuropsychological assessment, with explicit emphasis on the paucity of work in this direction in individuals with mental handicap. Chapter three presents the aims and objectives, methodology, sample and procedure of conduct of the main study. The attempts to validate and determine the sensitivity of the presently developed battery is also hihglighted. Chapter four surmiarises the results of the main study. Chapter five highlights the salient findings of this study in the context of the available cognitive researches on mental retardation. APA guidelines have been attemptedly adopted in the design and write up of the bibliography. It is fervently hoped that the present study will stimulate more research along these same lines in the field of disabilities and impairments.

ACKNOWLEDGEMENTS

Individual names are only incidental signposts in the process of any collective human endeavour, especially in the realm of Science or Art. To accredit a single person as sole proprietor for any product of human industry, small or big, smacks of vanity, if not impropriety in human conduct. These sentiments are equally true for the origin and development of this document being submitted for award of doctorate in Philosophy.

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It was during a brief, but memorable meeting during a Conference of Clinical Psychologists that I happened to meet Professors Elizabeth K. Warrington from United Kingdom and Professor Kevin Walsh from Australia. It was encouraging to learn that my ideas of adopting neuropsychological assessment practices to the field of mental handicap was not misdirected. In retrospect, I deem that meeting as fortuitous and no word of thanks will be sufficient to eulogise these internationally eminent personalities in the field of neuropsychology.

I reserve a special note of thanks to my supervisor and guide, Professor K. Ramchandra Reddy, Department of Applied Psychology, Osmania University, Hyderabad, for graciously accommodating my interests in this field and accepting me as his pupil. His guidance has been inspiring, instructive as well as informative on various aspects of the chosen topic. My spontaneous feelings of gratitude go to him for being instrumental in the completion of this work.

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It is customary not to acknowledge the contributions of those who are genuinely close to ones heart, as it would flavour self praise. However, it is also difficult to refrain from expressing appreciation to my

CHAPTER I

AN INTRODUCTORY OVERVIEW OF PSYCHOLOGICAL ASSESSMENT

PSYCHOLOGICAL ASSESSMENT: MEANING AND DEFINITION

Most dictionaries in English refer to the term assessment only in connection with "valuation of properties, taxes and income" (Webster, 1985; McLeod, 1986). One of the earliest references to psychological assessment is found in the book titled "Assessment of Men" (O.S.S. Staff, 1948). Thereafter, several works have appeared on general psychological assessment (Freeman, 1965; Anastasi, 1976; Sattler, 1988) and also, with reference to persons with special needs (Mittler, 1970; Schopler and Reichler, 1979; Matson and Breuning, 1983; Rotatori and Fox, 1985; McLoughlin and Lewis, 1986; Salvia and Ysseldyke, 1988).

At a general level, psychological assessment involves forming impressions and making judgement about others. It carries an evaluative flavour while dealing with the whole person (Fiske and Pearson, 1970). At a technical level, psychological assessment is defined as the process of "systematic collection, organisation and interpretation of information about a person and his situations" (Sundberg and Tyler, 1962), to which is added, "and the prediction of his behaviours in new situations" (Jones, 1970). The key element in psychological assessment is "the act of acquiring and analysing information" (Hammill, 1987). Besides, "it is a continuous ongoing process that involves the systematic collection and interpretation

of many pieces of information" (Mitt et al, 1988). In specific terms, psychological assessment involves "measurement and evaluation of individual skills, capabilities and limitations by gathering and interpreting information about the said person" (Williams, 1988).
The aim of psychological assessment is stressed when it is defined as the process of collecting data for the purpose of making decisions about an individual or a group (Salvia and Ysseldyke, 1988).

Often psychological assessment is viewed as synonymous to psychological testing. Although related, both are not the same (McLoughlin and Lewis, 1986). Psychological testing involves exposing an individual to a particular set of questions under specified and structured conditions in order to obtain a score. The score is the end product of psychological testing, which is also called as a "measure of the assessed variable" (Bolton, 1987). According to the Joint Committee of the American Psychological Association (APAJ, the American Educational Research Association (AERA) and the National Council on Measurement in Education (NCME), a psychological test is defined as "a set of tasks or questions intended to elicit particular types of behaviours when presented under standardised conditions and yield scores that have observable psychometric properties". Cronbach (1984) defines a psychological test as "a systematic procedure for observing behaviour and describing it with the aid of numerical scales or fixed categories". Goldstien and Hersen (1984) defines a psychological test as "a standardised stimulus situation, containing a defined instruction and node of response in which a person is measured on the response in a predetermined way, the measure being used to predict or make inference about other behaviours of the person". Thus, psychological testing becomes a part of the larger process of psychological assessment. Psychological assessment includes more than psychological testing.

PURPOSE OF PSYCHOLOGICAL ASSESSMENT

Several authors have succinctly stated the purpose of psychological assessment. According to Karmal (1970), the reasons for psychological assessment are, identification and classification, remediation, evaluation (including process evaluation and outcome evaluation), certification and research. While clarifying that it is people, not psychological assessments per se that aid in decision making, Thomdike and Hagen (1977) enumerate the following types of decision that these assessments enable:

1. Selection Decisions:

This involves decisions about what criteria should a given pupil or class of pupils satisfy before they make entry into the next phase of curricular instruction.

2. Placement or Classification Decisions:

Depending on specific abilities or disabilities of a given individual or group as elicited during psychological assessment, these decisions are made to plan special programmes or curriculum.

3. Instructional Decisions :

Instructional decisions maybe about an individual or a group as a whole. For example, reviewing the concept of borrowing in subtraction and assessing if most of the pupils in a class have adequate competency in this skill.

4. Curricular Decisions :

These are decisions regarding what should be taught to the assessed individual.

5. **Personal Decisions :**

These are decisions to be made about ones own self.

Hawkins (1979) justifies the role of psychological assessment by considering its importance in arriving at specific decisions, such as, screening, classification and placement, monitoring individual progress, programming and/or evaluating programme effectiveness.

According to Rotatori, Galloway and Rotatori (1980), the specific aims of psychological assessment are, collect data, meet administrative requirements, assist classification, enable placement decisions, plan programmes and provide realistic and specifically meaningful intervention objectives.

In a different model of psychological assessment called as "funnel model", Elliot and Piersel (1982) incorporate the various purposes as different phases in the ongoing and continuous process of assessment. They identify three phases, reflecting three major purposes, through which all psychological assessments proceed. They are screening decisions phase, diagnostic decision phase and programming decision phase.

In a recent book, Salvia and Yesseldyke (1988) recapitualte the different purposes of psychological assessment as screening, identification and referral, classification and placement, instructional/interventional/ treatment planning, programme/instructional/interventional evaluation and progress evaluation.

ASSUMPTIONS UNDERLYING PSYCHOLOGICAL ASSESSMENT

1. Recognition of Individual Differences:

All psychological assessments proceed the basic premise that each individual is unique. Although an avowed purpose of psychological assessment is the systematic collection, organisation and interpretation of information about an individual and his situations to enable screening and placement into theoretically constructed diagnostic categories, this does not mean that individuals within the specified diagnostic category are homogeneous and identical to one another (Rotatori, Fox and Macklin, 1985). While ail individuals categorised under a single diagnostic category share certain common psychological characteristics, they also differ in many other aspects (Berger, 1985). Psychological assessment enables us to identify and express these qualitative and quantitative variations between individuals within the same diagnostic categories. In the diagnosis of mental retardation, there are more problems in classifying a smaller sample as 'different' from its general large population because such a classification tends to assume that smaller sample encompass a homogeneous class of individuals who are somehow different from persons in the representative 'normal' or upper levels of intelligence. But, a similar feature of individual differences may not be generally assumed to exist in individuals with mental handicap. The fact of individual differences is of greater relevance to the psychological assessment of low functioning or handicapped individuals (Witt, et al, 1988). This is readily exemplified in the case of two mentally handicapped persons functioning at the same level or having the same IQ, but still showing no comparable similarity in terms of specific psychological assets or deficits between them.

2. Training Prerequisites for Assessment:

Psychological assessment needs to be systematic and standardised in that they follow prescribed procedures of test administration, scoring and interpretation of subject's performance. A test is said to be standardised only if it has undergone thr^ rigors of test development, field trials validation, establishment of its reliability, sensitivity, etc. Different examiners can obtain the same results only on a standardised test. As Nunnally (1978) points out, standardised tests and procedures have four advantages over unstandardised observations and clinical judgments, viz., objectivity, quantification, communication facility and economy. While aiming to be systematic, precise and organised, psychological assessment must also be necessarily objective and uninfluenced by subjective or personal evaluations. Anyone attempting a psychological assessment does so according to some uniform or specified set of procedures. The resultant information from the tests are to be uniformly recorded, scored and interpreted (Freeman, 1965). It requires a certain amount of skill and competence to conduct psychological assessments efficiently. A formal academic training and certification of the examiners is contingent for conducting psychological assessments (Newland, 1973).

3. Error in Assessment:

In spite of all the rigid academic training that is required to develop and conduct psychological assessments, no assessment can be free from error. Some error will be always present. Nunnally (1978) differentiates two kinds of errors common to psychological assessments. They are,

i) Systematic Error; and,

ii) Random Error.

Systematic error denotes differences between true value of the measured psychological characteristic and its estimated or approximated value as provided by the sample statistic. This discrepancy is stable over any number of times or anybody making measurements of the said characteristic. For example, if one uses a clinical thermometer which always reads one degree Fahrenheit less, the instrument is said to have systematic error. In psychological assessments, systematic errors are likely due to sampling errors, such as faulty sample selection, sample heterogeneity, improper use of statistical techniques, etc.

Random errors or non systematic errors in psychological assessment can occur in two ways,

i) Measurer inconsistency; and,

ii) Instrument inconsistency.

Measurer inconsistency occurs due to examiner bias. In physical measurements this is illustrated in case of a myopic physician who misreads the numbers on an instrument. In psychological assessments, it maybe the examiners attitude, belief, prejudice, etc., which can lead to errors in measurement. Psychological assessment procedures have been too often misunderstood and blamed for the ambiguities of conflicts found in the examiner's value system.

Instrument inconsistency occur due to faults in measuring instruments. In physical measurements, this is exemplified by use of an elastic ruler to measure physical dimensions of concrete objects. In psychological assessments, this maybe the use of a faulty test. The reliability of psychological assessments depend on the degree of their vulnerability to errors. The lesser the degree of error, the greater is the accuracy of assessment. Psychological assessments vary in their degree of reliability depending on their susceptibility to these errors (Murphy, 1988).

4. Developmental Perspective in Assessment:

Human behaviour undergoes continuous change throughout the life span of the individual. A series of orderly progressive changes characterise human behavioural development. Experiences during an earlier phase of development influence later stages in life. Hence, it is useful and essential to incorporate the developmental perspective as guide to psychological assessment especially in low achieving or mentally handicapped individuals (Hurlock, 1985).

5. Cultural Relevance in Assessment:

All psychological assessments are carried out in the context of cultural or experiential background of the assessee. Ideally, psychological assessment aim to be culture free, if not, at least, culture fair (Jensen, 1980). The cultural or experiential background also includes influence of sub cultures. For example, a test that is standardised on a normal population would not be appropriate for use with a special groups such as the mentally handicapped.

CONCEPT OF MENTAL RETARDATION - HISTORY TO CURRENT TRENDS

Before looking into psychological assessment of individuals with mental handicap, it would be apt to review the concept of mental retardation in the light of its history. The history of research in mental retardation can be roughly divided into three stages (Detterman, 1987).

The first stage, which occurs from the middle of last century to the early years of this century, was marked by an effort to identify and classify mentally retarded individuals as distinct from other conditions. At that time, the distinction between mental retardation and mental illness was still nebulous to laymen as well as professionals. The early attempts at psychometric assessment were singularly directed towards identification and classification of persons with mental handicap. At that time, it was realised that no phenomenon can be scientifically studied unless it could be reliably identified. Before this phase in history, there were subjective evaluations of the mentally retarded. The psychometric movements initiated by Binet-Simon (1905) toiled towards reliably identifying and isolating children who were not progressing in the state French schools. They bear testimony to the major theme of efforts during this phase of research in the field of mental retardation (Terman, 1916).

The second stage, which comes after the turn of this century till somewhere around World War II, began with a relatively satisfactory note that psychometric procedures can reliably identify and isolate individuals with mental handicap from general population. During this time, there was an increasing realisation that even mentally retarded persons possess certain psychological assets which were hitherto unknown. Investigators were surprised and impressed to find that mentally retarded persons show evidence for learning and memory just like normals. These historical movements led research on assessment to focus on cataloging various psychological characteristics of persons with mental retardation. If the first phase of research on psychological assessment in mental retardation could be loosely labelled "diagnostic", the second phase was attemptedly "descriptive" of the abilities of mentally handicapped.

The third stage, which includes the period after World War II to the present, has witnessed a gradually evolving skepticism on the utility of psychometric approaches to assessment of persons with mental handicap. According to earlier tradition, if the IQ of a person fell one standard deviation below the mean, he was labelled as 'mentally retarded' (Grossman, 1959).

Frey (1984) offers an historical overview of assessments in the field of disabilities and impairments by focussing on developments after World War II. According him, the history of assessments in this field can be considered over three phases:

1. Assessment for Compensation (1920-1940)

   In this phase, assessment concerns were aimed at reimbursing loss of function in individuals with disabilities and impairments. With the enactment of Worker Compensation Laws, disabilities were viewed as defect with 'cash value'. The primary objective of assessment was to identify, measure and classify the physical limitations suffered by the disabled in relation to the amount of compensation to be claimed from the State. The assessments were primarily aimed at answering this remunerative question (Kessler 1970).

2. Assessment for Rehabilitation (1940-1960)

Over time, the aim of rehabilitation shifted from mere reimbursement for loss of function to teaching or training persons in the use of their individual capacities to the optimum. Laws changed from mere compensation laws to increasing State responsibility for care and rehabilitation of the disabled. The single physician approach to certification was abandoned in favour of a multi-disciplinary-team approach. It was felt that psychometric assessments of IQ/SQ, etc., were of minimal value in planning, education or training of handicapped (Reynolds and Birch, 1977, Anthony 1979; Halpern et al, 1982). A greater emphasis was placed on functional assessments for training/rehabilitation as is evidenced by the upsurge of numerous Scales of ADL ('Activities of Daily Living' - A term coined by Deaver 1945) (Hoberman et al, 1952; Kelman and Willner 1962; Donaldson et al, 1973; Hedrick et al, 1981; Klein and Bell 1982). The term ADL referred to the wide range of behaviour patterns considered necessary for the impaired person to meet demands of daily living (US Department of Education, 1982) including activities, such as, bathing, eating, dressing, toiletting, etc.

3. Assessment for Documenting Accountability (1960-1983)

In the past few decades, legislative concerns with disabled highlight issues such as their maintainance, health and medical care, social or educational services, vocational rehabilitation, independent living, etc. As a sequel to this, assessment concerns are increasingly emphasizing on IEP (Individualized Education Programme) or IWRP (Individualized Written Rehabilitation Programme) which involves clear documentation of the functional assets/deficits of the individual.

The identifying and defining characteristics of mental retardation were the major concern of researchers in earlier phases. Recently, the defining characteristics of mental retardation has undergone a sea change. Apart from sub average level of intellectual functioning, deficits in adaptive behaviour manifested during the developmental period (i.e., before the age of eighteen) has become an added criteria in the definition of mental retardation (Heber, 1961; Grossman, 1973). The revised definition considers a mental age equivalent of two or more standard deviations below the mean on standardised intelligence tests as the criteria for "sub average intellectual functioning". For example, a score of less than 63 on Binet Kamat Intelligence Scale (Kamat, 1967) is termed as mental retardation.

Table l.
Distribution of IQ's

Level of Dental retardation	Approximate percent in population	S.D.Range	IQ levels Wechslers' (SD=15) (X =l00)	Approximate range mental age in adult
Mild	2.7	-2.00 to -3.3	50-70	8-3 to 10-9
Moderate	0.2	-4.33to-3.B	35-49	5-7 to 8-2
Severe	0.1	-5.33 to -4.33	20-34	3-2 to 5-6
Profound	0.05	Less than -5.33	Less than 20	(3-2

The term 'mental age' describes 'the degree of general mental ability possessed by the average child of that chronological age (Sattler, 1982). In spite of several limitations and lack of statistical rigor, mental age continues to offer an easily understood and descriptive picture of functioning at lower levels of intelligence. The tentative relationship between mental age and IQ differs for various tests in adults with mental handicap (See Tables 1 and 2). Although the tables indicate the highest degree of competency expected at each level and age, they are meant for illustrative purposes only and are not to be used as means of classifying individual cases. "Clinical judgment" supplemented by measures of adaptive behaviour is also suggested as another criteria for diagnosis and classification of mental retardation.

Table ?.
Distribution of IQ's on Various Tests of Intelligence

Levels of mental retardation	Approh-mate per-cent population	I.Q. Levels				Approximate range of mental age in adult
		S.D.Range	Wechslers !Mean:100 (SD:+l5}	' Bhatias' !tMean:100! (SD:45i	Binet-Kamat (Mean:99.5) (SD:*18.7)	
Mild	2.7	-3.33 to -2.00	50-70	50-70	38-62	8-3 to 10-9
Moderate	0.2	-4.33 to -3.33	35-49	35-49	19-37	5-7 to 8-2
Severe	0.1	-5.33 to -4.33	20-34	21-34	Below 19*	3-2 to 5-6
Profound	0.05	Less than -5.33	(20	(20		< 3-2

'indicates that this test cannot discriminate between severe and profound ME

The term "adaptive behaviour" refers to "the effectiveness with which an individual meets the standards of personal independence and social responsibility expected of his or her age and cultural group (DSM III, 1980). According to Doll (1935; 1953), adaptive behaviour is defined as "the functional ability of the human organism for exercising personal independence and social responsibility". The basic elements in any definition of adaptive behaviour are (1) it is age related, i.e., it becomes more complex as the individual grows old; (2) it is defined by social standards and expectations of others around the individual; and (3) it is modifiable through training or experience.

Adaptive behavior refers to typical behaviours, not abilities, of individuals (Cichetti and Sparrow, 1990). Thus, the child who knows how to get a drink of water without assistance, but typically chooses not to do so is not functioning adaptively to that area/domain of behaviour. The inclusion of adaptive behaviour in recent definitions of mental retardation is a crucial development in West as well as our country (Upadhyaya and Borikar, 1974; Upadhyaya, 1977; Gunthey and Upadhyaya, 1982). Baroff (1974) is of the opinion that the attempt to add adaptive behaviour as a criterion of mental retardation has failed and that IQ continues to be the primary diagnostic determinant in research and practice. Smith and Polloway 1979) found that less than ten per cent of the research publications they examined included adaptive behaviour in the description of their subjects. Even if adaptive behaviour measures are available, many workers are inclined to base their diagnosis (Adams, 1973) or placement decisions (Junkala, 1977) primarily on IQ scores. Ideally, both, IQ scores as well as measures of adaptive behaviour are to be used in diagnosis of mental retardation.

The third aspect, i.e., retardation must be evident before the developmental period differentiates mental retardation from other traumatic or degenerative disorders in adulthood. Due to these additions and revisions in concept and definition, the role of psychological assessment in mental retardation has become even more complex and challenging than ever.

The current definition of mental retardation does not attempt to determine the cause of mental handicap. Actually, the range of causal factors in mental retardation are wide and covers heredity or disease as well as biological and environmental influences. Maloney and Ward (1979) report more than two hundred and fifty known aetiological conditions resulting in mental retardation. Further, there is no indication of permanency in diagnosis of mental retardation. Indeed, Grossman (1977) observed, "...within the framework of mental retardation, an individual may meet the criteria of mental retardation at one time in life and not at some other time". A person may change status as a result of alteration in intellectual functioning, improvement in adaptive behaviour, differing expectations of society or for other known or unknown reasons (Zimmerman and Woo-Sam, 1987). The issue of social expectation is crucial to the definition of mental retardation. In recent times, there is an increasing demand for elimination of the label "mental retardation" (Mercer, 1973; Braginsky and Braginsky, 1974; Oakland, 1977). With rapid industrialisation and urbanisation, difficulties in social adaptation traceable to intellectual deficits would increasingly limit the degree of expectations of social responsibility from the individual. It is possible that the present requirement of intellectual functioning which is two standard deviations below the mean may require revision. As Zigler, Balla and Hodapp (1984) point out, raising the cut off point from two to one standard deviation will proportionately increase two to sixteen per cent of population being labelled as mentally retarded. With the current Indian population at over eight hundred million, the effect would include one hundred and fifty million, instead of the present fifteen million mentally retarded individuals in our country. All this would end up as more than an academic issue.

A potential problem in classifying any smaller sample as 'different' from the general larger population is the assumption that the smaller sample encompasses a homogeneous class of individuals who are somehow qualitatively different from persons in the representative normal sample. The fact of individual differences within normal or upper levels of intelligence due to an interaction of genetic and environmental factors is agreed upon. However, similar influences to produce individual differences in mentally retarded is often viewed as uncommon. The mentally retarded are seen as one homogeneous group (Beck, 1983).

Zigler (1967) insists that mentally retarded individuals are indeed, a heterogeneous group. Based on a polygenic model, he proposed a theory of intelligence which assuntes that intelligence is the result of number of units, with IQ distribution falling between 50 and 150. He proposed that an IQ of approximately 50 appears to be the lower limit of intelligence. Individuals with an IQ of 50 are an integral part of the distribution curve as are three per cent of the population whose IQs are seen as superior. However, an exception to this theoretical distribution are individuals with IQ below 50. According to Zigler (1967), persons with less than IQ of 50 form the second group of mentally retarded with identified organic or genetic deficits.

Zigler, Balla and Hodapp (1984) stress that any classification system based on the notion of Gaussian distribution of intelligence commits a 'fundemental error'. When a large population is tested, a bellshaped curve of intelligence is not what is discovered (Penrose, 1963; Vemon, 1979). The distribution of intelligence obtained in large scale surveys show a significant deviation from bisymnetry in the lower tail of normal curve, where there are many more cases than are discovered in the opposite tail at the high end of intelligence. In order to explain this excess of very low IQs at one tail of distribution the view has been advanced that there are really two distinct, but overlapping distributions of intelligence (Lewis, 1933).

The two groups approach for distribution of intelligence (see figure one) highlight that one of the curves account for interaction between heridity and environmental components, and the other for those whose intellectual apparatus has been physically damaged, thereby altering the biological side of the formula. The normal curve in two groups approach represents the polygenic distribution of intelligence. The second curve represents all those individuals whose intellectual functioning reflects factors other than the normal polygenic elements. The superimposed curve also represents a somewhat normal distribution having a mean of approximately 35 and range from 0 to 70 respectively. It has been empirically shown that the larger group of retarded persons have no known organic determinants (Slater and Cowie, 1971) and are referred as "familially retarded". These persons typically have IQs between 50 and 70, with an immediate relative who is below average in intelligence. There are four distinct, but somewhat overlapping determinants of this type of retardation, viz., psychosocial disadvantage, or unspecified interaction between genetic and environmental factors, some subclinical organic damage which has not been identified, or a mere expression of the lower portion of normal distribution of intelligence (Knoblach and Pasamanick, 1961; Kugel, 1967; Hagberg et al, 1981).

While doubting the empirical veracity of Zigler's two groups approach, and also arguing against some of its basic tenets, Barnett (1986) cautions that adoption of Zigler's proposals would impede progress in research and practice, besides not clarifying the conceptual confusions that prevail about the definition of mental handicap. Bamett (1986) highlights the fundemental property of mentally retarded persons as their "cognitive inefficiency", which is to be judged relative to cultural background of the individual. Both, cognitive tasks as well as the importance a society assigns to specific cognitive abilities depending on the requirements for survival and success vary in social and physical environments at given historical moments. From a socio-cultural angle, the stability of diagnosis for mental retardation over time or across cultures becomes questionable. Also, Bamett (1986) is against Zigler's distinction between organic and familial retardation as he fears that research and services directed towards increasing mental abilities through environmental manipulation in organic retardates may get discouraged.

APPROACHES TO PSYCHOLOGICAL ASSESSMENT IN MENTAL RETARDATION

The preliminary purpose of psychological assessment in mental retardation is screening, identification and classification. Even though diagnostic classification is necessary for administrative reasons, psychological assessment cannot do without it. It is also the aim of assessment to objectively describe behavioural capabilities and limitations of individuals and thereby suggest training programmes for behavioural remediation. In recent times, several new approaches have evolved for identifying target behaviours in training mentally retarded persons and to evaluate effectiveness of such programmes of behaviour change. The range of behaviours requiring training in mentally retarded is growing so broad that no single assessment approach or strategy would be adequate. Different approaches to psychological assessment are needed to undertake different types of decisions. It is against this backdrop that one must view various approaches to psychological assessment in mental retardation.

NORMATIVE OR PSYCHOMETRIC APPROACHES

Historically one of the oldest approaches to psychological assessment is psychometric or normative approach. It is also called as standardised or norm referenced or nomothetic approach to psychological assessment. This approach owes its origin to pre nineteenth century efforts at testing individual abilities to discriminate sounds, odours or weights, or measuring sensory acuity or speed, reaction times to various stimuli, etc. Such data was collected in large numbers to compare individual performance with a group. Most of these procedures were subjective and developed on an ad hoc basis.

The beginning of nineteenth century witnessed the pioneering efforts of psychometricians like Binet-Simon (1905), who sought to develop a measure for identifying academically underachieving pupils in State French schools so as to provide them with suitable education. Their major concern was to use psychological assessments to screen, identify, isolate and classify slow learners and mentally retarded from those who could benefit from regular school education. They devised the first Intelligence Scale consisting a series of items arranged in an increasing order of age graded difficulty. The number of correct solutions to these items by the subject were converted into a single numerical index of intelligence called as 'mental age' and later, into Intelligence Quotient (Stern, 1914). The disparity between chronological age and mental age of subjects were used as an index of the severity of mental handicap.

By stressing on comparative evaluations of the individual with others who are supposedly like him, these early workers were following the spirit of normative approaches. The critical element in their approach was their comparison of individual performance to performance of his peers. In other words, this approach discriminates among the performances of a number of individuals and interprets how an individual's performance compares with others having similar characteristics. Normative approaches derive their name from their procedure in which the test scores of various psychological characteristics get their meaning by comparison of similar characteristics against a representative group of scores (Witt et al, 1988). The procedure of this approach involves assessment of typical performances on a given psychological variable by groups or subgroups of persons as against a large collectively representative sample of general population known as the norm group or reference group. The raw scores obtained are transformed into standard scores or transferred scores such as percentiles, stanines, point scales, grade equivalents, etc., so as to enable interpretations and comparisons of individual scores to group scores.

A notable property of normative approaches is their emphasis on objectivity. They lay down prefixed and objective criteria for test construction, administration, scoring and interpretation by disallowing subjective evaluations from contaminating the assessment process. For example, when an examiner gives the subject a test task for identifying the odd man out of a series of pictures such as ship, car, bus, train and a passenger van; the keyed response is ship (which is the only water transport). Even if the subject reasons that car is the only private transport, the response is scored incorrect; or even if he insists that train alone runs on rails, the response is wrong.

To summarise, normative assessments are characterised by procedures which make comparative evaluations of individuals or similar groups of individuals on given psychological variables, thereby seeking to determine whether there is, and if so, by how much, deviation between the individual or group on the given psychological characteristic (Williams, 1988).

ASSUMPTIONS UNDERLYING NORMATIVE ASSESSMENTS

Goldfried (1977) proposed the following assumptions underlying psychometric or normative approaches to psychological assessment:

1. A psychological test is only an assessment tool. It has no intrinsic importance of its own. It is only an indicator or measure of some underlying psychological variable. For example, an item which requires the subject to indicate parts of human body on verbal command is assumed to assess receptive language;

2. The purpose of a psychological test is to reveal differences between comparable groups of individuals;

3. What a psychological test measures (validity) is shown by its correlation with other available and established tests measuring the same variable in question;

4. The distribution of persons on a psychological variable underlying a test score is assumed to be normal unless there is some reason to believe otherwise;

5. The individual score of a person on a psychological test derives its meaning by comparison with scores of other persons on the same variable.

TYPES OF NORMATIVE PSYCHOLOGICAL ASSESSMENTS

For the convenience of easier understanding, the various types of normative psychological assessments are discussed as follows:

1. Norm Referenced Tests of Intelligence:

Normative instruments share the contnon characteristic of being 'standardised'. This means that uniform procedures prevail in test construction, administration, scoring and interpretation of individual performances in order to compare such performances against established norms that have been derived under similar conditions^ Standardised tests of intelligence are built on the assumption of normal distribution of intelligence in any large population. Some of the normative tests of intelligence that have been routinely used with the mentally handicapped are Binet Simon Intelligence Scale (Binet-Simon, 1908), Block Design Test (Koh, 1923), Draw a Person Test (Goodenough, 1936), Adult Intelligence Scale (Wechsler, 1949), Leiter International Performance Scale (Leiter, 1952; 1959), Ravens Progressive Matrices (Raven, 1956; 1960), The Maze Test (Porteus,1959), Columbia Mental Maturity Scale (Burgemeister et al, 1972), and others. The recent revisions of most of these tests, such as, Stanford Binet Intelligence Scale (Terman and Merrill, 1960), Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 1967), Wechsler Intelligence Scale for Children, Revised (Wechsler, 1974), and Wechsler Adult Intelligence Scale (Wechsler, 1981) have abandoned the simple rationale of IQ in favour of deviation IQ scores. The deviation IQ is a form of standard scores in which the obtained distribution of IQ's are converted into a normal distribution with a mean of 100. The standard deviations for Stanford Binet is 16, and for Wechsler Scales is 15 respectively.

Although ancient Indian literature is replete with anecdotes of testing mental abilities by historical charecters, such as, use of puzzles and coins by Kalidas, "Drashtkupad" by Surdas, "Ulatbansia" by Kabirdas, mazes by Kautilya and others; the formal movement towards psychometric testing in our country can be dated only to early work done by Rice (1929), who adapted Binet Simon Intelligence Scale for Hindustani Children.

In the past decade, research on normative techniques has increased in our country (Pareek and Rao, 1973; Wig, Pershad and Verma, 1974; Verma, 1975; Kulshrestha, 1979). Beginning with the publication of the "First Mental Measurements Handbook for India" (Long and Mehta, 1966), "Behaviour Sciences Research in India- A Directory" (Pareek and Kumar, 1966), "Tools of Indian Researchers" (Kulshrestha, 1979), and many critical reports on psychometric assessment (Prabhu, 1967; Verma, Teja and Shah, 1970; Wig and Akhtar, 1974; Neki and Prabhu, 1974), trend reports (Krishnan, 1972; Shanmugam, 1972; Sinha, 1972; De and Sinha, 1977) and methodological viewpoints (Murthy, 1975; Wig, Mehta and Verma, 1975; Wig and Menon, 1975) it has culminated into a recently concluded National Seminar on the Issues and Problems of Psychological Testing (NCERT, 1992). This Seminar highlighted research problems in psychometric assessment, such as, inadequate documentation and circulation of research findings lack of coordination/communication between researchers, poor response rate of behaviour scientists in India, and the tendency towards slavish use of foreign tools by translating or adapting them to suit local needs and conditions, etc.

Some normative tests of intelligence used in our country are Battery of Performance Tests of Intelligence (Bhatia, 1955), Draw a Person Scale (Phatak, 1961; 1962), Wechsler Adult Performance Intelligence Scale (Pasricha and Pagedar, 1963; Ramalingaswamy, 1975; Pershad and Verma, 1978), Binet Kamat Intelligence Scale (Kamat, 1967), Senguin Form Board (Ramachandran et al, 1968; Bharatraj, 1971; Pershad Verma and Randhawa, 1979), Intelligence Scale for Indian Children (Malin, 1969), Binet Kulshrestha Intelligence Scale (Kulshrestha, 1971), Gessells Drawing Test (Verma, Pershad and Kaushal, 1972), Measures of Intelligence and Social Maturity (Ram, 1978), and others.

2. Norm Referenced Developmental Schedules:

Developmental tests ' 'schedules' represent a downward extension of standardised normative tests of intelligence used for assessment of children. The construction, administration, scoring and interpretation of findings on developmental schedules follow similar procedures as with normative tests of intelligence. However, a major difference is that the global score that is provided by developmental schedules are more appropriately called 'developmental quotients' (DQ) rather than 'intelligence quotients' (IQ). The target population on whom developmental assessments are carried out children within the so called developmental period. Also, DQ's are relatively unstable quotients than IQs (Bharatraj, 1977). Most developmental schedules cover assessment in areas of language, motor, social, adaptive, etc. Rarely, even temperamental variables are included (Seifer, 1988). The focus is on calculating developmental ages of the individual by taking normative developmental points from a larger population as index for comparison. According to Johnson and Goldman (1990), the focus of developmental assessment is on,

i) obtaining an overall index of development;

ii) securing detailed assessment of the child's level of functioning across areas like motor, language, etc.;

iii) evaluating changes in developmental behaviours over time;

iv) eliciting information on associated variables, such as, home environment, amount and type of environmental stimulation and factors that either impede or facilitate development.

The following prerequisites have been proposed to ensure reliable and valid developmental assessments:

i) a strong general/clinical child background (Johnson and Tuma, 1985; Roberts, Erickson and Tuma, 1985);

ii) skills in parent/child interviewing (La Greca, 1983)

iii) skills in administration of a range of developmental schedules (Sattler, 1988);

iv) primary and thorough knowledge of child development (Campbell, 1983; Eisenberg, 1987; Cole and Cole, 1989);

v) knowledge of prenatal and post natal factors that can facilitate or impede child development (Wachs and Weizmann, 1983; Willis, Swanson and Walker, 1983);

vi) knowledge of child psychopathology (Ollendick and Hersen, 1989; Schwartz and Johnson, 1985);

vii) knowledge of intervention strategies (Johnson, Rasbury and Siegel, 1986; Matson, 1988).

The source of data for developmental assessments can be parent or child interviews, report questionnaires, observation, etc. Usually, no single source of data is sufficient. All possible sources of data, including teacher ratings and medical records aid in developmental assessments (Milich and Krelbiel, 1986). Some commonly used developmental schedules in the field of mental handicap are Kuhlman Infant Rating Scale (Kuhlman, 1922; 1939), The Merrill Palmer Scale of Mental Tests (Stutsman, 1931; Wellman, 1938), California First Year Mental Scale (Bayley, 1933), Developmental and Intelligence Scale (Cattell, 1947), Gessell Developmental Schedules (Gessell and Amatruda, 1947; Gessell, 1971). Tredgolds Table of Normal Developmental Data (Tredgold and Tredgold, 1952), Mental Developmental Scale for Testing Babies from Birth to Two Years (Griffiths, 1954), Sensori Motor Intelligence Scale (Piaget, 1958; Elkind, 1969), Denvers Developmental Screening Test (Frankenburg and Dodds, 1967), The Bayley Infant Scales of Mental and Motor Development (Bayley, 1969), Mc Carthy Scales of Childrens Abilities (McCarthy, 1972), Comprehensive Identification Process (Zehrbach, 1975), Kaufman Infant and Preschool Scale (Kaufman, 1979), Minnesota Preschool Inventory (Ireton and Thwing, 1979), Preschool Screening System (Hainsworth and

Hainsworth, 1980), Dubowitz Neonatal 'Assessment (Dubowitz, 1981) and others.

A few Indian adaptations of these normative developmental schedules are Mental and Motor Growth of Indian Babies (Pathak, 1969; 1973), Gessells Developmental Schedule (Muralidharan, 1976), Infant Intelligence Development Scale (Kulshrestha, 1977), Developmental Screening Test (Bharatraj, 1977; 1983; Verma, Pershad and Menon, 1979), NIMH Development Assessment Schedule (Arya, 1988), etc.

3. Norm Referenced Adaptive Behaviour Scales:

The measurement of adaptive behaviour present greater problems because of its variability due to maturational and/or cultural factors. For example, during pre school years, sensori-motor development tasks, such as, grasping objects, sitting on own, standing, walking, etc., are of greatest importance. In later years, domestic skills, greeting skills, vocational skills, community orientation skills, etc., become important aspects of social competence. Further, unlike IQ, adaptive behaviour deficits are readily amenable for remediation by short environmental manipulation. Further, adaptive behaviour skills are conceptualised as ordinarily developing in a sequential pattern by building on previously mastered skills.

In spite of conceptual difficulties, early attempts to objectively measure the theoretical construct of adaptive behaviour was the publication of Vineland Social Maturity Scale (Doll, 1935). Doll viewed adaptive behaviour as a dynamic phenomenon of social competence, which can be quantified in terms of normative scales and deviations from such normative social maturational expectations of different age groups of individuals. He generated a numerical value called 'social age' and its derivative 'social quotient' (SQ). In the history of assessment in mental handicap, the Vineland Social Maturity Scale has remained the best measure of adaptive behaviour for a long time. In 1960's investigators gradually realised the limitations of this Scale, and also, the paucity of research on measurement of adaptive behaviour in mental retardation. In 1964, the American Association of Mental Deficiency (AAMD) used funds from National Institute of Mental Health (NIMH) and co-sponsored a project with Parsons State Hospital, Kansas, to review all existing Scales of adaptive behaviour and develop a new Scale of their own (Leland et al, 1966; 1967). A need was felt for a assessment tool to measure adaptive behaviour to predict community adjustment rather than to individually plan training programmes. Initially, a single form of the Adaptive Behaviour Scale was developed (Nihira et al, 1969) which was later revised (Nihira et al, 1974). In 1977, a survey of existing scales of adaptive behaviour was carried out (IDB Project, 1977). The Individualised Data Base Project Team identified 132 measures of adaptive behaviour in use, both, in Great Britian and United States. The commonly used tools for assessment of adaptive behaviour in persons with mental retardation were Vineland Social Maturity Scale (Doll, 1935; 1953; 1965), Caine Levine Social Competency Scale (Caine, Levine and Elzey, 1963), The Primary Progress Assessment Chart of Social and Personal Development (Gunzberg, 1966; 1968a; 1968b; 1977), AAMD Adaptive Behaviour Scales (Leland et al, 1966; 1967; Nihira et al, 1969; 1974), The Development Team for Mentally Handicapped Assessment Form (DTMH, 1978; 1980; 1982), Behaviour Development Survey (IDB, 1979), Scale for Assessing Coping Skills (Whelan and Speake, 1979), AAMD Adaptive Behaviour Scale-Classroom Version (Lambert and Mindmiller, 1981), The Disability Assessment Schedule (Holmes, Shah and Wing, 1982), Hemisphere Assessment for Living with Others (Shackleton-Bailey and Pidcock, 1983), Normative Adaptive Behaviour Checklist (Adams, 1984), Scales of Independent Behaviour (Bruininks et al, 1984), Vineland Adaptive Behaviour Scale-Revised Form (Sparrow, Balla and Cicchetti, 1984a; 1984b, Vineland Adaptive Behaviour Scale-the Classroom Edition (Sparrow, Balla and Cichetti, 1985) and others.

In a study, Morrow and Coulter (1978) requested State agencies to list the specific measures of adaptive behaviour with which they were familiar. The four most frequently used measures of adaptive behaviour, as reported by professionals, were Vineland Social Maturity Scale (Doll, 1965), Vineland Adaptive Behaviour Scale-School Edition (Lambert et al, 1974), Adaptive Behaviour Scale, 1975 version (Nihira et al, 1975), and System of Multicultural Pluralistic Assessment (Mercer and Lewis, 1977).

Concurrent research on normative assessments of social . individuals with mental retardation, have been undertaken in our own country (Upadhyaya, 1977). Some popular measures of adaptive behaviour in our country are adaptations of Vineland Social Maturity Scale (Malin, year not mentioned), Adaptive Behaviour Scale, Indian version (Upadhyaya and Sinha, 1974; Upadhyaya and Borikar, 1974; Gunthey and Upadhyaya, 1982) and others.

4. Norm Referenced Achievement Tests:

Achievement tests constitute one more type of normative approach to psychological assessment. They are useful in assessment of children with learning disability, and possibly, in mild mentally retarded.

These tests describe the grade level achievements of subjects in commonly taught academic areas across different grades. They provide scores in terms of various grade levels called as "Grade Equivalent Scores" (GES). According to Anastasi (1976), GES enjoys the same popularity in academic settings as mental age estimates in clinical practice.

According to these test procedures, GES is assigned on the basis of mean raw scores attained by a group of persons in a given grade. For example, if a student earns a GES of 2.0, it implies that his standing is equal to that of a begining second grader. Normative achievement tests are constructed by dividing the academic year into ten months (nine academic months and one summer month). The intermediate months are expressed as decimals. If a student gets a GES of 2.1, it means that his standing is equal to that of the average achieved by a student in two year one month grade. At times, these scores are expressed in terms of percentile ranks or norm derived scores, which are stretched or compressed to conform normal curve parameters even though these changes maybe far from perfect. For example, if a fourth grader is placed at a reading grade equivalent of 2.0, would it mean that he is placed at the begining of second grade? Such inferences reflect misinterpretation of the meaning of GES. In the above case, a low GES does not signal anything more than the fact that the child has poor fourth grade performance. It does not say that he is at second grade performance. It means that he falls below average in reading among his fourth grade peers. Similar is the interpretation of better performing students in normative achievement tests. A fourth grade pupil who gets a GES of seventh grade does not suggest that he can be placed among seventh graders. These risks of misinterpretation are particularly true of normative achievement tests. There is little work available in normative achievement tests in our country (Kulshrestha, 1984), even though some changes and developments are taking shape in that direction (Sinha, 1977; Jangara et al, 1990; Ramaa, 1990).

PROFILE ANALYSIS OF TEST PERFORMANCE ON NORMATIVE ASSESSMENTS

In the middle of nineteenth century, when criticisms on normative assessments started to pour in, few workers started to modify some procedures to enable a detailed examination of individual performances on standardised tests. These procedures have been called 'scatter analysis' or 'profile analysis'. It is claimed that within the broad framework of normative assessments, classificatory schemes of profile analysis provide for evaluation of individual's specific successes or failures (Cronbach, 1984). These schemes attempt to overcome the allegation that normative assessments simply provide a numerical index (IQ, SQ, DQ, etc.).

According to Sattler (1974), there are two kinds of approaches to 'scatter analysis'. The first approach involves use of specific items or groups of items to determine particular functions in which the individual is strong or weak. In this approach, explicit or implicit comparisons of the individual's strengths or weaknesses are made against a standard profile of strengths or weaknesses of a normative group. The second approach studies the variability in performance in relation to individual's own levels disregarding the content of items or groups of items.

It is always pointed out that normative measures of intelligence and adaptive behaviour provide only an overall quantitative numerical index of performance for the individual. They do not provide any qualitative information about the individual or groups of individuals. The concept of profile analysis has evolved as a result of such criticisms in order to provide a qualitative measure of test performance. It can be observed that individuals with the same IQ or mental ages can still show different profiles in distribution of assets and deficits (Jastak, 1950). Several workers have given different schemes of scatter analysis for different normative measures. However, much of the work has concentrated on schemes of profile analysis for Binet-Simon Intelligence Scales (Brigham, 1917; Kendig and Richmond, 1945; Slutzsky, Justman and Wrightstone, 1953; Valett, 1964; Lezak, 1983; Venkatesan, 1987; Sattler, 1988).

The procedure of profile analysis involves analysis of test tasks into their respective functions or specific abilities such as vocabulary, language, verbal fluency, conceptualisation, visuorrtotor, etc (Newland and Meeker, 1964). This is to facilitate plotting of performance patterns for individuals on the standardised scale, besides getting a numerical score such as IQ or SQ. It also facilitates plotting individual abilities over a course of time to monitor progress during training or treatment. Thus, it helps comparing discrepencies between pre and post treatment levels of functioning in individual or groups of individuals (Venkatesan, 1987).

The history of profile analysis can be divided into two periods, viz., period upto the review by Harris and Shakow (1937) and the period thereafter. In their reveiw of literature upto 1937, Harris and Shakow report that the focus of profile analysis was to account for the amount of scatter, i.e., for the general unevenness in distribution of success and failures. They evaluated nine different measures of scatter, i.e., number of age levels from basal level to the level where all tests are failed, area of scatter, number of tests passed above and failed below mental age level, and a combination of range and area of scatter. They concluded that research has failed to demonstrate clearly any valid clinical use for numerical measures of scatter analysis. Furthermore, they were unable to recommend even one best measure among the nine.

In the period after the review by Harris and Shakow (1937), a host of criticisms appeared on scatter analysis (Lorr and Merster, 1941; Hendricks, 1954). Several technical drawbacks in the routine use of profile analysis were pointed out. Scatter may result from a number of factors inherent in construction of the Scales, including lack of perfect correlation among tests, test unreliability, incorrect order of test difficulty, lack of discriminatory power in certain tests, increase in variability with increase in absolute mean test performance, presence of a series of tests that call for some special ability and systematic errors in testing due to language handicaps, sensory defects, special training, lack of cooperation and ambiguous scoring instructions, etc. Scatter can occur even in absence of any clinically significant variability in subject's responses (Garner, 1966). McNemar (1942) concluded that it is difficult to see how any clinical significance can be attached to the concept of scatter. Lorr and Meister (1941) were opposed to use of scatter even as a crude estimate of the individual examinee.

In spite of severe criticisms, profile analysis continues to be used or studied (Venkatesan, 1987). Scatter was found to be greater among emotionally disturbed children than non emotionally disturbed children (Schafer and Leitch, 1948; Vane, Weitzman and Applebaum, 1966), while another study has refuted this (Schneider and Smillie, 1959). In individuals with mental handicap, scatter is reported to be a sign of organic aetiology than familial aetiology (Riggs and Burchard, 1952), or could help discriminate from normal children (Sattler, 1955). Exogenous brain injured children were found to have more scatter on test performance than endogenousa brain injured (Berko, 1955). Gittleman and Birch (1967) did not find scatter to be an indicator of higher potential in schizophrenic children. Although clinicians and researchers continue to use scatter analysis in tentative ways (Lezak, 1983; Venkatesan, 1987), the weight of evidence indicate that it cannot be used with any degree of certainty in making diagnostic decisions in individual cases. At best, they can be used for generating hypothesis in individual cases (Hammill and Wiederhalt, 1973). Scatter maybe useful in studying patterns of group performance rather than in individual cases. In any given population, scatter is the rule rather than an exception, and may result from acquisition of certain skills and not from abnormal conditions. It is now acknowledged that scatter analysis should not be used to determine specific abilities since specific groupings of these tests have not been found to be reliable. In addition, if specific categories are needed, the examiner should not loose sight of what individual tests actually require of the examinee. Wikoff (1971) concluded that classificatory systems developed by Valett (1964), Sattler (1965) and Meeker (1969) are not valid because the results of factor analysis failed to provide more than one general factor. However, Wikoff (1971) also reported that performance on various test categories of scatter analysis are differentially related to socio economic status. For example, in Sattler's scheme, correlation between visuo motor category and SES was 0.17, while that of between socio economic status and language category 0.34. These results suggest that the categories provide somewhat different information.

The various classificatory schemes are intended to assist in making interpretations. For example, a child failing consistently in visuo motor, while passing all other types of subtests may need further testing to evaluate his visuo perceptual abilities. In such cases, the procedure of scatter analysis is useful to generate hypothesis about individual performance. This can help in making more meaningful recommendations for further assessment. However, they cannot be used independently to make a diagnosis in individual cases.

Even though, historically, scatter analysis owes its origins to the general dissatisfaction over providing quantitative indices in normative tests, these procedures have not be able to provide a satisfactory answer. The categories within scatter analysis do not naturally fit into classificatory schemes of tests not really developed for that purpose. Because of this, there can be no single uniform system of scatter analysis which is satisfying or acceptable to all conditions. The allotment of specific sub tests to specific categories have been repeatedly questioned as arbitrary and inaccurate. The categories are not mutually exclusive nor exhaustive. For example, an item such as, "enumerate objects from a picture" can be classified under "social intelligence" and/or "language" functions. Other difficulties arise when categories are not continuously represented at all age levels in a age scale. For example, in the Indian version of Binet Simon Scale (Kamat, 1967), there are no language items at specific age levels, such as four years and seven years. Suppose a person passes a language item at age three and fails at age five, it becomes difficult to decide whether his language level is four or five.

CRITERION REFERENCED APPROACHES

This approach to psychological assessment of individuals with mental retardation follow recent trends in the field of special education and rehabilitation medicine (Glaser, 1963). In contrast to normative approaches, this approach uses strategies that are not essentially concerned with comparing individuals with a norm or standard. The point of reference is to an absolute standard within an individual rather than a population norm (Glaser and Nitko, 1971; Popham, 1973). Instead of indicating a person's development of specific behaviours relative to a norm or average of his group, criterion measures appraise individual's standard in terms of absolute levels of mastery. Criterion measures try to answer specific questions, such as, does this child name the color red? Does this boy recite a-z when asked to do so ? In a sense, criterion approaches measure "achievements" or learnt skills or activities of an individual. The interest in criterion assessment is to see whether the individual can or cannot do the given skill or activity (Kiernan, 1987).

The proponents of this approach argue that conventional normative approaches do not really provide any useful information except stating the obvious, i.e., the individual testee deviates from the normal. In target populations, especially persons with mental handicap, individual differences are so great that group comparisons are futile. This is particularly true, if assessment information is required to decide on training or rehabilitation programme (Livingston, 1977).

Criterion approaches are also called as curriculum based assessments because they directly lend to the instructional needs of the individual student. These approaches are also called as "minimum competency test techniques" or "basic skills test techniques" meaning that an individual performance is judged not by how well it compares with other persons taking the test, but by how well it compares with the criteria set for attainment of minimum competencies for the individual himself. In fact, the term "criterion" comes from experimental psychology of learning in which it is meant "a critical level of mastery beyond which additional learning trials are not helpful". As Fremer (1972) warns, criterion approaches should not be confused with criterion validity, which involves cross validation of scores of a normative test to another measure.

ASSUMPTIONS UNDERLYING CRITERION REFERENCED APPROACHES

Goldfried (1977) summarises the following assumptions to criterion approaches :

1. Unlike normative approaches to assessment, a criterion meausre assessment does not sample function of behaviours or skills, but actual behaviours or activities of interest.

2. The purpose of criterion measures is not so much to compare individuals. It is to compare or estimate individual skill levels or achievements in absolute terms and to classify the individual as a master or non master of a specific behaviour or skill.

3. What a criterion assessment measures (validity) is indicated by the specification of domains from which the particular activities or items are selected and the extent to which it classifies persons in the same way as other classification procedures.

4. Unlike normative approaches to assessment, the distribution of functional profiles for variables underlying criterion measures is not of interest at all. Even if it is of interest, it is a sort of Bernoulli distribution, i.e., a two point distribution, since the parameters are dichotomous (either present or absent).

5. The scores of an individual on a criterion test measure is a direct estimate of the absolute level of proficiency and they derive their meaning from a conditional probability distribution of some related variable. For example, the score maybe an index of probability of mastery in the individual on a specific domain of activity such as self care or language, etc. The scores derive their meaning from

comparison with a predetermined specific reference point of success or failure in that domain.

GUIDELINES FOR CONSTRUCTION OF CRITERION REFERENCED MEASURES

Although criterion measures do not aim to evaluate or compare individual performances against a normative performance, this does not mean that they are ad hoc procedures of assessment. Even criterion tests require careful standardisation. The specific steps in the construction of CRTs vary from those of normative tests (Engelmann, 1980; Weisberg, Packer and Weisberg, 1981; Baine, 1988; Engelmann and Carnine, 1982). Some guidelines to be followed in the construction of CRTs are:

1. To begin with the purpose of developing criterion measures must be clearly stated. For example, a proposed measure maybe for assessment of persons with mental handicap or emotional disturbances or others. In other words, the target population/sub population for which the measure is intended should be clearly specified.

2. The broad domain of behaviours that are to be assessed must be clearly specified. The proposed domains within a criterion measure should be exhaustive. Some common domains seen in CRT are, self help

behaviours, communication, academic, etc., or more specifically, eating skills, dressing skills, bathing skills, etc.

3. The domains or sub domains within a CRT should be mutually exclusive. If specific test items are overlapping in the criterion measure, it may lead to ambiguity in scoring administration and interpretation.

4. The specific items of behaviours within a domain/sub domain must be arranged in a sequential order of increasing difficulty. Item difficulty can be ascertained on the basis of developmental perspectives. For example, the selected items within the domain of "eating behaviours" maybe; swallows food, drinks from cup or glass unassisted, picks food, eats on own, etc.

5. The specific distance in terms of difficulty between two or more items in a domain/sub domain can also depend on the extent of sensitivity that is required of the test. For example, if a criterion tool is needed which is sensitive to three month changes in behaviours of pupils in a class, the items must be more specific and simple to

achieve within three months, than if the tool is needed to be sensitive to annual changes in behaviours of students.

6. The performance objectives described in each item within a domain/sub domain of a criterion measure is to be written in clear observable and measurable terms. The statements should specify the behaviour, conditions and deadline within which it is to be achieved or performed by the subject. For example, a well written performance objective with al1 the four components would be, "When asked ' show me red', Shyam will point to red coin from three other blue coins at least four out of five times correctly by the end of this week"

7. There must be specific procedures for reliably administering, scoring, recording, use of materials for testing as well as interpretation of results for every standardised criterion measure (Howell, Kaplan and O'Connell, 1979).

Becker and Engelman (1976) propose two sources from which criterion test items can be generated during test construction. According to them, test items or performance objectives described in a CRT can be 'objective based', depending on what is to be taught to the subject, or it can be instruction based depending on how it is to be taught to the subject.

Objective based CRTs have become more popular in the field of special education (Bloom, 1956; Mager, 1962; Popham, 1973).

Some of the commonly used criterion referenced tests, especially relevant to the field of mental retardation are, Portage Project: Teaching Parents to Teach their Preschool Children in the Home (Shearer and Shearer, 1972; Shearer and Loftin, 1984), Portage Project: A Model for Early Intervention (Bluma et al, 1986), Minnesota Developmental Programming System (Joiner and Krantz, 1979), Behaviour Assessment Battery (Kiernan and Jones, 1982), Minnesota Developmental Programming System, Alternate Form C for use with Profoundly Handicapped Individuals (Silverman et al, 1983), Wessex Revised Portage Language Checklist (White and East, 1983), Bereweeke Skill Teaching System (Jenkins et al, 1983), Developmental Checklist (Perkins et al, 1983) and others.

In India, some of these CRTs have been adapted for use with mentally handicapped, such as, Madras Developmental Programming System (Jayachandran, Vimala and Kumar, 1983), Portage Basic Training Course for Early Stimulation of Preschool Children in India (Kohli, 1987), Functional Assessment Guide of the Project Integrated Education for Disabled (Jangira et al, 1990) and others.

FUNCTIONAL OR BEHAVIOURAL APPROACHES

Individuals with mental retardation are frequently charecterised by behaviours which can be viewed as the result of powerful influence of environmental variables. The environmental influences maybe highly variable and subject to unique interaction effects between the individual and his setting. Each behaviour is unique and bears a 'functional-utilitarian' relationship in its consequences for the individual. The proponents of this approach view behaviour as objective, observable and measurable units of actions with precise or exact functional consequences. Hence, these assessments are also called as "functional assessments".

Halpern and Fuhrer (1984) define functional/behavioural assessments as measurement of purposeful behaviour in interaction with the environment. The target behaviour being measured must fulfill some goal or objective for the individual. Hence, it is also called as assessment of "operational" behaviours. The environment plays a vital role in the occurrence of purposeful behaviours. For example, a mentally retarded individual may learn to cook on a particular stove, but find it difficult to use a slightly different model. This shows that results of a behavioural/functional assessment are very specific and cannot be automatically generalised across different situations. The interpretation of results must be necessarily in the context of their intended uses, whether it is for providing compensation, eligibility in terms of services, development of IEP's, building a national profile or incidence or prevalence of functional disabilities, conducting research, etc.

The legitimate concern of behavioural/functional assessments began to flourish in the 1970's (Goldfried and Pomeranz. 1968; Mischell, 1968; Bandura, 1969; Goldfried and D'Zurilla, 1969; Kanfer and Saslow, 1969; Goldfried and Sprafkin, 1974). There is no single definition of behavioural assessment (O'Leary, 1979). There is neither a single element that characterises a particular assessment as behavioural. Rather, it is a series or pattern of overlapping emphasis that serves to identify behavioural assessments as such (Mash, 1979). The earlier approaches to behavioural assessment (Ullmann and Krasner, 1965) involved the specification of target behaviours intended for change and their alteration through arrangement or rearrangement of environmental contingencies in a manner loosely conforming to operant learning principles (Skinner, 1953). For example, approval is given to a retarded individual for good eye contact and smiling (Hopkins, 1968), tantrums are ignored (Williams, 1959), etc. Behavioural assessment consists of obtaining the frequency, rate and duration of target behaviours by observers recording and counting them.

Following operant principles, applied behaviour analysis (Baer, Wolf and Risley, 1969) fuelled behavioural assessments in mental retardation. This approach examines target behaviours as well as their antecedents and consequences (Bijou and Peterson, 1971). Its major emphasis is on observable events, current behaviour and situational determinants of the specified behaviour. The systematic assessment of target behaviours, accurate observation and objective recording are the foundations on which behavioural assessment, is are built (Gelfand and Hartmann, 1975; Sulzer-Azaroff and Mayer, 1977).

With the evolution of behavioural technology in recent times, greater emphasis is placed on viewing the individual as part of a larger network of interacting social system (Patterson, 1976; Wahler, 1976), and on the vital role of cognition and affect in mediating behaviour change (Bandura, 1969; 1977; Kanfer and Phillips, 1970; Mischel, 1973; 1979; Meichenbaum, 1977; Karoly, 1981). These developments have changed the quality of behavioural assessments from sheer measurement of target behaviours to general problem solving strategies based on ongoing functional analysis and encompassing a greater range of independent/dependent variables.

According to Mash (1979) "behavioural assessment" is "characterised at a conceptual level by a view of human behaviour as predominantly under control of contemporaneous environmental variables rather than determined by underlying intrapsychic mechanisms or inferred personality traits". Most discussions and definitions of behavioural assessment include a comparison with traditional assessment approaches (Goldfried and Kent, 1972; Mash and Terdall, 1976; Hartmann, Roper and Bradford, 1979). Such comparisons serve to identify the major defining characteristics of behavioural assessment, although they have resulted in definitions based on what behavioural assessments is not than what it is (Mash, 1979).

The successful use of behavioural technology in individuals with mental retardation has been extensively documented (Meachem and Wiesen, 1969; Ayllon and Roberts, 1974; Azrin, Azrin and Armstrong, 1977; Kazdin and Geesey, 1980; Leudar and Fraser, 1987). Some commonly used tools for behavioural assessment in the field of mental retardation are Standardised Psychiatric Interview (Goldberg et al, 1970), Balthazar Scales of Adaptive Behaviour, Part II (Balthazar, 1973), Adaptive Behaviour Scale, Part II (Nihira et al, 1974), Disability Assessment Schedule (Holmes, Shah and Wing, 1982), Aberrant Behaviour Checklist (Aman et al, 1985a; 1985b), Psychopathology Instrument for Mentally Retarded Adults (Senatore, Matson and Kazdin, 1985), Behaviour Disturbance Scale (Leudar, Fraser and Jeeves, 1987), and others. Few behavioural assessment Scales are available for mentally handicapped children in our country. They are, Madras Developmental Programming System (Jeyachandran, Vimala and Kumar, 1983), Assessment of the Mentally Retarded Individuals for Grouping and Teaching (NIMH, 1991), Problem Behaviour Checklist (Arya et al, 1990) and Behaviour Disorder Checklist (Mishra, 1976). However, all the Scales suffer from several drawbacks, including the fact that they are all not Standardised nor are they exhaustive, in rigid behavioural tenor, etc. By far, the best available and Standardised Scale BASIC-MR (Behavioural Assessment Scales in Children with Mental Retardation) developed as part of a three year project by NIMH, Secunderabad (Peshawaria and Venkatesan, 1992).

Although traditional and behavioural assessments share the same desire to produce reliable, valid and useful data, their methods vary considerably because of differing assumptions as below:

1. Focus of Assessment:

Behavioural assessments focus on contemporaneous controlling variables, whereas traditional approaches focus on historical causes. The unit of analysis in behavioural assessments is behaviour in specific situations rather than behaviour per se. On the other hand, traditional assessments view behaviours as important only in so far that they reflect underlying causes. In behavioural approaches, all behaviours are seen as having an intense functional-utilitarian relationship with the environment. The behaviour analyst attempts to map these determinants of behaviour. Behavioural assessment is carried out by means of two strategies, viz., static analysis and functional analysis. Static analysis focus on the characteristics of the behaviour itself, such as, frequency, intensity and duration of behaviour (Ferster, 1965). Functional analysis determines antecedents and consequences controlling the behaviour in question. Antecedents are events or situations that are present at the time of occurrence of behaviour. In behaviour analysis, a distinction is made between original causes and maintaining factors in a behaviour. The focus of behaviour analysis is on the latter.

This difference can be readily exemplified in the concept of personality as held by the two orientations (Mischel, 1968). For example, traditionally, both state (dynamic) and trait (psychometric) approaches have inferred some underlying constructs that account for the consistency in individual behaviour. Traditional assessments view behaviour as a sign of these hypothetical constructs which are of central importance in predicting behaviour. In contrast, behavioural approaches are less inferential in postulating underlying factors to account for overt behaviour. The focus of behavioural assessment is on what a person does in a specific situation, rather than on inferences about what attributes he has got globally.

Traditional assessments regard behaviour as stable, regardless of the situational context in which they occur. Hence, they show little concern for the content of their test items. In certain cases, such as, protective techniques, there is even an overt attempt to disguise the content of test items by making them ambiguous (Goldfried and Sprafkin, 1974). On the other hand, content validity of test items assume greater importance in behavioural assessments as they sample specific behaviours in particular situational contexts (Goldfried and D'Zurilla, 1969).

2. Sign Versus Sample Approach:

Traditional approaches to assessment is a kind of "sign" approach in contrast to behavioural assessments which follow a "sample" approach (Goodenough, 1949). The sign approach assumes that a behavioural response is an indirect manifestation of some stable or enduring underlying construct, such as, personality, intelligence etc. The sample approach assumes test behaviour as only a subset of actual behaviours. In this sense, traditional approaches to interpretation of test data is largely intuitive, as behavioural assessments are more empirically oriented.

3. Assessment for Intervention:

A major difference between normative and behavioural approaches is their relationship to treatment or intervention (Goldfried and Pomeranz, 1968; Peterson, 1968; Bandura, 1969). There is little relationship between traditional assessments and treatment or intervention planning. In fact, traditional assessments bear only an indirect relationship to intervention planning through screening and diagnosis. Moreover, the diagnosis offered by traditional assessments do not accurately predict what treatment programmes should be implemented (Stuart, 1970). In contrast, behavioural assessments obtain information that is directly relevant for treatment or treatment evaluation.

4. Purpose of Behavioural Assessments:

The three major functions of behavioural assessments are: (i) description of the problem; (ii) selection of a treatment strategy; and, (iii) evaluation of treatment outcome.

An initial function of behavioral assessment is identification and description of specific behaviours for remediation. It also involves discovering specific variables (both, antecedents and consequences) controlling that behaviour. There are many models for describing behaviour, such as, the S-R-K-C model (Kanfer and Saslow, 1969), the S-O-R-K-C sequence (Kanfer aned Phillips, 1970), the S-O-R-C paradigm (Goldfried and Sprafkin, 1974), etc. Each model stresses on observation and analysis of stimulus (S), response (R), contingencies (K), or consequences (C) of specific behaviours depending on their given sequences. These sequences provide a complete description of specific behaviours as also, their functional analysis will suggest techniques for remediation. Research has found that certain behavioural techniques are inappropriate for managing specific kinds of behaviours or behaviours in specific persons, etc. For example, De Moor (1970) and Hain, Butcher and Stevenson (1966) found that systematic desensitization techniques are ineffective in subjects having difficulty with visual imagery or relaxation. Marks, Boulougouris and Marset (1971) demonstrated that systematic desensitisation is ineffective in individuals with multiple phobias or with low levels of physiological arousal. There can be difference in selection of treatment strategies even depending upon the response mode of individuals, i.e., overt motor, physiological-emotional or verbal-cognitive. If the problem is in overt behaviours (as is usually the case with mentally handicapped persons), operant techniques are most effective. When disturbances are predominant in the physiological-emotional response mode, techniques like relaxation training, emotive imagery, flooding, systematic desensitization, etc., are effective. If the problem is basically at a verbal cognitive level, an approach such as Ellis' Rational Emotive Therapy or other cognitive based therapies are effective (Borkovec, 1973). Thus, behavioural assessment can directly lead to decisions regarding specific treatment techniques best applicable in a given individual (Evans and Nelson, 1977).

Behaviour assessments are also useful in evaluating effectiveness of training programme. The comprehensive system of functional analysis is like a simple A-B experimental single case design, where phase A represents a baseline and phase B represents some form of treatment followed by a terminal assessment to evaluate if right changes have occurred due to the intervention programme (Hersen and Barlow, 1976).

5. Techniques of Behavioural Assessment:

Just as there are many techniques in traditional assessment approaches, such as, protective tests, questionnaires, etc., there are a variety of behaviour assessment techniques, each having their merits or demerits. The three important techniques of behaviour assessment are, self report measures, direct observation and physiological measures. Self report measures include data collected through behavioural interviews, inventories and self monitoring procedures. Direct observation maybe collected in a naturalistic setting or in contrived analogue settings. A variety of physiological measures are also available for use in laboratory settings.

The specific form of self report measures using behavioural assessment may vary from behavioural interviews (Kanfer and Saslow, 1969; Meyer, Liddell and Lyons, 1977), written behavioural inventories (Stuart and Stuart, 1972; Rathus, 1973; Wolff and Merrens, 1974), and others. As with traditional psychometric measures, behavioural checklists or survey schedules, must also possess characteristics of reliability, validity, norms, standardisation and statistical rigors, etc.

Self monitoring techniques are used in behavioural assessments of covert behaviours that cannot be observed by external observers. The major problem with self report measures is their unreliability and reactivity with the observed phenomena.

Direct behavioural observation constitute a hall mark of behavioural assessment techniques. Direct observation is possible only with overt motor responses. Direct observation techniques help identify specific target behaviours, its controlling events as also facilitate in later evaluation programmes. This technique can be used in natural settings (Kent and Foster, 1977) as well as in contrived (analogue) settings (Nay, 1977). Although direct observation has an advantage over self report techniques, there are other problems like observer bias, reactivity of the subject due their knowledge of being observed, etc., that can endanger the accuracy of behavioural assessment.

The physiological measures of behavioural assessment are specially used to assess behaviours in their physiological-emotional mode. Some physiological measures are indirect indices of behaviour change (such as, urine analysis to measure drug usage, blood alcohol levels to measure alcohol consumption, etc.), while others may be direct indices (such as, electromyograph or electrocardiograph readings in anxiety disorders, etc.). In spite of criticism against use of these measures (Wolff and Merrens, 1974), many investigators consider this form of behavioural assessment as vital (Borkovec, Meerts and Bernstein, 1977).

6. Behavioural Interpretation of Observations:

A charecteristic feature of behavioural assessment is an intentionally maintained a low level of inference in interpreting observations about human behaviours (Mischel, 1968; Goldfried and Kent, 1972; Goldfried, 1976). As Jones (1970) writes, "To say that Henry is mean implies that he has some sort of inherant trait, but it tells us nothing about what Henry has done. Consequently it fails to suggest any means of improving Henry. If, on the other hand, it said that Henry snatched Billy's cap and threw it on the bonfire, the situation is rendered somewhat more clear and actually more helpful. You might never eliminate 'meanness', but there are fairly definite steps to be taken in order to remove Henry's incentives or opportunities for throwing caps in bonfires...". Behavioural assessments do not seek to understand what a person is or what a person has, but what he does and the condition in which he does it.

7. Behavioural Assessment for Intervention:

The upsurge of interest in behavioural assessment is unmistakable in the past two or three decades (Wiggins, 1973; Mc Reynolds, 1975; Goldfried, 1976; Hersen and Bellack, 1976; Kazdin and Geesey, 1980; Leudar and Fraser, 1987). Much of this development is due to the recognition that assessment needs are to be directed towards treatment rather than mere diagnostic screening and classification. No doubt, behavioural assessment approaches play a vital role in providing decisions for treatment (Stokes and Baer, 1977; Goldstein and Kanfer, 1979; Karoly and Steffen, 1980).

Owing to the emphasis of behavioural assessments on intervention, its focus is more on the individual case rather than on groups (Kanfer and Saslow, 1969). There are fewer occasions for inter individual comparisons in behavioural assessments than in traditional approaches to assessment. This is also another reason why behavioural assessment deemphasises the role of diagnosis. For the behaviourist, it is unimportant whether the individual in question is diagnosed as mentally handicapped, schizophrenic or some other condition (Melin, Sjoden and James, 1983). This does not mean that diagnosis itself is

Table 3
Differences between Behavioural and Traditional Assessment

Behavioural Assessment	Traditional Assessment
Behaviour is understood as a function of its environment;	Behaviour is viewed as a function of its underlying causes;
Behaviour is sample of the individual phenomena per se;	Behaviour is a sign of some underlying construct, such as, personality, intelligence, etc.
Behavioural assessment samples varied and specific behaviours in particular situations;	Traditional assessment samples limited behaviour in broad and general situations;
Behaviour assessment is assessment for treatment and evaluation;	Traditional assessment is for identification and diagnostic labelling;
Behavioural assessments lead on directly to treatment planning and programming;	Traditional assessments bear indirect relationship to treatment planning and programming;
Behavioural assessment continue throughout treatment planning, programming and evaluation.	Traditional assessment occur mainly prior to diagnosis and treatment.

irrelevant to behavioural assessment and rehabilitation. It only means that the medical diagnosis is only considered as one and not the most important piece of information on which decisions are to be based. A diagnostic assessment is always history based, whereas a training or rehabilitation programme is always future oriented. Behavioural assessments are most useful for programme planning and intervention.

To recapitulate, there are important features of behavioural assessment in contrast with traditional approaches to assessment (See Table 3).

CRITICALAPPRAISAL OFVARIOUS APPRQACHESTO PSYCHOLOGICAL ASSESSMENT IN MENTAL RETARDATION

The history of psychological assessment has witnessed the evolution of various approaches to assessment. An attempt is made below to critically evaluate the relative merits and demerits of these approaches to psychological assessment. In the next chapter, there is a proposal for exploring the possibility for use of a new approach to assessment in persons with mental handicap.

CRITIQUE OF NORMATIVE APPROACHES

Normative approaches to psychological assessment in the field of mental retardation has evolved within the historical framework of a need to screen, identify, isolate and diagnose low achieving individuals from others. To this effect, normative approaches provide information by making comparitive evaluations of an individual with others or groups of similar persons. A merit of normative approaches is that they enable diagnostic decisions and facilitate labelling individuals as "exceptional", "special" or "mentally retarded", etc. Normative decisions are frequently required by law or administration to certify individuals eligible for social or economic benifits (Mash and Terdall, 1976). Normative assessments provide information that can be easily communicated to parents/caretakers of individuals being tested. Many times telling parents that their child is in the lower five per cent of general population with respect to an ability makes more sense than providing individual based performance scores (Singh, 1986). Normative assessments have received utmost attention in terms of the vast technical data and research it has generated in a given population or sub population of individuals. The population data that normative assessment researches have provided enable large scale policy decisions in a State. Besides, normative assessments have a long and proud history with proven utility in screening/problem identification (Witt et al, 1988).

According to Hartmann, Roper and Bradford (1979), some of the potential uses of normative assessments are:

1. They are useful for screening/identification of specific conditions within a large population.

2. They help in deriving norms for certain types of behaviours, related to age, sex or other variables. Such information may lead to decisions about whether or not to treat the problem.

3. Where norms exist for behaviours, they can be used to establish intermediate or final treatment targets, even though more specific treatment objectives are better derived through measures from other approaches.

4. Norms are useful in grouping individuals into relatively homogeneous treatment groups, which can later produce greater precision with respect to certain types of treatment most appropriate for persons with particular types of difficulties.

5. Normative data permits direct comparison of studies using different samples of individuals.

6. Normative data facilitates comparability of findings obtained through different sources;

7. Normative data is useful in evaluating clinical significance or social validity of treatment outcomes.

The essential feature in normative assessments is the comparison of individual performances to performance of his peers. In other words, they assess "differential learning" (Salvia and Yesseldyke, 1988). Normative assessments can be age scales or point scales. Earlier, normative tools were developed by scaling test items to appropriate ages. For example, an item would be placed at six year level if twenty five per cent of five year olds responded to it correctly, fifty per cent of six year olds responded to it correctly and seventy five per cent of seven year olds responded to it correctly. This means that if a test item is placed correctly at a age level, younger children fail that item and older children pass it. On the other hand, point scales are constructed by selecting and ordering items of various levels of difficulty. The levels of difficulty may not be associated with ages. The correct responses are scored and the points are summed up before total raw scores are transformed into derived scores or standard scores.

There are many conceptual limitations in the use of these Scales. The interpretation of scores on these Scales require great care. A child who has earned a age equivalent of 12-0 may have answereed correctly as many questions as the mean twelve year old. But, he may not have necessarily performed as a twelve year old, in the sense that they may well have 'attacked' the problems in a different way or demonstrated a different performance pattern than many other twelve year olds. Similarly, an eight year old and a four year old may, both, earn a age scale of six years even though they may not have performed identically. The younger child may have performed lower level work with greater accuracy (for example, successfully answered thirty eight out of forty five presented problems), while the older child has attempted more problems (for example, successfully answered thirty eight out of seventy eight problems).

The use of age scores pose problems in interpolation and extrapolation. An average score is estimated for groups of children who are never tested. Consequently, a child can earn an age scale equivalent of 3.2 when only three year and four year old children have been tested. In a sense, most tests of intelligence are standardised on non handicapped population and mental age scores are extrapolated in assessment of handicapped persons. This is an unreliable procedure (Gould, 1981).

Another problem in the use of these Scales is that they promote "typological thinking" (Salvia and Yesseldyke, 1988). The average child with mental age of six does not simply exist. The "average" child is a composite of all six year old children. By an "average" six year old, we only mean a representative range of performance typical in the median of ninety per cent.

The use of age scales imply a false standard of performance. One expects a four year old to perform like a four year old, or a eight year old to perform like a eight year old child, etc. However, in actuality, equivalent scores insure only fifty per cent of any age group of children will perform below that age level.

Most normative intelligence or adaptive behaviour scales are ordinal and not equal interval scales. Although some normative scales of intelligence, such as, the Stanford Binet Scale (1972 revision) appear like age scales they are actually point scales (Salvia, Yesseldyke and Lee, 1975).

It is frequently criticised that normative approaches are unable to meet the individual needs of assessees. Weiss (1980) demonstrated that general assessment strategies espoused by normative approaches are only remotely connected to the content and skills targetted for teaching or training

(Rotatori, Fox and Macklin, 1985). At times, the information derived from normative approaches have even led to inappropriate recommendations concerning training or rehabilitation in individual cases (Becker and Englemann, 1976).

Normative assessments possess low ecological validity, i.e., the individual examinees may not be required to perform his natural behaviours in order to perform successfully on these tests. Normative test items often invoke artificially contrived situations and sample behaviours within specially contrived situations. Although such items may have diagnostic validity, they prove ineffective in guiding programme planning or intervention (Melin, Sjoden and James, 1983).

Most normative assessment tools have been designed and developed for use with non handicapped individuals. All these tools have to be modified or adapted before use with the handicapped population. Otherwise, normative comparisons would be inappropriate. For example, verbal items designed for use with normal children need to be pantomimed for children with hearing impaired, or written items may have to be read for children with visual impairment. It is not only stimulus demands of the test, sometimes response demands of the test may need to be modified to suit the special needs of handicapped children. It is questionable if ad hoc modifications of tests bo suit individual needs of the special children remain any more "standardised" once the conditions under which they were standardised have been altered. These problems of adaptation are equally true of normative tests of intelligence, adaptive behaviour as well as achievement tests. Although, some normative adaptive behaviour scales, such as, Vineland Social Maturity Scale (Doll, 1953), are standardised on persons with mental handicap; they have been criticised for being standardised solely on institutionalised individuals with mental retardation. Hence, they cannot be justifiably used to discriminate all persons with mental retardation.

Most of the expectancies of social competence in institutionalised persons with mental retardation become less useful in the current context of a trend towards deinstitutionalisation (Kazdin and Matson, 1981). A similar limitation exists in use of normative tests of achievement. Although norm referenced tests of achievement were proposed as a supplement to normative tests of intelligence or adaptive behaviour, its focus is limited to assessment of specific areas. Indeed, several teaching or training programmes have evolved based on these specific assessments, such as, Peabody Individual Achievement Test (Dunn and Markwardt, 1970), Learning Potential Assessment Device (Feuerstein et al, 1972; Haywood et al, 1975), DISTAR (Englemann and Osborn, 1976), Wide Range Achievement Test (Jastak and Jastak, 1978), Woodcock Johnson Psychoeducational Battery (Woodcock, 1978), Wide Range Achievement Test, revised (Jastak and Wilkinson, 1984) and others which help in the differentiation and diagnosis of mentally retarded individuals (Liepmann, 1981).

When we review the progress of normative assessments in India, we encounter specific problems or inadequacies as referred by Mukherjee (1980) about Sharma's Draw a Bicycle Test of Intelligence (Sharma, 1977). This test of intelligence is allegedly standardised on 11-16 years age group of persons, and developed in the absence of any discussion on the construct of intelligence. The test is built on an erroneous assumption that individual differences in the drawings of a bicycle would reveal variations on intelligence. It ignores the fact that graphical ability can be easily developed by training or exposure to environment (Sinha, 1986).

There are many normative tests of intelligence which have been developed or standardised in our country in the absence of any description of its sample characteristics. In most cases, sampling is incidental or purposive and not stratified or random. Some tests do not give details about the samples on which norms have been prepared or whose validities and reliabilities are established (Dubey, 1977; Sharma, 1977; Malin, year not mentioned). In some other instances, size of stratified sub samples are so low (even less than ten) that no meaningful comparisons can be made. An example of this error is Phatak' (1984) Draw-a-Man (or Woman) test which has less than ten persons in the age group of 16 years.

Sometimes psychological tests designed to measure intelligence have actually measured something else. An example is Sinha's (1977) Draw Yourself Test, which aims to measure intelligence, but actually measures the child's self concept (Kulkarni and Puhan, 1988). In rare cases, where adequate normative measures of intelligence and social maturity have been indeed developed for mentally handicapped, the results are not published (Ram, 1978).

These problems are aggravated in Indian setting, particularly with reference to mental retardation, because the value of time, spirit of competition, concept of working for a score, using paper pencil to write, etc., are all alien to our culture (Ramalingaswami, 1975). A special problem encountered in Indian settings is with regard to knowing correct chronological age of the child being assessed (Ramachandran et al, 1968) so as to enable accurate normative comparisons. Verma and Pershad (1984) point out to this arbitrary nature of chronological age and date of birth information provided even in school records to suit admission rules, not to speak of children who do not go to school. This arbitrariness of age has led some workers to seek grade norms rather than age norms (Jalota and Singh, 1967; Jalota, 1973). If norms based on grade level performance is considered, the Indian situation is so grim that an overwhelming majority of our children drop out at the end of primary school. We can neither take Western norms in toto. Whereas in West, the mean age of pupils in Class V is ten years, the average Indian pupil of ten years is not in Class V. He is no longer in school (Verma and Pershad, 1984). The construction of normative verbal scales of assessment pose additional problems owing to multiplicity of languages in our country. We need to develop different comparative norms for rural-urban, literate-illiterate, upper and lower SES, etc.

Williams (1971) has cautioned the dangers in using tests standardised on white children with black children. The situation being so even with different races of children, one can imagine the peril of using tests standardised on one population with another. Hence, it is small wonder that some Western courts are beginning to question the legality of normative assessments (Larry P vs Rifles, 1979). In fact, IQ testing has been outlawed in San Francisco, while group tests of intelligence have been banned in New York city schools (Bersoff, 1973). There is an urgent need to compile and standardise test batteries especially for individuals with mental retardation. Some work is already underway in this direction by Bondy et al (1971) in Germany, De Meyer (1978) and Schopler and Reichler (1979) in United States and others.

The problems of psychological assessment in cross cultural context can be subdivided into two broad categories. First, as pointed out by Mukherjee (1980) and Sinha (1966) there are normative measures which have been developed in foreign cultures, but are blindly used on Indian samples by even assuming their original reliabilities and validities in our settings. Second, some investigators have studied two or more cultural groups specifically on some common cognitive/intellectual characteristic using the same or equivalent foriegn tools. What is required is not a slavish imitation of foriegn tools, but a truely epic approach in development of indigenous or local norms. Sinha (1986) suggests to give up the habit of blind borrowing from Western culture, avoidance of duplication of efforts, developing theoretically adequate framework and concepts and relating them to the rich Indian heritage.

As pointed out earlier, normative assessments do not directly facilitate decisions regarding instructional activities to be taught to assessed individuals. Normative assessments provide inadequate information about curriculum content as well as process evaluation. Process evaluation or formative assessments involve continuous measurement of identified behaviours before the final outcome or summative evaluation is conducted (Scriven, 1967). Process evaluation involves design sequencing, integration of the contents of curriculum composition, etc. In short, it fine tunes the instructional system. Normative assessments lack precision for generating such information (Bereiter, 1972).

Normative assessments promote and reinforce a belief that the locus of problem is within the child or assessee. Even though the examinee may differ from the norm, the real problem may not be within the child. It maybe that the teaching, placement or curriculum was inappropriate to the needs of subjects. Normative approaches fail to give allowance to such idiosyncratic features in assessment of individual examinees.

Normative assessments are also criticised for their single objective of giving numerical indices (such as IQ, SQ, DQ or MQ) to individuals. Despite the caution (Binet and Simon 1905), several later investigators from Goddard (1911) to Jensen (1980) have argued, in vain, that IQ is an immutable entity of the construct of intelligence. It has been reliably demonstrated that environmental and educational variables greatly influence scores on intelligence tests (Hunt, 1951), IQ scores cannot be typically viewed as predictors of school or vocational performance (Matarazzo, 1985).

Although there is a relationship between intelligence and academic or vocational achievement, the relationship is not one to one. The scores of an individual on an intelligence test fail to predict future potential at school or vocation (Ross, 1980). These scores cannot even say much on the level of competence a person can achieve as a function of systematic training (Beck, 1983). And, wherein DQs are involved scores are relatively even more unstable over time than IQ scores (Bhakoo et al, 1977). Hence it may be argued that normative procedures involve a dangerous oversimplification, particularly in the context of assessment of individuals with mental retardation (Wolfensberger, 1968) It can be reiterated that persons with mental handicap show marked inter individual as well as intra-individual discrepencies in their abilities. Once an average numerical score (such as IQ) is given it overshadows the distinct variabilities in performance and also blinds us to the fact that inter and intra individual differences exist in persons with mental handicap (Kay, 1977).

The use of normative developmental schedules and adaptive behaviour scales have become commonplace in assessment of individuals with mental retardation because of their ease in administration and also the practical advantage of identifying observable behaviours. These instruments are quick and efficient to use, easily yield quantifiable data and do not require extensive professional training for scoring and administration. However, there are troublesome interpretative problems. Many of these measures depend on objectivity and reliability of information provided by respondents. Most researches report poor agreements between parental or teacher evaluations of developmental skills or adaptive behaviours, and the actual observations of individuals with mental retardation (Rutter, Tizard and Whitmore, 1970). It is defended that low agreements between informants and actual observations may not be due to invalid techniques, informants bias, interviewer error or observer's shortcomings (Mitchell and Shepherd, 1966). The same problems exist even with highly structured instruments and objective tools of assessment (Haipern, 1977). It maybe that the behaviours of individuals with mental handicap are themselves situationally variable, in home and school or between informants. These limitations indirectly question the foundations of normative assessments i.e., relevant psychological characteristics are not independent of the assessment situation (Liepmann, 1981).

There have been instances when different normative tests measuring the same psychological variable has given different numerical scores for the same individual. In an epidemiological study on mentally retarded children below fifteen years, at Camberwell in London, it was found that some children classified as severely retarded on a test of language were reported mild or moderate retarded on tests of visuo motor and social maturity functioning. The score discrepancies were found to be statistically significant in a major proportion of children included in the study (Gould, 1977).

A special problem in normative assessments occur for children with multiple handicap. Nizamie et al (1989) present five cases to highlight the special difficulties and limitations in use of normative assessments in nental retardation, especially in children with associated problems like epilepsy, hyperkinesis, problem behaviours, severe language deficits, sensory impairments, cerebral palsy, etc. Depending on the nature, modality and severity of their problems, often, these persons are dubbed as "unstable'. If a rigid approach is applied in test administration, scoring and interpretation, the actual potential of these individuals are grossly underestimated. Besides, attentional, motivation, comprehension or emotional variables influence test performance. The onus of test compatibility is shifted from test/test procedure onto the patient (Kay, 1977).

Some authors have questioned the basic premise of Gaussian distribution of intelligence (Zigler, Balla and Hodapp, 1984), and consequently, the pernicious effect of labelling persons which leads to drawing unsubstantial inferences about an individual's present or future behaviours. For example, when a moderately mentally retarded person is being labelled as "trainable", it suggests that he can only learn rudimentary academic skills or that he has low ceiling of adaptive behaviours in his repertoire. In fact, further assessment of the individual is likely to show that he is functioning adequately in several adaptive skills. It is argued that normative tests are particularly insensitive to variations at the lower extremes of intelligence (Kay, 1977; Gould, 1981; Liepmann, 1981).

In the area of normative achievement tests, most work in India has been in the direction of designing such tests to predict educational or scholastic achievement on the basis of pupil's performance (Chatterjee, Mukherjee and Mitra, 1978; Shantamani, 1979) or in relation to socio economic status, family background and other actuarial variables (Vasantha, 1978). There is not much work done in this area by psychologists either in terms of using educational achievement tests as means to devise instructional objectives, discover student cognitive strategies for learning, etc. (Puhan and Das, 1979). A fresh line of thinking on normative assessments comes from Puhan, who insists on ascertaining psychometric invariance of a test before using it. In a series of studies (Puhan, 1975a; 1975b; 1979c; 1982), he describes the concept of psychometric invariance as simply "meaning invariance" of test across different developmental, cultural and other groups and assessees whether or not a test is "perceived" similarly by individuals belonging to charecteristically different groups. His research in the area suggests that many standardised tests, which are often used in India, are differently perceived by testees belonging to different age (Puhan, 1979b), culture (Puhan, 1980) and sex (Puhan, 1979a) groups. Emphasising on the matrix equivalence of psychological tools, Puhan (1978a) suggests that conventional reliability and validity assessment should be substituted by psychometric invariance assessment which simultaneously evaluates both consistency and meaning of these tools in more relevant terms. However, he cautions researchers to fulfill the prerequisite of including many marker variables in factor analysis of the test under consideration before assessing its psychometric invariance (Puhan, 1978b; 1981). He also investigated the nature of marker variables and found that "unrelated markers" are more effective in accounting for a greater portion of the test's variance then "related markers" (Puhan and Dash, 1981).

CRITIQUE OF CRITERION REFERENCED APPROACHES

The information from criterion assessments lead directly to instructional decisions in individual cases (Proger and Mann, 1973). It goes beyond providing a numerical index and helps monitor the student's progress, provides for programme evaluation and periodical midcourse corrections in training. When the individual performs adequately in one of the series of instructional objectives, he can move to the next specified objective; or else, retraining in the same instructional objective can be prescribed.

It is difficult to establish suitable criteria of success or failure to enable decisions regarding what specific activities are to be included or excluded in the curriculum using criterion measures (Witt et al, 1988). Since the assessed behaviours on a criterion referenced test becomes the goal for instruction, rather than select samples of what the individual should know, a potential trouble spot in criterion approaches is that teachers may narrow their focus and teach only what is assessed on the test. This can result in loss of richness and variety of curriculum that maybe otherwise generated from normative assessments. Ebel (1975) summarises the demerits of criterion measures, when he writes, "...criterion referenced tests have the appeal of novelty and innovation. It may seem to offer more meaningful measurement of achievement, and also, escape the problems inherent in normative measurements. But it creates special problems. There is the problem of repeated testing of those who do not reach the criterion at first, plus the problem of creating multiple parallel test forms for use in repeat testing. Even two levels above the criterion is treated as completely satisfactory, while achievement even so slightly below the criterion may be treated as unsatisfactory. There is also the problem of distributing and using detailed, bulky, but ephemeral reports".

Although criterion measures aim at identifying whether a given behaviour is present or absent in an individual, it is erroneous to consider them as valid instruments for assessment of underlying psychological functions of the said behaviours. For example, in Behaviour Assessment Battery (Kiernan and Jones, 1982). there is an item related to object permanence in which it is implied that a child has object permanence if he succeeds in removing a cloth from an object in front of him. However, the question remains, whether the child has really attained object permanence in the performance of the said activity or for any and all circumstances related thereof. Criterion measures do not aim, nor can they answer such functional assessments.

The appearance of CRT's in a formal and standardised fashion is of recent origin in our country (Verma, and Pershad, 1984). There is still need for psychologists to overcome their shyness about developing such measures and contribute towards Individualised Guided System of Instruction (IGSI) or

Competency Based Learning (CBL) or Individualised Education Programmes (IEP) or Individualised Written Rehabilitation Programmes (IWRP) (Yadav and Govinda, 1978; Frey, 1984; Mathur and Gupta, 1984). There is urgent need to work on criterion measures, especially in the assessment of persons with mental retardation.

CRITIQUE OF BEHAVIOURAL APPROACHES

As we know, normative measures of intelligence are essentially screening devices to isolate or identify mentally handicapped persons from others. But, the crucial question is whether mere screening and/or identification of these subnormal individuals is sufficient. In fact, the movement towards isolating children with mental retardation from the mainstream has led to countless abuses of IQ testing that have been now documented (Runt, 1951). In everyday clinical practice, the allure of IQ score is still very strong, despite the fact that its predictive validity for most populations is largely unknown. What, for example, would be anticipated out of an eight year old autistic child with an IQ score of 110? Obviously we do not expect him to outperform seventy per cent of his peers in third grade. But we might be grateful on the grounds of reports that the long term outcome of autistic children with high IQ score is somewhat better than those with lower scores (De Meyer, 1973). Given such predictive limitations behaviourists ignore IQ testing and instead concentrate on direct observation (Bersoff, 1973) or daily measurements in a systematic and standardised manner (Bijou and Peterson, 1971) in order to permit comparisons between behaviours, techniques or populations.

Despite the availability of several measures for behavioural assessment this approach is yet to achieve the same level of methodological sophistication that is associated with many behavioural remediation programmes. The field of behavioural assessment appears to be at a point when the need for measures currently outstrips available procedures. Hence, there is the danger of poorly conceived assessment procedures establishing themselves as "behavioural measures". There are certain basic issues in the current efforts to develop and validate behavioural assessment measures that need to be attended to in order to ensure that the field will progress in a nethodologically sophisticated and clinically useful manner. Even though behavioural measures have evolved to a large extent as a rejection of the traditional modes of assessment, the same problems of validity and reliability of these measures continue to plague both these orientations (Goldfried and Kent, 1972; Evans and Nelson, 1977). Behavioural measures also need to be standardised in order to allow for clearer interpretation and generalisation of research findings across several outcome studies. The only Scale available for behavioural assessment of children with mental handicaps in India is BASIC-MR (Peshawaria and Venkatesan, 1992).

In an attempt to establish a different paradigm for understanding and changing behaviours, behaviourists have maintained that any given behaviour is to be understood within its environmental context. To say that each person's behaviour will vary from situation to situation is just as naive as asserting that everything an individual does maybe understood in terms of an underlying generalised 'construct. The true state of affairs undoubtedly lies somewhere between the two extremes (Goldfried and Linehan, 1977). However successful behavioural approaches maybe in the field of mental retardation, it cannot escape the criticism of being a highly sophisticated technology. It requires a certain degree of specialised training before one can use the technology effectively in persons with mental retardation. Moreover, it involves high expenditure on time, energy and money to train expertise in the field of behavioural technology. If assessment strategies and management technologies can be explored wherein this high investment can be minimised, it would facilitate management of individuals with mental handicap (Bates and Hansen, 1983).

CHAPTER TWO:

IDIOMETRIC APPROACHES TO NEUROPSYCHOLOGICAL ASSESSMENT

INTRODUCTION

The brain is one of the most complex anatomical structures in human body. It has been long argued that brain forms the primary basis for control and modulation of all behaviours (Luria, 1973; Widroe, 1974; Filskov, Grim and Lewis, 1981). In fifth century BC, Herophilus regarded brain as the "seat of intelligence". He guessed that middle ventricle is vital for cognition, and posterior ventricle is important for memory. In second century BC, Galen denied this postulation and proposed that there were certain substances in brain which performed all its functions.

The greatest impetus to unravelling the mysteries of human brain came after the anatomical studies by Vesalius in eleventh century AD. He postulated that brains of all living creatures (aves, mammals and man) were structurally similar. Although Vesalius' original proposition of the absolute value of brain mass as an index of intelligence has been abandoned, it has led to a revised proposal that the ratio of brain mass to total body mass of organism maybe an appropriate index of specii intelligence (Jerison, 1973). For a given body mass, mammals have consistently higher brain mass. The brains of mammals are ten to one hundred times more massive than brains of contemporary reptiles with comparable size. Further, when we look at primates (a taxon that includes man), they are separated from the rest of mammals. On an average, primate brain is more massive by a factor of about two to twenty than those of non-primate mammals of the same body mass. The beast with largest brain mass for its body weight is man.

In seventeenth century, Descartes proposed that "human soul" resided in "pineal gland". Towards the end of eighteenth century, Gall contended that various faculties in humans are localised at different centres or organs of brain. According to him, the vital forces behind human brain was located in brain stem, intellectual forces are situated within areas covered by the two hemispheres and corpus collosum respectively. He even proposed that the shape of skull enabled deduction of moral intellectual or social qualities of an individual. This was the basis of his phrenology. In 1825, Bouillard held that brain functions are localised. He illustrated that discrete lesions in cortex led to paralysis of one limb rather than other. In some way or other, all these simplistic postulations have become the basis for development of a modem scientific discipline-neuropsychology.

DEFINITION OF NEUROPSYCHOLOGY

Hecaen and Albert (1978) viewed neuropsychology as an "interface between neurosciences (such as, neurology, neuroanatomy, neurophysiology and neurochemistry) and behavioural sciences (such as, physiological psychology, developmental psychology and psycholinguistics)". Neuropsychology draws from several disciplines, but its central focus is on development of a science of human behaviour based on brain functions. Luria

(1973) defined neuropsychology as "a new branch of science with specific and unique aim of investigating the role of individual brain systems in complex forms of mental activity". According to Beaumont (1983), neuropsychology is "a science that seeks to understand relationship between brain and behaviour, i.e., it attempts to explain the way in which activities of brain are expressed in observable behaviours". In simpler terms, neuropsychology is "concerned with study of relationship between brain functions and behaviour" (Gilandas et al, 1984) or " study of brain behaviour relationships" (Obrzut and Hynd, 1986). There are many branches of neuropsychology, classified on the basis of a life span approach (such as, pediatric neuropsychology, child neuropsychology, adult neuropsychology, geriatric neuropsychology, etc.), or on their content of investigation (such as, general neuropsychology, experimental neuropsychology, forensic neuropsychology, behavioural toxicology, etc).

PRINCIPLES OF BRAD) BEHAVIOUR RELATIONSHIPS

In their attempt to understand brain-behaviour relationships, neuropsychologists have proposed several principles to explain the working of brain. They are broadly summarised as follows:

1. Principle of Cerebral Lateralisation:

Since the discovery of two hemispheres in human brain, it is proposed that they may be controlling or modulating different behavioural functions. Research and speculation on cerebral specialisation of functions extends almost over a century (Bogen, 1977; Kinsbourne and Hiscock, 1978; Allen, 1983). The Greek philosopher, Hippocrates, had early contended that human brain is "double" (Bogen, 1969a; 1969b). Plato recognised "duality of mind": "one partaking of reason and the other devoid of it" (Rather, 1965). A reference to the dual ways of knowing or the two cognitive styles of functional brain is excellently surmmarised by Raina (1984).

A body of systematic evidence has been accumulated over years to demonstrate that the two brain hemispheres specialise in different functions (Hartlage and Telzrow, 1983). It has been shown that most sensory and motor functions of brain are enervated contralaterally, which means that left side of cortex controls right side of body and vice versa. Evidence for cerebral lateralisation of brain functions come from the following sources:

i) Split Brain Research:

Many studies have attempted to discover functional effects on behaviour of organisms by carrying out special procedures of separating the two hemispheres called "cramotomy" (Sperry, 1973; 1974; Gazzaniga, 1967; 1970; Bogen, 1977; Ornstem, 1978). Interestingly compelling evidence towards functional or behavioural changes have been collected from a mid sagital dissection of hemispheres but not seen when the brain is cut horizontally, coronally or diagonally (Bogen, 1977).

ii) Lesion Studies:

A body of evidence for or against relegating specific functions or behaviours to specific hemispheres have been collected by means of studying effects of brain lesions in individuals or groups of individuals (Ettlinger, Warrington and Zangwill, 1957; Bogen and Bogen, 1969a; 1969b; Luria, 1976).

iii) Anatomical Evidence:

Evidence for functional localisation and hemispheric lateralisation in CNS have been gathered by injecting sodium amytal to induce temporary anaesthesia of certain parts of brain, such as, by means of WADA technique, etc. (Wada and Rasmussen, 1960; Filbey and Gazzaniga, 1969; Bogen and Gorden, 1971; Wada, Clark and Hamon, 1975).

iv) Dichotic Listening Studies:

Research on cortical lateralisation of functions assumes the existence of contralaterality in hemispheric processing. Dichotic listening techniques involve application of two different verbal stimuli simultaneously to both ears in order to see which hemisphere processes verbal messages (Shankweiler, 1966; Gazzaniga, 1970; Krashan, 1975; Ingram, 1976).

v) Lateral Eye Movements and Tachistoscopic Studies:

The observation of Lateral Eye Movements (LEMs) when people engagein reflective thinking offer another clue to lateralization of brain functions. Empirical evidence shows that when right handed (i.e., left hemisphere dominant) individuals engages in reflective thinking, there is LEM from right to left; and when engaged in intuitive thinking, the eye movements are from left to right (Duke, 1968; Baken, 1971; Gur, 1975; Hines, 1975; Hines, Sutker and Satz, 1976).

vi) EBG Studies:

In recent years, use of electroencephalograph and evoked potentials have resulted in a wealth of data on cerebral asymmetry of functions (Butler and Glass, 1974; Galin and Ellis, 1975; Omstein and Galin, 1976; Brown, 1977).

The various functions that have been attributed to the two hemispheres are discussed below:

LEFT HEMISPHERE

The left hemisphere or "dominant hemisphere" (Lezak, 1983) in majority of right handed individuals organises and processes information in a logical, sequential, analytical fashion and is particularly well suited for processing verbal information (Reitan, 1955a). There is substantial evidence to show that higher cortical functions exclusive to human species, such as, planning, language, reading, writing. calculations and conversational thinking are vastly mediated by left hemisphere (Geschwind, 1970b; Hunter, 1976). Krashan (1975) lists the following evidence to justify the above.

i) Loss of speech is more common in left side brain lesions than in right side brain lesions (Russell and Espir, 1981);

ii) When left hemispheres is temporarily anesthetised by WADA technique, it results in temporary loss of speech. The same effects are not seen when right hemisphere is anesthetised (Wada andRasmussen, 1960).

iii) When competing simultaneous verbal material is presented to the two ears, there is a consistently high rate of response accuracy for right ear messages than for left ear information as seen in dichotic listening studies (Kinura, 1967; Springer and Eisenson, 1977).

iv) A split brain patient presented with a word in his left visual field will correctly write the word with his hand out of view. But, when asked what he has written with his left hand, he gives a totally incorrect response (Nebes and Sperry, 1971). Besides, when verbal material is presented to left and right visual fields simultaneously, most right handed subjects show right visual field superiority than left preferences.

v) There is increased alpha wave suppression and greater evoked potential responses for dominant hemisphere than non dominant hemisphere during performance of verbal tasks as seen in EBG studies (Robbins and Mc Adam, 1974).

In sum, left hemisphere mediates sequential processing and analytical thinking (Brandwein and Ornstein, 1977), acquisition of new habit patterns (May, 1977), analysis of common attributes from a task to form systematic relationships amongst them (Mc Fie and Piercy, 1952), etc.

RIGHT HEMISPHERE

The right hemisphere or "non dominant hemisphere" organises information holistically in a visuo spatial gestalt manner (Reitan, 1955b). The right hemisphere, more than left, participates in affective (Schwartz, Davidson and Meer, 1975) and melodic types of information processing (Gordon, 1975). Van Lancker (1975) points to the role of right hemisphere in analysis of voice intonation, an integral component of expressive language. The primary expressive mode of language in right hemisphere is metaphorical (Eccles, 1973; Samples, 1976). It plays a vital role in recognition of faces, retention of visual patterns, geometrical shapes, signs or graphs, iconic presentation of information in the form of diagrams or flow charts (Hines, Sutker and Satz, 1976), non verbal auditory pattern perception and graphic memory, such as, Morsey Code, awareness of body position, spatial orientation, perception of fine and gross motor activities, and tactile perception (Ornstein, 1978).

While left hemisphere sequentially processes a single mode of representation, owing to its greater neuronal capacitty, right hemisphere can deal with greater informational complexities. It can process many modes of information multiply or simultaneously within a single cognitive task. Thus, left hemisphere enables convergent thinking and right hemisphere is capable of aesthetic judgments, creative and divergent thinking (Hadamard, 1945; Perrone and Pulvine, 1977.

Although tentative distinctions and functional asymmetries of each hemisphere are postulated, they do not imply that brain works in discrete and simplistic fashion. For example, Goodglass and Quadfasal (1977) found that only 53 per cent of their 123 left handed subjects were left hemisphere dominant for language function, while the remaining 47 per cent were right hemisphere dominant. These observations reflect broad trends in working of hemispheres rather than being specifically diagnostic in individual cases. No simplistic dichotomy of function can do justice to the sophistication and complexity of human brain.

The ontology in asymmetry of brain function has its beginings at birth or even prior to birth by thirty one weeks of foetal life (Witelson, 1977). After birth, hemispheric asymmetry results in the expression of individual differences in behaviour, learning styles and interests (Hartlage, 1981a). In approximately eleven per cent of individuals with right hemisphere dominance (Geschwind, 1979), performance on non verbal measures were found to exceed scores on verbal tests (Hartlage, 1979). Such individuals learnt best via a visuo spatial experiential teaching approach and demonstrated difficulties with highly verbal sequential subject areas (Hartlage, 1981b). The behaviours of right dominant individuals were found to be less outgoing and they seemed to prefer hands-on, physical activities to listening a story. Asymmetry in the opposite direction, i.e., left dominance is evident in approximately 65 per cent of population. These individuals are characteristically more outgoing with below average visual discrimination skills. They perform better on verbal tasks than on non verbal measures and generally learn more efficiently with an auditory-phonetic sequential teaching approach (Hartlage, 1981b; Raina, 1984).

2. Theory of Specific Lobe Functions:

Brain behaviour relationships can be also unravelled locally in terms of specific functions connected with specific areas in brain. The cerebral cortex is differentiated into four main lobes, such as, frontal, parietal, temporal and the occipital respectively.

The frontal lobe, located most anteriorly, contains the primary motor strip. The expression of functional deficits on injury to this area is related, among other things, to the hemisphere that is involved. A left frontal lesion, for example, may disrupt expressive language functions. The specific area of left frontal lobe associated with speech production is called Broca's area (Broca, 1861). A right frontal lesion interferes visuo spatial motor activities, such as, reproducing letters or copying figures. The parietal lobe, located posterior to frontal lobe, is the site of sensory and receptive abilities. Lesions in this lobe disrupts sequential organisation of speech (in dominant hemisphere) and visuo spatial perception (in non dominant or right hemisphere). The temporal lobe in each hemisphere, lying inferior or underneath frontal and parietal lobes, is associated with auditory processing and related memory functions. Wernicke's area, located in auditory association area of left temporal lobe, is the site for receptive speech. Posterior to parietal lobe is occipital lobe, which is primarily associated with visual functions.

3. Cytoarchitechture of Brain:

In addition to bilateral and lobe wise functional organisation of brain to understand its relationships with specific behaviours, neuropsychologists utilise cytoarchitechture to 'map' specific regions in cortex to mark specific functions (Brodman, 1909). According to Brodman's system, specific areas of cortex are assigned particular numbers to facilitate communication between investigators. For example, Brodman's area 4 corresponds to primary motor strip (Walsh, 1978; Moyer, 1978).

4. Theory of Localisation:

A common feature to all the above discussed approaches to understanding brain-behaviour relationships is their identification of specific locations in brain related to discrete behavioural functions. Beginning with the impressive discoveries by Broca (1861) and Wemicke (1874) that a complex mental function is localised in a particular region in cortex and that right and left hemispheres have radically different functions, similar centres were sought to be identified even for other behavioural functions (Ferrier, 1876; Kleist, 1936). Penfield and Roberts (1959) postulated specific brain sites below cerebral cortex as connected with appetite, balance, thermal regulation, blood circulation, precision movements and breathing. They stimulated specific regions of the cortex and found that patients reported a snatch of memory, a smell from the past, a sound or color trace, etc. In some cases, stimulation of occipital regions led patients to see a fluttering butterfly with such compelling reality that some of them even stretched out their hands to catch them. These findings led to the irresistable conclusion that memories are stored somewhere in the cortex waiting to be retrieved by electrical impulses, which, of course, are ordinarily generated within brain itself (Geschwind, 1965).

A host of studies on localisation of brain functions continued to flourish in the "splendid seventies". Some investigators postulated specific centres for concepts (left inferior parietal lobe), writing (posterior part of left middle frontal gyrus), mathematical calculations, reading, spatial orientation, etc. An extreme form of localisationist view identified centres for perception of living objects against another centre for perception of non-living objects (Nielsen, 1946).

5. The Antilocalisation Position:

Even while localisation theories continued to flourish, Jackson (1878) argued that complex mental processes are organised and reorganised within different levels of brain, not merely localised in circumscribed areas of cortex. The antilocalisationists contend that neurological organisation in human beings cannot be localised within a single or small segment of cortex, but require the integration of many different brain structures (Goldstein, 1936; 1944; 1948). At an extreme, some antilocalisationists regard human brain as an undifferentiated entity (Head, 1926; Lashley, 1929). For example, Lashley (1929) conceptualised brain as equipotential, i.e., each portion of brain tissue is capable of performing almost any function. He argued that complexity of functioning determines then mass of brain tissue required. He supported evidence for his laws of equipotentiality and mass action by numerous ablation studies on animals and lesion studies on human beings.

Thus, at one extreme, localisationists consider behaviour as a function of specific brain structures, and, at another extreme, antilocalisationists consider behaviour as a function of undifferentiated holistic neurological activity. Obviously, neither position can provide a completely satisfactory explanation for understanding brain behaviour relationships. Localisationists cannot explain general cognitive deficits resulting from specific brain lesions, just as antilocalisationists cannot account for specific cognitive deficits resulting from generalised brain damage.

Implicit in both these positions is the recognition of human brain as a machine or reactive system, whose activities are entirely determined by stimuli from outside world. This mechanistic view of human brain as a passively responding device is being increasingly questioned. The situation is rapidly changing towards considering the brain as a more active and creative entity in formulating, planning and designing schemes, but in a determined way such that it is subject to deterministic analysis and scientific explanation.

6. Luria's Model of the Working Brain:

Luria (1973; 1980) reexamined basic concepts of "function", "localisation" and "symptom" as held by earlier theorists. Earlier investigators had understood the term "function" to mean function of a particular tissue, such as, secretion of bile as function of liver, secretion of insulin as a function of pancreas, etc. According to Luria (1973), this definition does not meet every use of the term "function". When we speak of function of digestion, for example, we cannot understand it as a function of a particular tissue. Obviously, the whole process of digestion is carried out, not as a simple function of a particular tissue alone, but as a complete functional unit or system embodying many components and different levels of related apparatus. A functional system differs not only in complexity of its structure, but also, in mobility of its component parts. The same task maybe performed by varying mechanisms of the given functional system. For example, different body movements made by a person has the character of a complex functional system. The elements performing this activity maybe interchangeable in character and can be achieved by totally different methods. In Hunter's well known experiments, for example, a mouse achieved its goal in a maze by running in a certain way. But when one element of the maze was replaced by a dish of water, it did so by swinming movements. The same interchangeable character of movements necessary to achieve a required goal can be clearly seen m any human cognitive or behavioural activity. Naturally, all mental processes such as perception, memory, gnosis, praxis, speech, thinking, reading, writing, etc., cannot be presumed to be the direct function of a limited cell groups or localised in particular tissues of brain. The basic forms of conscious activity must be considered as complex functional systems (the term was introduced and developed by Anokhin, 1963).

When the concept of functional systems is accepted, classical ideas of localisation need to be revised. While functions of specific tissues may have precise localisation in particular tissues, there can be no question of localisation of complex functional systems in limited areas in brain cortex. Mental functions are organised in systems of concertedly working zones each of which performs its role within a complex functional system and which maybe located in completely different and often distant areas of brain.

According to Luria, external aids (such as a knot in a handkerchief to remember an important thing) are vital elements in establishing functional connections between individual parts of brain. By means of such aids, even those areas of brain may become connected into components of a single functional system (Leontiev, 1959). Vygotsky (1960) calls this as " extracortical organisation of complex mental functions".

Further, "localisation" of higher cortical functions is not static or constant, but changing in nature during the entire course of ontological development of brain. During ontological development of higher mental functions, it is not only the structure but also inter relationships between them undergo changes with in the organism (Vygotsky, 1960). For example, the initial concrete level of thinking in a child changes to more abstract mode of thoughts involving complex forms of logical analysis and synthesis. Thus, the whole scheme maybe understood as a theory of "dynamic localisation", rather than "static localisation" is postulated by earlier workers. In fact, there is evidence to show that lesion of a particular part of brain in early childhood has a systematic effect on higher cortical areas superimposed above it. By contrast, a lesion of the same region in adult life affects lower zones of cortex, which now begin to depend on them. For example, lesions in secondary areas of visual cortex in early childhood may lead to systematic under development of higher zones responsible for visual thinking, whereas lesions of the same area in an adult can lead to only partial defects in visual analysis and synthesis, by leaving more complex forms of thinking unaffected.

Luria (1973) offers a revision of the classical concept of "symptom". Earlier "symptom" was understood as directly localised to a specific area of brain. For example, disturbance in general sensation must always indicate a lesion of post central gyrus or its tracts. The loss of part of visual field must indicate a lesion of retina or optic tracts or visual cortex. The same concept of "symptom" cannot hold true in understanding brain behaviour relationships. Wherein a mental activity is viewed as a complex functional system, a lesion m any of its connected areas may lead to disintegration of the entire functional system. Hence, "symptom" or "loss" of a particular function tells us nothing about its "localisation". It requires a detailed psychological analysis of functional system as a whole in order to relate a symptom to a location. A detailed "syndrome analysis", not "symptom analysis", is what is required to understand brain behaviour relationships. Therefore, as Luria (1973) cautions, neuropsychologists should be vary of attempting direct localisation of an observed behavioural symptom.

To summarise, human mental processes are complex functional systems and they are not "localised" in narrow circumscribed areas of brain. Higher mental functions take place through participation of groups of concertedly working brain structures, each making its own contribution to the organisation of functional system. The first essential is to discover basic functional units in human brain, and then their role in complex forms of mental activity.

According to Luria (1973), there are three principal functional units of brain participating in any type of mental activity. There is a unit for regulating tone or waking, a unit for obtaining, processing and storing exostimuli and a unit for programming, regulating and verifying mental activity. Human mental processes always take place only with the participation of all these three units. Each of these basic units are arranged hierarchically in structure and consist of three cortical zones built upon one another: primary (projection) area which receives impulses from and sends impulses to the periphery, secondary (projection-association), where incoming information is processed or programmed, and finally, tertiary or latest systems of cerebral hemisphere, responsible for most complex mental functions requiring participation of many cortical areas.

i) The unit for regulating tone and waking states:

Most mental functions occur only under optimal waking conditions. The precise regulation of mental process is impossible during sleep or coma. As Luria (1973) states, "organised, goal directed activity requires the maintenance of optimal level of cortical tone". Later EEG studies have been able to visualise the "point of optimal excitation" in the brain (Omstein and Galin, 1976). Pavlov (1949) explained that the process of cortical excitation obeys a law of strength, which states that every strong stimuli evokes a strong response while every weak stimuli evokes a weak response. This fundamental property of optimal neurodynamics disappear in sleep or in states preceding it. In states of cortical inhibition or "phasic" states, the law of strength is broken and a weak stimuli may either evoke equally strong responses as strong responses (called equalising phase), or may evoke stronger responses than strong stimuli (called paradoxical phase), or may even continue to evoke a response even when strong stimuli cease to do so (called ultra paradoxical phase). During cortical inhibition, the normal relationship between cortical arousal and inhibition is disrupted. This shows that optimal level of cortical arousal is essential for an organised course of mental activity. There are specific brain structures, called reticular formation, which regulates, modify and maintain optimal level of cortical tone in human beings Some fibres of reticular formation run upwards from thalamus, caudate nucleus to neocortex. They are called ascending reticular system. They play a crucial role in activating cortex and regulating the state of its activity. Other fibres of reticular formation run down wards, in opposite direction, beginning at neocortex to thalamus, hypothalamus and brain stem. They are called descending reticular system. Both structures constitute a single vertically arranged function system-the first functional unit of brain for maintaining cortical tone or waking state according to actual demands confronting the organism (Lindsley, Bowden and Magoun, 1949; Lindsley, 1960; 1961; Pribram, 1960; 1961; Jasper, 1963).

The reticular activating system is reportedly non specific in its anatomical characteristics as well as its sources and manifestations (Anokhin, 1963). The system is influenced by several sources including metabolic processes leading to internal equilibrium of the organism (homeostasis), inborn or instinctive behavioural system (the unconditioned reflexes), exostimuli from the outside world, etc.

ii) The unit for receiving, analysing and storing information:

Whereas the first functional unit is located in brain stem, the second unit is located in lateral regions of neocortex especially occipital, temporal and parietal regions. Histologically, it does not consist of a continuous nerve net as in first unit. Rather, it is made up of several isolated neurons scattered in neocortex. The neurons of second unit obey an "all or nothing" rule by receiving discrete impulses and relaying them to other groups of neurons. This unit is functionally adapted to reception of stimuli travelling to brain from peripheral receptors. They analyse such stimuli into large number of small component elements and synthesise them into whole functional systems.

A feature of this unit is its high modal specificity, i.e., its component parts are adapted for receiving auditory, visual, vestibular or general sensory information, and to a lesser extent, olfactory and gustatory stimuli from outside world in man. The neurons of second unit undergo a high degree of differentiation to preserve a strict modal specificity. For example, there is no cell responding only to sound in primary occipital cortex, just as there are no cells responding only to visual stimuli in primary temporal cortex. There are about less than four per cent cells in this unit, which are also multimodal in character and respond to several types of stimuli. It is also important to remember that most human gnostic activity do not take place with respect to one single isolated modality. The perception and representation of exostimuli is a complex phenomenon and the result of polymodal activity. Therefore, it must necessarily rely on combined working of a complete system of cortical zones.

Another feature of second functional unit is their hierarchical structure. The modality specific zones of second unit are built in accordance with the principle of hierarchical organisation, from lower layers of visual (occipital) cortex, auditory (temporal) cortex, secondary auditory cortex, general sensory (parietal) cortex, secondary sensory cortex to tertiary zones in brain. The tertiary zones of second brain system, particularly, play a crucial role in conversion of concrete perception into abstract thinking and memorising of organised experience. Sumnarily, all these zones are adapted to serve as a apparatus for reception, analysis-coding and storage of information received from outside world.

Luria (1973) postulates three basic laws governing the working of second functioning system. They are, (a) Law of Hierarchical Structure of Cortical Zones, (b) Law of Diminishing Specificity of Hierarchically Arranged Cortical Zones, and, (c) Law of Progressive Lateralisation of Functions.

According to Law of Hierarchical Structure of Cortical Zones, the relationships between primary, secondary and tertiary cortical zones form an increasingly complex synthesis of incoming information depending on their position in the hierarchy. Their inter relationships do not remain static, but change in the ontogenic course of development of brain.

According to Law of Diminishing Specificity, there is gradual decrease in the specificity of cortical zones depending on their position in hierarchy. While the primary zones of this system posses maximnal modal specificity, it decreases as it comes down to secondary cortical areas and the tertiary zones of this unit.

According to Law of Progressive Lateralisation of Functions, there is a gradual transfer from primary cortical areas to secondary and ultimately, tertiary areas of brain. Luria (1973) accepts the basic postulates of the principle of cerebral lateralisation discussed earlier. However, he cautions, that the principle operates only within the transition to secondary and,

especially, tertiary zones of cortex. It is for this reason that functions of secondary and tertiary zones of left hemisphere differ radically from functions of same zones in right hemisphere.

iii) The unit for programming, regulation and verification of activity:

The working of first and second functional systems of brain is closely linked with the third functional system, which is responsible for programming, regulation and verification of activities. Human brain is not a passive reactive unit. It creates intentions, forms plans and programmes of actions, inspects performance and regulates behaviour to conform to those plans and programmes. The human brain also verifies its own conscious activity by comparing effects of its actions with original intentions and correcting any mistakes that have been made. All these processes are associated with the third brain unit which is located in anterior regions of hemispheres, especially in frontal lobes. A feature of the frontal lobe, including its motor strip, prefrontal area and premotor area is that they are richly connected with lower levels of brain. The prefrontal area is the most evolved part of brain and it does not mature until very late in ontogeny, when the child has reached an age of four to seven years (Rose and Wbolsey, 1949; Pribram, 1961; 1971; Nauta, 1971). The prefrontal cortex is a superstructure over and above all the parts of cerebral cortex so that they perform a far more universal function of general regulation of behaviour. They synthesise information, plan actions and direct behaviour to the future. The human frontal lobes are much more evolved than in higher apes or monkeys. Hence the functions of third functional unit largely rests on frontal lobes in human beings.

All the three principal functional units of brain always work in combination, each making its own contribution to brain behaviour functions in man. All cognitive and motoric behaviours require coordination and integration. of all three functional units of brain. Disruption of any one of them is likely to result in uncoordinated or incomplete behaviours or even a total absence of voluntary conscious behaviour.

INFORMATION INTEGRATION MODEL

Luria's (1973) analysis of information processing in terms of simultaneous and successive processing is greatly derived from Sechnov (1878). Sechnov distinguished auditory perception as involving successive processing is greatly derived from Sechnov (1878). Sechnov distinguished auditory perception as involving successive processing and visual or tactile perception as involving simultaneous processing respectively. In other words, verbal elements are successively processed and non verbal elements are simultaneously processed. Based on these assumptions, Luria (1980) proceeded to develop tests for assessment of simultaneous and successive processing. The test markers for simultaneous processing include copying figures, reproducing maps from memory, performing numerical operations, etc. The test markers for successive processing include reproducing auditory signals, digit span tests, speech pattern analysis, etc. (Das, Kirby and Jarman, 1979). The process orientation in Luria's theory promotes an ideal neuropsychological framework for developing a model to describe cognitive processes. The Information Integration Model (Das, 1972; 1973; 1980; 1984; Das, Kirby and Jarman, 1975; 1979) owes its roots to Luria's theory, but extends beyond to include principles of information processing.

According to this theory, there are four basic components of information integration. They are, (a) sensory input; (b) sensory register; (c) central processing unit; and, (d) behavioural output respectively. Sensory inputs maybe presented to any sensory receptors in a parallel (simultaneous) manner or in a sequential (successive) manner. Simultaneous integration refers to synthesis of separate elements into groups, and these groups often take on spatial overtones. Successive information processing refers to processing of information in a serial order. The main distinction between this type of information processing and simultaneous processing is that in successive processing the system cannot be totally surveyed at any point of time. Rather, a system of cues consequently activates the components (Das and Heemsberger, 1983; Merritt, 1984; Willis, 1985). Since the emphasis of this model is on Simultaneous-Successive-Planning processes within Luria's second and third functional units of brain, it is also called as S-S-P Model. In this model, it is believed that all verbal visual stimuli are successively processed, as all non verbal auditory stimuli are simultaneously processed in the two hemispheres of human brain.

The sensory register is the second component of this Model and it acts essentially as a buffer. It receives sensory information and transmits it to the central processing unit. This transmission occurs in a serial fashion irrespective of the mode or manner of stimulus presentation. All information received by the sensory register need not be transmitted t^ central processing unit. Only the required information is sent to central unit consequent to a complex interaction between all three functional units described by Luria and the information received in the sensory register. The central processing unit consists of two major components, viz., simultaneous and successive processes, and the planning and decision making processes. Simultaneous processes synthesise separate units of information into a quasi-spatial, relational organisation. Successive processes synthesise separate units of information into a temporally organised sequence. The mode or manner in which information is originally received by sensory register does not affect the type of processing that occurs in central processing unit. For example, a verbal-visual stimuli maybe processed simultaneously or successively, depending on individual's preferred mode of processing (which is influenced by experiential, sociocultural and genetic factors). A child may solve a mathematical problem successively by using a mnemonic table, as another child solves the same problem simultaneously by using learned addition facts through flashcard practice.

The final component of Information-Integration Model is responsible for behavioural output. This unit determines or organises cognitive or motoric behaviour as a function of task demands or planning processes. Output can be simultaneous or successive in nature and is independent of both input mode and manner of presentation or processing.

Lesion studies have suggested that occipito-parietal areas are crucial for simultaneous processing, as fronto-temporal regions are responsible for successive integration. Even though both the processes maybe evoked to solve a particular problem, they are essentially independent. Evidence has it that fronto-temporal lesions may also not impair simultaneous synthesis any more than occipito-parietal lesions impair successive synthesis. This means that there maybe a orthogonal relationship between the two coding processes (Luria, I960), alongwith a planning factor which is orthogonal to the coding factors and serves as a somewhat super ordinate function in integrating coded inputs (Ashman, 1982; Snart, O'Grady and Das, 1982).

Thus, this model recognises two coding processes in addition to a planning factor in functional organisation of brain (Das, 1980). This model also proposes a hierarchical arrangement for the two modes of processing, wherein one mode may prove effective for certain tasks than the other.

In an attempt to examine and compare performance of mild mentally retarded adults on selected cognitive processing tasks, Snart and Swann (1982) administered specific "marker tests" on a sample of fifty adults. The Memory for Designs Test (Graham and Kendall, 1960) and Figure Copying Test (Ilg and Ames, 1964) were used as markers for simultaneous processing; whereas Auditory Serial Recall Test (Ashman, 1978) and Digit Span Tests were used as markers for successive processing; Visual Search Task (Teuber, Battersby and Bender, 1949) and Trail Making Test (Reitan, 1955b)were used as a measure of planning ability. The results indicated in favour of Information-Integration Model besides recommending its utility in designing vocational remediation strategies for this population of individuals. Similar success in planning and implementation of remedial programmes based on this Model have been claimed with Learning Disabled children (Brailsford, Snart and Das, 1984).

Other studies have shown that the two modes of cognitive processing are remarkably stable across many different IQ scores, age, culture, socio economic status and educational attainment (Snart, O'Grady and Das, 1982). These modes of processing have also shown significant correlations with various measures of school achievement, linguistic processing (Ashman, 1978; 1982; Wachs and Harris, 1986) and WISC-R factors (Cummins and Das, 1980).

NEUROPSYCHOLOGICAL ASSESSMENT STRATEGIES

Since World War II, neuropsychology has evolved number of tests sensitive to understanding brain behaviour relationships in human beings. Earlier approaches to neuropsychological assessment emphasised the observation of specific behavioural changes to particular sites or types of brain lesions (Teuber, 1964; Benton, 1974; Luria, 1980). It was then believed that there can be a single, quick test of brain damage, such as, Rorschach Technique (Piotrowski, 1937; Baker, 1956), Bender Gestalt Visuo Motor Test (Bender, 1938; 1946), Shipley Hartford Retreat Scale (Shipley, 1940), Hunt Minnesota Test for Organic Brain Damage (Hunt, 1943), Wechsler Scales (Aita et al, 1947), Human Figure Drawing Test (Andrews, et al, 1980; Gasparrini, Shealy and Walters, 1980), etc. However, it was soon argued that it is too simplistic and conceptually limited to assume a single perfect test of organicity which would reveal all the inherent complexities of brain behaviour relationships. Recent approaches to neuropsychological assessment are based and designed to elicit a comprehensive profile of behavioural assets/deficits related to integrity of brain system (Gilandas et al, 1984). The earlier terms such as "testing for organicity" or "testing for brain damage" have been replaced by "neuropsychological assessment".

PURPOSE OF NEUROPSYCHOLOGICAL ASSESSMENT:

A neuropsychological test is "one that is sensitive to conditions of brain" (Reitan, 1969). Lezak (1983) highlights three purposes of neuropsychological assessment, viz. diagnosis, intervention planning or programming and research.

Earlier, neurodiagnosis was the sole purpose of neuropsychological assessment. In the radio-graphically "premodern days", before advent of Computerised Tomography (CT) and Magnetic Resonance Imaging (MRI) Scanners, the major search of clinicians was for techniques that would effectively discrimante between ""organic' and 'functional' disturbances. Clinical neuropsychologists attempted to answer these hard diagnositic questions of clinicians by devising single tests or a battery of tests that would be sensitive indicators of brain damage or organicity (Spreen and Benton, 1965). At that time, clinicians were reluctant to employ vainful, potentially dangerous and, too often, non-informative invasive diagnostic procedures available before CT Scanning. Hence they turned eagerly to neuropsycnology for help with the difficuit-to-diagnose patients (Lezak, 1983).

The usual procedures of standardising such neuro-diagnostic indicators was to device a test or battery of tests, administer them on two or more diagnostic groups (including one group with manifest brain damage and another carrying a functional diagnosis) and attempt to predict the patients diagnosis. The predictive accuracy of test(s) or 'hit rate' was expressed in terms of the combined percentage of 'true' predictions, both, positive (i.e. correct identification of patients carrying an organic diagnosis) and negative (i.e. correct test identification of patients not diagnosed as organic) (Spreen and Benton, 1965).

The implicit assumption in these procedures was that if test(s) correctly identify high percentage of diagnostic classifications from a mixed sample of patients, then they would be valid procedures. Although predictive validation procedures for various diagnostic categories continue to be a popular endeavour among neuropsychologists (Adams, Kvale and Keegan, 1984; Kane, Parsons and Goldstein, 1985) such attempts appear redundant after the advent of advanced radiological techniques which are easily available for making accurate neurodiagnosis of brain damage in specific cases.

An implicit, but now discredited, notion underlying the emphasis of neurodiagnosis as sole purpose of neuropsychological assessment appears to be the understanding that brain damage reflects some kind of an unitary dysfunction (Klebanoff, 1945; Reitan, 1966). The inter relationships between brain-behaviour is not a simplistic binary classification between brain damage or not. The better approaches have invariably looked upon cerebral functioning from a multidimensional point of view (Armitage, 1946; Halstead, 1947). In the contemporary scene, neurodiagnostic test data is only supplementary information to the neurologists diagnostic arsenal. The purpose of neuropsychological assessment cannot be neurodiagnosis alone. Even though such an emphasis has been a historical necessity, this has been somewhat detrimental to the growth of this discipline (Boll, 1978; 1981; Golden, 1979; Barth and Boll, 1981; Lezak, 1983). Current research on neuropsychological assessment focus pertinently on its direct use in treatment or rehabilitation (Lezak, 1983).

Another purpose of neuropsychological assessment is to evaluate the brain damaged individual's cognitive, behavioural and psychological strengths and weaknesses in view of their brain-behaviour relationship (Barth and

Macciocchi, 1985). This information is useful in planning or programming intervention strategies. Neuropsychological assessment of brain impaired individuals is also vital for assessing the level and rate of improvement or deterioration in behavioural functions for clinical and research purposes (Boll, 1977).

APPROACHES TO NEUROPSYCHOLOGICAL ASSESSMENT

There are many approaches to neuropsychological assessment which are useful in understanding brain behaviour relationships. They are,

1. Test Battery Approaches:

In 1930's, the neuropsychological test battery approaches for identifying mental deterioration in adults were at best speculative and lacked sound data or interpretations of test performance. This approach employs standardised test batteries to yield quantitative scores about behavioural assets/deficits in an individual with brain damage. An example of this approach is Halstead Reitan Neuropsychological Test Battery (HRNTB) (Halstead, 1947; Reitan, 1969). Test batteries are a kind of intervening variables as they indirectly study brain-behaviour relationships in a quantative way. In this approach, the same tests are administered to all patients and the accumulated standardised data base provides a comprehensive profile of an individual's abilities or deficits. The relatively controlled, standardised samples of behaviour accumulated over many similar cases increase validity of the instrument.

This approach is simple, cost effective and easy to use. Besides, they follow the same rationale as normative approaches to psychological assessment. The emphasis on standardisation and normative guidelines imply less reliance on clinical intuition. This strategy facilitates pattern analysis of the behavioural assets/deficits in an individual as also the study of intercorrelations between them. Test batteries are amenable to computerization and electronic processing for scoring and interpretation. A major demerit of this approach is its atheoritical framework. In other words, it lacks a guiding theory of cognitive functioning to give a clear understanding of brain-behaviour relationships. Even though there maybe a theory, such as the Four Factor Theory of Biological Intelligence (Halstead, 1947; 1973), this approach does not rely rigidly or heavily on them. The theoritical framework is highly flexible enough to facilitate new avenues for assessment (Venkatesan and Reddy, 1990).

2. Qualitative Syndrome Analytic Approaches:

This approach to neuropsychological assessment follows Luria's (1980) inductive tradition of setting up an hypothesis for testing. It uses a flexible, but systematic set of tests selected for their qualitative significance in assessing an individual. Instead of using specific cut off points in performance scores on a single test as basis for neurodiagnosis, this approach is designed flexibly to measure individual deficits per se. This economises testing time. They assist in localisation of behavioural functions to brain. structures. However, hypothesis testing or qualitative syndrome analytic approaches are a complex procedural exercise and necessitates rich experience and clinical intuition for understanding or interpreting underlying brain-behaviour relationships. This approach pays less importance to procedures of administration, scoring and interpretation. There is also a paucity of literature documenting the reliability and validity of these procedures.

3. Integrated Assessment Approaches:

The current trend in neuropsychological assessment integrates quantitative and qualitative assessment strategies. An example of this approach is Luria Nebraska Neuropsychological Test Battery (LNNB)

(Golden, Hammeke and Purisch, 1980), which has been developed based on the extensive theoretical and clinical contributions of Luna (1973; 1976; 1980).

The LNNB is derived from data base of seven hundred persons, besides being subjected to several validity studies (Golden, Hammeke and Purisch, 1980). There are specific score cut off points to differentiate or diagnose brain damaged individuals from nomal subjects. The pattern of test performance can even suggest lateralisation of specific brain lesions. The qualitative aspects of a subjects performance can be interpreted within the context of Luria's theory. A detailed interpretation of the LNNB involves five steps:

i) profile analysis of the general pattern of performance on various subscales in the Battery;

ii) use of localisation scales to guide locations of brain injury (Mc Kay and Golden, 1979);

iii) application of factor scales which involves breakdown of performance into clusters of elementary skills to facilitate syndrome analysis (Mc Kay and Golden, 1981);

iv) analysis of test item patterns as a further step in syndrome analysis; and.

v) a qualitative analysis of response styles on individual test items (Golden et al, 1982).

REPRESENTATIVE NEUROPSYCHOLOGICAL TEST BATTERIES

Some representative neuropsychological test batteries, including LNNB, HRNTB and their childrens revisions and other batteries proposed by Royal Prince Alfred Hospital, etc., are discussed below:

THE LURIA NEBRASKA NEUROPSYCHOLOGICAL TEST BATTERY

The LNNB was earlier known as Luria South Dakota Neuropsychological Battery or Standardised Version of Lurias Neuropsychological Tests (Golden, Hemmeke and Purisch, 1978). In the history of neuropsychological assessment procedures, Luria's tests gained little recognition in US for a long time. This was because Luria's works were not published for scrutiny by the Western world till 1970's (Christensen, 1975). Luria's techniques originally lacked standardisation. Indeed Luria believed that diagnostic and interpretative value of its procedures would be lost if his procedures were administered in a standardised fashion (Luria, 1976). His approach to neuropsychological assessment was truly idiometric and varied considerably from patient to patient depending on features of individual performance. He readily adapted administration procedures to elicit exact qualitative information about individual deficits. He relied greatly on clinical skill and intuition gained from experience with over hundreds of brain damaged persons. His procedures lacked objective scoring techniques. Luria never attempted a blind analysis of his patients with his procedures. In fact, he even used data from the patients' neurological, radiological and other investigations in understanding brain behaviour relationships in individual cases.

The LNNB attempted to overcome these limitations by presenting a standardised version of Luria's battery. The LNNB consists of eleven scales with a total of 269 test items, such as,

1. Motor Functions:

The Motor Scales are one of the most complex scales in LNNB. It taps a wide variety of motor functions including simple movements of hands, movements that are to be performed with patient's eye closed, movements requiring kineasthetic or tactile feedback for correct responses, oral movements with or without kineasthetic feedback.

complex bucco-facial movements, constructional dyspraxia, kinetic melody, grapho-motor tasks, etc. There are 51 items in this Scale.

2. Rhythm Functions:

The Rhythm Scale is much more simply organized than Motor Scale. Most of the stimulus materials in this section are presented on tape. Many of the test tasks involve r-nmparison of two groups of tones, saying whether one is higher or lower, reproduction of tones, perception of tonal qualities, expression of tonal relationships, perception and reproduction of rhythm, etc. There are 12 items in this Scale.

3. Tactile Functions:

The items in this Scale tap different levels of cutaneous sensation, localization, two point threshold, stereognostic perception, etc. All items in this section are administered with the subject being blind folded. There are 22 items in this Scale.

4. Visual Functions:

The Visual Scale evaluates a wide range of visual functions including object recognition, picture description, naming or perception, visuo-spatial perception, orientation to time-space, three dimensional analysis of pictures, spatial rotation, etc. There are 14 items in this Scale.

5. Receptive Speech:

This Scale evaluates ability of the patients to understand receptive speech from simple phonemic analysis to the understanding of complex sentences with inverted English grammer, understanding simple phonemes, repetition writing phonemes, understanding, naming, pointing, identifying, or defining simple words, etc. There are 33 items in this Scale.

6. Expressive Speech:

This Scale evaluates individual's ability to repeat simple phonemes, words or sentenses in an increasing order of complexity, naming or describing objects or events on their visual presentation, generative expressive speech, etc. There are 42 items in this Scale.

7. Writing:

The Writing Scale involves evaluation of patients' ability to analyse words phonetically in English and then copying them in order of increasing difficulty, copying simple letters, combination of letters, and words, writing their first and last names, dictation, cursive writing on a given topic, etc. There are 13 items in this Scale.

8. Reading:

The Reading Scale closely parallels Writing Scale. The patient is asked to generate sounds from letters that the examiner reads aloud, integrate letters, conduct auditory analysis, name simple letters, read simple sounds, words or letter combinations having a meaning, analyse grammatical structures, etc. There are 13 items on this Scale.

9. Arithmetic:

The Arithmetic Tests require subjects to write numbers from dictation in arabic and roman numerals, compare numbers with each other, add and subtract, discover missing numbers or signs, divide, multiply, etc. There are 22 items in this Scale.

10. Memory:

The Memory Scale taps ability to memorize a list of simple words, visual memory, auditory memory, verbal memory, rythmic memory, tactile memory, each with or without interference, etc. These are 13 items in this Scale.

11. Intellectual Process:

Unlike in MAIS, wherein most items are not responsive to presence of brain dysfunction, all the items included in this Scale are able to discriminate brain damage. The items require subjects to understand thematic pictures, interpret pictures, arrange pictures, detect absurdities, interpret fables, discover similarities and differences, analyse opposites and analogies, etc. There are 34 items in this Scale.

12. Pathognomonic Scale:

In addition to eleven Scales, LNNB has a Pathognomonic Scale with items that are highly sensitive to brain damage. There are specific cut off points for identifying a patient's performance as either normal or pathological on this Scale.

13. Right Hemisphere and Left Hemisphere Scales:

These Scales provide a measure of lateralisation. The Right Hemisphere Scale consists of items reflecting left hand sensory motor performance, while Left Hemisphere Scale consists of items reflecting right hand sensory motor performance. Extreme differences in the scores between the two Scales are indicative of a lateralised dysfunction. In general, right hemisphere injuries produce an elevation on Right Hemisphere Scale, but Left Hemisphere Scale would be in normal limits. However, until more empirical data is available, only 75 per cent accuracy rate for lateralisation is claimed for these Scales (Golden, 1979). The scoring procedure for each test item varies specifically in LNNB. Broadly, the scoring system involves giving a score of zero for normal performance, one for borderline performance and two for defective performance respectively.

LURIA NEBRASKA NEUROPSYCH0L0GICAL BATTERY FOR CHILDREN (8-12 YEARS)

Initially, the adult LNNB was itself used with children of average or above average intelligence (Wilkening et al, 1981). Many difficult items were eliminated, instructions were revised and new items were developed for children between ages of 8-12 years. The children's battery went through four separate revisions prior to its final form (Plaisted et al, 1983). The LNNB-Children's Revision presently comprises of 149 items. It takes approximately two to three hours per child for a complete administration of the Battery. The LNNB-Children's Revision comprises of eleven scales (Plaisted et al, 1983).

1. Motor Scale:

The 34 items on this Scale require the child to carry out simple and complex hand movements, bucco-facial movements, reproduction of simple geometrical shapes, etc. Besides, motor speed, strength, imitation and coordination of subjects are also evaluated.

2. Rythm (Acoustic Motor Organisation):

On the 8 items on this Scale, the subject is to perceive tones, reproduce melodies, evaluate auditory stimuli and motorically reproduce rythm, discriminate and reproduce sound patterns, etc.

3. Tactile Functions:

The 16 items in this section require the child to identify, discriminate and localise simple and complex tactile information in, both, left and right side of body.

4. Visual Functions:

The 7 items in this Scale measure visual perception, object or picture identification, similarities and differences between concrete objects, etc.

5. Receptive Speech:

The 18 items in this Scale examine the child's ability to discriminate phonemes, identify words, comprehend words, sentences and complex grammatical structures, etc.

6. Expressive Speech:

The 21 items in this Scale require the child to repeat or read letters, sounds, words and sentences, automatic speech, describe pictures, make speeches, etc.

7. Writing:

The 7 items in this Scale require the child to copy and write letters, graphemes, words and phrases from dictation, etc.

8. Reading:

The 7 items in this Scale require the child to read letters, words. sentences or complete passages, etc.

9. Arithmetic:

The 9 items in this Scale are designed to assess arithmetic skills, including number recognition, comprehension of number values, addition, subtraction and multiplication, etc.

10. Memory:

The 8 items in this Scale assess memory competencies on a wide range of verbal and non verbal tasks including repetition of a series of simple unrelated words, recall pictures exposed on a card, remember list of words with or without interference, etc.

11. Intellectual Process:

Many of the items on this Scale resemble those on WISC-R, especially picture arrangement, picture completion, vocabulary, comprehension, arithmetic and similarities sub tests, etc.

As in LNNB-adult version, there are three additional clinical summary Scales to provide further information concerning the functional status of brain. They are, (1) Pathognomonic Scale; (2) Left-Sensory-Motor Scale; and, (3) Right-Sensory-Motor Scale (Sawicki et al, 1984). These Scales aid in the differential diagnosis of brain damaged from normal children. The scoring procedures for LNNB-Children's version is based on a three point rating scale, viz., (0) representing normal performance, (1) representing performance between one and two standard deviations below the mean and (2) representing performance more than two standard deviations below the mean (Gustavson et al, 1981). Separate age norms have been developed for some test items from a sample of 125 children, with 25 subjects in each age range from 8-12 years. Raw scores were converted into t-scores for each of the eleven scales.

A number of studies support the validity of LNNB-Children's version for determining normal and abnormal brain functions (Gustavson et al, 1981; Wilkening et al, 1981; Gustavson et al, 1982; Sawicki et al, 1984). Most validation studies of LNNB-Children's version have been carried out against neurodiagnostic radiological findings and resulted in 91.3 per cent accuracy in classification for normal group and 65.3 per cent accuracy rate for brain damaged, and an overall hit rate of 81.6 per cent. However, interestingly, no validation study has attempted to rate LNNB-Children's version against success in intrervention programmes.

Some studies have used LNNB-Children's version for differential diagnosis of normal children against children with learning disability, slow learners, brain damaged, etc. (Wilkening et al, 1981; Gustavson et al, 1982; Nolan, Hammeke and Barkley, 1983; Plaisted et al, 1983; Oehler-Stinnett et al, 1988).

A few studies have attempted within scale factor analysis of LNNB-Children's revision and identified that there are 34 to 35 factors (Karras et al, 1987). However, these studies have yielded contradictory results to Snow and Hynd (1985), who identified three factors in a group of learning disabled children. There is a need for more studies in this direction.

Other studies have examined relationship of LNNB-Children's revision with traditional or psychometric measures (Gilger, Geary and Jennings, 1984). However, there has been little work on the implications of assessment on LNNB-Children's version for remediation planning/programming or as predictors for potential rehabilitation (Golden and Wilkening, 1986).

THE HALSTEAD REITAN NEUROPSYCHOLOGICAL TEST BATTERY

In 1935, Ward Halstead opened his own neuropsychology laboratory at University of Chicago, which has inspired about half a century of applied research on test battery approach and psychometric aspects of adaptive human abilities or "biological intelligence" (Halstead, 1947;). Over the years, Halstead's Four Factor Theory of Biological Intelligence received minimal empirical attention. But his development of test batteries to assess abilities in normal and brain damaged subjects have become the foundation for modem research in neuropsychological assessment. Halstead set out with an obvious interest in documentation of the effects of cerebral dysfunction on a broad range of human behaviour. He used naturalistic observations as well as experimental measures to search for tests that were sensitive to brain damage. In the process of exhaustive field trials, he developed and discarded hundreds of tests. He used factor analytic techniques to identify eight tests (and ten test scores) as a measure of Biological Intelligence, which would separate brain damaged from normal individuals (Halstead, 1947). In recognition of the fact that a vast range of psychological abilities are controlled by cerebral functions, and that a single test can never measure them fully, he devised a braod spectrum of measures to sample a comprehensive range of functions. The tests developed by Halstead (1947) included, Halstead Category Test, Seashore Rythm Test, Speech Sounds Perception Test, Tactual Performance Test (Total Time, Memory and Localisation), Finger Oscillation Test, Critical Flicker Frequency, Critical Flicker Fusion and Time Sense Test.

Ralph Reitan, one of Halstead's students, began his career in his teacher's laboratory. Later, they parted ways, before Halstead established his own laboratory at Indiana University Medical Centre in 1951. Reitan (1969) was the first person to validate a comprehensive neuropsychological test battery for differential diagnosis of brain damaged persons from normal controls. Reitan found all tests in Halstead's Battery to be extremely sensitive to brain damage, except Critical Flicker Frequency, Cntica] Flicker Fusion and Time Sense Test, which demonstrated lower levels of significance. Hence these tests were dropped eventually front the Battery. In next thirty years, Reitan revised, modified and expanded Halstead's original Battery, validated two batteries for children and made great contribution to the differential effects of brain damage.

The latest version of adult HRNTB comprises of ten tests, including two allied procedures (marked with an asterisk below). They are,

1. The Halstead Category Test

2. Speech Sounds Perception Test

3. Seashore Rythm Test

4. Tactual Performance Test

5. Finger Oscillation Test

6. Trail Making Test (A and B versions)

7. Halstead Wepman Aphasia Screening Test

8. Reitan Klove Sensory Perceptual Examination

9. Wechslers Adult Intelligence Scale, Revised*

10. Minnesota Multiphasic Inventory*

With a wide range of cognitive, behavioural and psychological abilities included in HRNTB, it is not difficult to see why it forms an excellent Battery in assessment of brain behaviour relationships. The seminal contributions of Halstead and Reitan have led to acceptance of test battery approach throughout US, Peoples Republic of China (Doerr and Storrie, 1982) and several other countries. Many centres in the world have modified or adapted the original Battery to suit local conditions. As Mathews (1981) remarks, " HRNTB procedures do not necessarily operate in an orthodox rigid manner, applying a single or fixed set of interpretative principles handed down once and for ever". Rather, its flexibility is its main asset for routine use in understanding brain behaviour relationships.

Several validation and cross-validation studies have been attempted on HRNTB as a measure of brain damage, cerebral dominance or even as diagnostic of brain tumors, etc. (Reitan and Davison, 1974, Boll, 1978; Hervern, 1980). The concurrent validity for diagnostic accuracy of HRNTB has been established by correlating with clinical reports, autopsy reports.

skull x-rays, EBG reports, pneumoencephalograms (PEG), angiograms, CAT sans, cerebral blood flow (CBF), etc. (Spreen and Benton, 1965; Vega and Parsons, 1967; Filskov and Goldstein, 1974; Golden, 1986; Matarazzo et al, 1976).

Other validation studies on HRNTB or its sub tests have tried to correlate individual performance with specific variables, such as, age, education, sex, socioeconomic status, race, examiner characteristics, etc. (Reitan, 1957; Davies, 1968; Pauker, 1977; Fromm-Auch and Yeudall, 1983; Stanton et al, 1984). Although the influence of these variables on individual performance on HRNTB is yet to be researched in detail, evidence so far suggests age to be a important variable influencing performance (Prigatano and Parsons, 1976; Parsons and Prigatano, 1978).

A few validation efforts on HRNTB have tried to discriminate between sub groups of diagnositc conditions, such as, alcoholics and schizophrenics (Fields and Fullerton, 1975), learning disabled children (Selz and Reitan, 1979), Huntingtons Chorea (Hevern, 1980), Multiple Sclerosis, Phenylketonuria, Prader-Willi children (Gabel et al, 1986). The obtaining of detailed descriptions of neuropsychological test performance from various diagnostic conditions appear to be a productive area of research within the test battery approach.

Factor analytic studies of individual performances on HRNTB have been attempted as another line of research on these Batteries. Fowler et al (1985) used HRNTB on 108 epileptic patients and postulated five factors, viz., verbal comprehension, perceptual organisation, simple motor skills, selective attention and abstract reasoning. Newby, Hallenbeck and Rnbertson (1983) proposed four sets of parallel factors, viz., receptive, memory, cognitive and expressive in which verbal and non-verbal factors were second order. However, as in LNNB, factor analytic studies on HRNTB are still inconclusive and inconsistent about the number factors assessed on this Battery.

One can see that all above mentioned validational efforts were necessary in the early development of HRNTB in order to demonstrate its "clinical validity" or determine whether the behavioural variations between brain damaged persons reflect their neurological status (Boll, 1981). However, the original purpose of these batteries, i.e., to facilitate treatment or rehabilitation decisions appears to have been relegated to the background (Barth and Macciocchi, 1985).

HALSTEAD REITAN NEUROPSYCHOLOGICAL TEST BATTERY FOR CHILDREN (9-14 YEARS)

The HRNTB-Children's revision (9-14 years) (Reitan and Oavison, 1974) comprises of twelve domains, such as follows:

1. Category Test

Each of the 168 items in this Scale are to be projected on a screen in front of the child during administration. The child is required to pull and operate on any one of the four levers to indicate the correct answer. There is a feedback mechanism, either a bell or buzzer, informing whether the answer is right or wrong. The items are divided into several sections. The test measures abstraction, concept formation, rental efficiency learning skills. The test is sensitive to general or global brain functioning.

2. Tactual Performance Test

There are six figures on a form board. The child is required to place the blocks into the correct forms. At no time, the child is allowed to see the correct forms or the board because he is blindfolded. The performance of the child is assessed with his preferred hand, preferred hand and both hands. The timing for each trial of performance is noted. After all the trials are completed, the child is instructed to draw as many of the designs from memory as possible.

3. Finger Tapping Test

In this test, the child is required to tap a mounted key (similar to a telegraph key) as quickly as possible. There are five trials each with preferred hand, non preferred hand and both hands. The task is a measure of fine motor speed.

4. Speech Sounds Perception Test

This test comprises of 60 nonsense words on a tape recorder with different begining and ending consonant sounds. The child is required to identify the correct sound from three alternatives. This test measures attention, auditory discrimination and error modal skills (auditory input-output).

5. Seashore Rythm Test

This test is adapted from Seashore Test of Musical Talent, where pairs of rythm are presented to the child from a tape recorder. The child is required to determine whether the rythms are same or different. This test measures attention, concentration, auditory perceptual abilities, etc.

Allied Procedures:

The following subtests were not originally included in HRNTB-Children's Revision (Reitan and Davison, 1974). They were included later to facilitate comprehensive evaluation (Boll, 1981).

1. Trail Making Test

There are two parts of this test, A and B, consisting of 15 items in each. On trial A, the child is required to connect circles from 1 to 15 as quickly as possible. On Trial B, the child must connect alternating circles from A to G and 1 to 8. These tasks require motor speed, visual perception, sequencing ability, symbol recognition and simultaneous processing of two series of symbols.

2. Strength of Grip Test

In this test, hand strength is measured by using an adjustable dynamometer. Alternating trials are administered with preferred and non preferred hands to facilitate differential hand strength.

3. Sensory Perceptual Exam

Tactile, auditory and visual perceptions are measured unilaterally and bilaterally. Tactile perception is assessed unilaterally by touching the child's hand or face, while eyes are closed. The child is required to indicate the side of the body that has been touched or when double/simultaneous stimulation has been provided. Auditory perception is assessed by presenting soft stimuli behind one ear, then other and then simultaneously. The child must indicate which ear has been stimulated. Visual perception is determined by asking the child to ascertain whether the examiner is moving one or two hands from a peripheral level. The visual field is tested in quadrants, above and below eye level.

4. Tactile Form Recognition

This test requires the child to place one hand through an opening in a board. The examiner places either a square, circle, cross or triangle in the child's hand. The subject is then asked to point to the object on another board. Both hands are tested for tactile discrimination.

5. Tactile Finger Localisation

This test requires the examiner to touch the child's finger lightly in a prescribed order and the child has to indicate which finger has been touched. Tactile localisation is assessed for all fingers.

6. Finger Tip Number Writing

Using a pen tip, the examiner traces a series of numbers in a prescribed order on each of the child's fingers. As a cue, each number is written on the palm of hand before the trial begins and the child is informed which numbers will be used.

7. Aphasia Screening Test

This is a modified version of Wepman's Aphasia Screening Test to assess receptive and expressive aphasia. The 32 items in this test include naming, copying, spelling, reading and simple arithmetic calculation tasks.

To recapitulate, HRNTB-Children's Version (9-14 years) differs from the adult version in the following aspects:

1. the number of subtests or items in Category Test are reduced;

2. the Speech Sounds Perception Test answer sheet has been reduced to have only three alternative choices per trial;

3. the Tactual Performance Test has only six instead of ten cut out shapes as in adult version;

4. there is a reduction in the number of circles on Trail Making Test for both parts A and B, from 25 to 15 items, while the two tasks remain same.

REITAN INDIANA NEUROPSYCHOLOGICAL TEST BATTERY FOR CHILDREN (5-8 YEARS)

The RINTB-Children's Version (Reitan, 1969) and its modified versions (Reitan and Davison, 1974; Boll, 1981) comprise of the following tests:

1. Category Test

The 80 items in this test are arranged in five simple categories of sub tests. On the first sub test, the child must pull the lever corresponding to the color of stimulus card, while other subtests involve principles of size, color or shape. The right answer is reinforced by a bel1.

2. Tactual Performance Test

The same six form board from HRNTB-Children's version haws been retained in this battery, but has been turned horizontally to allow younger children ample room for exploration.

3. Strength of Grip and Finger Tapping Test

The strength of grip test remains unmodified. A electric tapping key is used in this version of Finger Tapping Test.

4. Finger Symbol Writing Test

Using tip of a pen, the examiner writes a series of X's and O's (instead of numbers for older children) on the child's fingers. The child must indicate which symbol has been traced on his/her finger.

5. Tactile Finger Localisation, Tactile form Recognition and Sensory Perceptual Exams

These tests are similar to the ones in HRNTB-Children's version.

6. Aphasia Screening Test

The items in this test have been simplified and involve writing own name, copying a square, triangle and cross, identifying picture of a baby, clock and fork, reading letters and simple phrases, computing simple arithmetic functions, following verbal commands, etc.

7. Rythm, Speech Sounds Perception and Trail Making Test

These tests are excluded from the Battery for Children under nine years of age.

ALLIED PROCEDURES:

The following are a few new procedures that have been added to RINTB (Reitan and Davison, 1974; Boll, 1981).

1. Marching Test

This test measures gross motor functions and coordination of upper extremities. The child must follow a sequence of circles connected by lines up a page, by touching each circle as quickly as possible. Time and accuracy is recorded for each hand. The second part of this test involves using both hands "to march up the page" with right hand touching circles on right side of the page alternating with left hand touching the circles on left side of the page.

2. Colour Form Test

Three geometric shapes of different colours are printed on a tag board and the child is required to touch one figure and then another, moving in a sequence of shape-colour-shape-colour respectively. The child must selectively attend to one aspect of stimulus at a time (eg., color) and ignore the other (eg., shape). This is similar to

Trail Making Test for older children and adults.

3. Progressive Figures Test

There are 8 large shapes (such as a circle) on this test with smaller shapes (such as square) inside. The child must move from small square (inside) to a large figure with the same shape (square). The second large shape may have a smaller triangular shape inside indicating that the next move will be to larger triangular shape. The task requires visual perception, motor speed, attention, concentration and flexibility to change sets.

4. Matching Pictures Test

The child must match pictures that are initially identical, but progressively become more and more difficult.

5. Target Test

This test consists of a 18 x 18 square inch card with nine dots printed on it. The child is given a sheet with the same dot configuration. He has to draw the same design that the examiner has tapped out on the design in a larger sheet. The item requires visual memory abilities.

6. Individual Performance Tests

This includes three sub tests, viz.. Matching Figures Test, Matching V's, concentric square and star. The Matching Figures Test requires the child to natch a group of figures (printed on a square). The Matching V's task involves matching V's that vary in width of the angle. The Concentric Square and Star Tests involve copying complex designs. These tests measure visual perception and motor abilities.

This battery also includes WISC and WRAT along with a test of Lateral Dominance to elicit a comprehensive neuropsychological evaluation of children. The exacrt scoring procedure for each sub test on RINTB varies. In some sub tests, errors are calculated (Category Test), while in others, the number of responses are computed (Finger Tapping Test), or, in still others, time taken is calculated (Tactual Performance Test). The developmental noms for these tests are available for Western population (Knights, 1966; Spreen and Gaddes, 1969). According to Selz and Reitan (1979), the scores on this battery can be interpreted along four dimensions, viz., (1) analysis of child's level of performance against a comparison group; (2) analysis of patterns of performance to determine a particular child's strength's or weaknesses on various tasks; (3) analysis of pathognomonic signs to determine signs of brain damage; and, (4) analysis of left-right differences in performance to determine the functioning of two hemispheres.

The battery also attempts to interpret, data based on a child's level of performance. Rourke (1981) suggests use of normative approaches as absolutely necessary for children below 15 years, considering that they fall within the so called "developmental period". In children, there is greater risk of false positives in performance due to factors not related to brain pathology, including motivation, emotional disturbances, language deprivation, etc. Consequently, these factors are important considerations in interpretation of test performance. The second approach for analysing neuropsychological test data involves looking at specific deficit signs that indicate cerebral damage. They are called Pathognomonic signs (Reitan, 1981). Pathognomonic signs indicate pathology and occur almost exclusively in brain damaged individuals and rarely in normals (Rourke, 1981). However, pathognomonic signs are difficult to analyse in children because one must be certain that the skill has been developed prior to the insult or injury. This is easy to determine in adults since extremely poor performance on certain tasks indicate an impairment or loss of function; whereas, with children (especially mentally handicapped) it may simply reflect the fact that the skill has not been acquired.

A differential score approach has been proposed as an alternative to aid its use with special populations, especially brain damaged, learning disabled, etc. In this approach, patterns of performance between scores of verbal-performance differences or patterns on Trail Making test vs. Speech Sounds Perception test are measured to elicit left or right hemispheric dysfunction. Reitan (1969) suggests that left hemispheric dysfunction is present when verbal IQ is "clearly lower" than performance IQ. In contrast, right hemisphere maybe implicated when performance IQ is clearly lower than verbal IQ (Kaufman, 1979).

There have been several validity studies on RINTB-Children's version (Reed, Reitan and Klove, 1965; Selz, 1981). But, most of these studies have concerned with diagnostic validation rather than remedial validation, i.e., to plan and assist in intervention programmes. Reitan (1980) has developed a rehabilitation programme for training children with brain related disabilities. REHABIT (Reitan Evaluation of Hemisphere Abilities and Brain Improvement Training) Programme is organised into three phases:

1. evaluation of brain related deficits using Halstead Reitan batteries;

2. training of deficits using tests from the neuropsychological batteries; and,

3. training of deficits with special REHABIT materials.

The first phase obtains a comprehensive analysis of the child's factional status and identifies specific deficit areas. In second phase, Reitan has developed alternate forms for some subtests in the battery for training purposes. The materials for third phase have been gathered from a variety of training procedures varying from simple to complex tasks. The materials for training have been organised in five tracts.

1. Tract A, materials for expressive-receptive language and verbal skills;

2. Tract B, materials for abstraction, reasoning, organisation and logical analysis in the verbal-language domain;

3. Tract C, materials for general reasoning, abstraction and organisation skills;

4. Tract D, materials for abstraction emphasising visual-spatial manipulation and sequential processing;

5. Tract E, materials for basic visuo-spatial and manipulation skills.

The training begins at a level where the individual can be successful and proceeds to more complex materials (Reitan, 1980). Research efforts are underway to evaluate the utility of REHABIT procedures.

THE ROYAL PRINCE ALFRED HOSPITAL NEUROPSYCHOLOGICAL TEST BATTERY

In an obvious attempt to refine neuropsychological assessment techniques especially in remediation of Learning Disabled individuals, the staff of the Royal Prince Alfred Hospital, Sydney, have developed a constellation of tests to assess cerebral dysfunction (Gilandas et al, 1984). They caution that cerebral dysfunction cannot be completely understood from disparate descriptions of a host of disorganised tests. They insist that disparate test data must be meaningfully integrated into a conceptual framework of brain-behaviour relationships. They propose a battery, which is based on the notion of functional categories. Without making preemptive claims for attempting to develop a new neuropsychological test battery, these markers began on the core conceptual frameqork of the Halstead Reitan approach to revise and develop the following battery of tests:

1. Laterality Preference Schedule (Dean, 1982)

This 49 item checklist evaluates eyedness, earedness, handedness, footedness, etc., of the individual.

2. Grooved Pegboard

This is a manipulative dexterity task. It consists of 25 randomly positioned slots, Pegs having a key are to be rotated before matching them to the hole where they are to be inserted. It measures complex visuo motor coordination.

3. Finger Tapping Test

This is a measure of finger agility and consists of a tapping key with a device to record the number of taps made in given unit of time.

4. Hand Dynamometer

This involves measurement of grip strength, using subject's preferred hand, non-preferred hand and both hands.

5. Speech Sounds Perception Test

This measures ability to differentiate similar sounding nonsense syllables containing double vowels "ee" in middle of the syllable with various consonants at beginning and conclusion of each syllable. The subject is required to match sounds against a record form.

5. Seashore Rythm Test

This measures auditory perception for rythmic patterns. 30 pairs of rythmic patterns are presented on a tape and the subject discriminates similar versus dissimilar pairs.

6. Face Hand Test

This test monitors ability to recognise light tactile input. The examiner touches specific spots on the subject's body using cotton balls which are to be perceived and reported.

7. Finger Agnosia

The test involves application of light tactile stimulation randomly to fingers of the subject in order to evaluate any impairment in specific digital recognition.

8. Graphasthesia

This test involves tracing specific symbols on the finger tips of a subject which are translated and expressed as spoken responses.

9. Tactile Form Recognition Test

This test requires identification of geometric shapes by touch alone (stereognosis).

10. Trail Making Test

This test measures planning ability, visuo motor speed and concentration. It consists of randomly printed circles that are either numbered or lettered. The subject draws a connecting line alternating between numbers and letters. There are separate versions for children and adults. The adult version consists of 25 circles either numbered from 1 to 13 or lettered from "A" to "L". The Children's version has circles from 1 to 8 and letters from "A" to "G" respectively. Scores are recorded in terms of time taken to complete the task and the number of errors.

11. Benton Visual Retention Test

This test monitors visual construction, visual memory and visual perception. It requires the reproduction of a series of geometrical figures from memory after each card is exposed for varying periods of time (5 to 10 seconds). Three equivalent forms and four modes of administration are available for this test. Scoring is done according to the procedures in the manual (Benton, 1974)

12. Rey Osterrieth Comples Figures Test (Copy)

This test measures perceptual functioning, visual memory and higher planning functions. The subject has to copy a reproduction of Rey's Complex Figure, while the examiner times them. After completion of each section, a different colored pencil is given to the subject and the order of colors are recorded. Approximately, six colored pencils are required. They serve as documentation for the type of strategy used. After this task is completed, the patients copies are removed and three minutes time is allowed to elapse before he reproduces the design from memory, while his efforts are timed again (Rey, 1941; Osterrieith, 1944).

13. Aphasia Language Performance Scales

This measures language ability in a comprehensive, yet cost effective way. They assess receptive skills (listening and reading) and expressive abilities (talking and writing) to yield four discrete sub scales.

14. Controlled Word Association Test

This test measures verbal fluency and consists of three word naming trials using letters F, A and S in that order. Patients are asked to say as many words as they can think of beginning with the designated letter, omitting proper nouns, numbers and the same word with a different suffix. The total number of correct words pronounced during three one minute trials is recorded.

15. Modified Wechslers Memory Scale

This test (Wechsler and Stone, 1973) uses the scoring method proposed by Russell (1975). They measure verbal short term, verbal long term, figural short term and figural long term memory.

16. Rey Osterrieth Complex Figures Test (Recall)

This involves recall after three minute gap of the copy of complex figure (Rey, 1941; Osterrieth, 1944).

17. Walton Black Modified New Word Learning Test

This is a measure of new verbal information. It is essentially a vocabulary test of ascending difficulty until the subject is unable to give meanings of ten consequent words. The normal subjects can learn six new words by fifth trial.

18. Wechslers Intelligence Scale

The standardised tests of intelligence, such as, WAIS-R and/or WISC-R are also part of the battery.

19. Wide Range Achievement Test

This monitors educational achievement in reading, arithmetic and spelling from kindergarten to college level. It monitors word recognition without comprehension as the focus is on coding rather than semantic skills (Jastak and Jastak, 1978).

20. Stroop Color Word Test

This is a measure of capacity to maintain a uniform course of action independent of intruding stimuli. The subject required to show flexibility by shifting their perceptual set to adapt to changing situations. It consists of three 8 1/2 by 11 inch pages. Each page consists of 5 columns and 20 items. Each item on page one is one of these words: Red, Green or Blue. These words are repeated in a largely random order. Page two consists of 100 items as in page one, but each item is a sequence of XXXX. On this page, each XXXX is printed in the colors on page two, with the limitation that a word and the color it is printed may not match. Thus, the word "red" may appear in blue or green ink; "green" appears in blue or red; "blue " appears in red or green ink (Golden, 1979). On page one, the subject is required to read down each column as fast as possible pronouncing the words contained therein. On page two, the same procedure is followed, but the subject is to name the color of X's. On page three, subjects are asked to name the color of ink on which the word is presented rather than the word itself. The time limit is 45 seconds per page. The score is the total number of items correctly finished within the time limit on each page (Stroop, 1935).

21. Minnesota Multiphasic Inventory

The MMPI is by far the most popular measure of personality organisation. It is a self report instrument and computer compatible for scoring.

NEW BATTERIES AND APPLICATICNS TO NEOROPSYCHOLOGY

In the last decade, many neuropsychological tests for evaluating assets and/or deficits in brain damaged persons have been developed (Hanninen and

Lindstrom, 1976; Baker et al, 1983; Ekberg and Hane, 1984; Bowler, Thaler and Becker, 1986; Ryan et al, 1987). Most of these assessment devices use computerised techniques for administration, clinical analysis and interpretation (Adams and Brown, 1986; Adams and Heaton, 1987). Interpretative computer programmes for analysis and interpretation of neuropsychological test data, such as, SAINT (Swiercinsky, 1978a), BRAIN I (Finkelstein, 1977), Adams Revised Programme (Adams, 1975) are popular, yet not proven to be diagnostically superior to human clinicians (Heaton et al, 1981; Adams and Heaton, 1985).

The recent trends in neuropsychological assessment have attempted to chart profiles of performances in various groups or sub groups of clinical population, including, muscular dystrophy (Knights, Hinton and Drader, 1966), asthma (Dunleary and Baade, 1980), epilepsy (Herman, 1982), juvenile delinquency (Yeudall, Fromm-Auch and Davies, 1982), Gilles de La Tourettes Syndrome (Bornstein, King and Carroll, 1983), infantile autism (Dawson, 1983), learning disabilities (Nolan, Hammeke and Barkley, 1983; Geary and Gilger, 1984) and others.

While most investigations use well known neuropsychological test batteries, such as, LNNB, HRNTB or their children's versions, others have developed modifications thereof (Obrzut, Hynd and Obrzut, 1983; Harness, Epstein and

Gordon, 1984). There is growing interest in the fieJd of paediatric neuropsychology with its attendant focus on neuropsychological assessment of neonates (Wilson et al., 1982). Their investigations are directed towards early screening and identification of children showing predilection for later brain dysfunction (Rourke and Orr, 1981; Satz, et al., 1978; Spreen, 1978).

PRODUCT VERSUS PROCESS APPROACHES

Assessment for diagnosis is not the sole purpose of psychological assessment. If it were so, most psychological evaluation of persons with mental handicap would be unnecessary, superfluous and even unjustified. This is because most mentally retarded individuals come to the psychologist with some degree of failure in school related tasks. This information itself is sufficient to indicate about the condition of mental handicap. One might then well ask, why psychological assessment is to be done on individuals with mental retardation?

Haywood et al (1975) proposed two strategies for psychological assessment of mentally retarded persons. They are: (a) process approach; and, (b) product approach. The psychometric approaches to assessment are typically measures of products of prior learning of an individual. This approach assumes that assessed subjects, who are being normatively compared have equal opportunities for learning the measured variables. It also assumes, albeit implicitly, that all persons are equal in their retention of learned information/skills. Obviously, these assumptions are untenable (Haywood, 1970). Differential opportunities to learn have been clearly established to be associated with social class, educational opportunities, race, parental education, intelligence, etc. Similarly, there are individual differences in long term memory across intelligence levels (Haywood and Heal, 1968). Psychometric approaches seem to depend heavily on empirically untenable assumptions. Individual may score poorly on product oriented tests, not only because they lack opportunities to learn the skills demanded by such tasks, but also because they lack aptitudes for such skills. This is particularly true of mentally retarded persons (Mercer, 1971).

A cardinal principle of psychological assessment is that the best test of any event is a sample of that very event. For example, if one wants to know whether an individual will be a good drill press operator, the best test is a situation in which he must operate a drill press. However, instead of taking this direct approach, psychologists take a devious route for measurement, i.e., measuring a set of correlated functions and inferring the actual events. The process approach emphasises on measurement of process variables instead of products of a learned response. This is especially useful, wherein it is not the goal to establish the relative standing of a person against standardised norms of performance on a psychological variable, but to plan treatment or intervention programmes. The process approach aids in direct assessment and prediction of individual efficiecy on actual learning tasks because it provides data on the way an individual learns, his specific assets or deficits, the procedures of his generalisation of skills learnt in one situation or time to other situations or other times, etc.

The process approaches have drawn heavily from the developmental concepts of Piaget (Flavell, 1963), the psychometric procedures of Rey (1952) and later elaborated by Feuerstein (1970). All these theorists commonly emphasise on individual differences in learning specific tasks. A global score (such as, IQ) may be earned by persons who have attained these abilities or performance by different processes. Therefore, it would make little sense to adhere to a static, product-oriented assessment for planning treatment programmes (Vygotsky, 1960). Gordon (1965) suggests that the focus of psychological assessment should be on measurement of learning potential in an individual along with a description of his strengths and weaknesses in a qualitative or process manner. Several investigators have proposed assessment of learning potential as an index of educability to plan intervention programmes for individuals with mental handicap (Haeussermann, 1958; Budoff, 1973; Feuerstein, 1968; Schucman, 1968; Feuerstein, et al., 1972). They have pointed out that the emphasis of product approaches is only on the end performance of individual or specific set of test tasks. The result of this is that product approaches only provide a quantitative measure of the individual performance, such as, IQ, SQ, DQ, etc., which are in no way helpful in planning or programming instruction or remediation for the assessed individual.

Alternatively, the process approach draws heavily from concepts of Learning Potential Assessment Device (LPAD) Model (Feuerstein, 1968). This approach allows the examiner to assess not only an index of educability or potential, but also the type and amount of teaching needed for enhancing a particular skill or behavioural function. The LPAD approach is highly individualised and more appropriate in assessment of mentally handicapped persons. These theorists propose that the many behavioural weaknesses in persons with mental handicap are not so much a deficiency of abilities but deficiencies in intake of information that comes about owing to environmental deprivation. This is especially true in case of cultural-familial retarded persons with lack of educational or social opportunities, low levels of motivation, history of repeated failures, low achievement motivation and their generalised avoidance of test tasks. The product approaches do not consider these important variables in test performance. In standardised product oriented assessment approaches, the examiner generally attempts to describe the usual or typical way of individual functioning. There is no stress on eliciting the best performance of the Individual, and consequently, occasional high level responses are usually discounted as some kind of measurement error. Feuerstein (1968) sees these occasional excellent responses as indicative of the child's ability to learn. A few illustrative tests in the LPAD Battery are Organisation of Dots Test (Rey and Dupont, 1953), Representational Stencil Design Test (Arthur, 1930), The Plateux Test (Rey, 1934), The LPAD Matrices Test (Budoff, 1973), and others.

NEUROPSYCHOLOGICAL RESEARCH IN MENTAL RETARDATION

The scope of neuropsychology for the field of mental handicap is vast. Mentally handicapped individuals suffer from varying degrees of brain damage-either structural, functional or developmental. The cause of brain damage in mentally handicapped individuals may vary from infections, endocrine disturbances, metabolic disorders, vascular disturbances, congenital abnormalities, chromosomal aberrations, injuries, etc.

Neuropsychological studies with mentally handicapped use several techniques including auditory or visual evoked responses, regional Cerebral Blood Flow studies, dichotic listening studies, etc. (Hynd and Willis, 1988). One prominent line of research in understanding brain-behaviour relationships in persons with mental handicap has been the examination of cerebral specialisation in individuals with Down's Syndrome, a chromosomal aberration often associated with mental retardation. Dichotic listening studies of individuals with Downs Syndrome have shown a left ear-right hemisphere advantage for speech perception, which is the reverse of pattern shown in most non retarded individuals, i.e., right ear-left hemisphere dominance for speech perception (Reinhart, 1976; Sommers and Starkey, 1977; Zekulin-Hartley, 1978; 1981; 1982; Hartley, 1981; Pipe, 1983). This finding of reversed cerebral specialisation for language functions in Downs Syndrome subjects is of tremendous theoretical and practical interest. At a theoretical level, the existence of a large population of individuals with a specific chromosomal aberration showing reversed or, at least, atypical patterns of cerebral dominance has considerable implications for researchers trying to understand the genetic basis of cerebral specialisation (Tannock, Kershner and Oliver, 1984). At a practical level, research on cerebral specialisation in Downs Syndrome subjects may provide insight into the nature of the general (Gibson, 1975) and specific (Ashman, 1982; Hartley, 1982) intellectual deficits experienced by this group.

In related research, the hypothesis has been tested to see if Downs Syndrome subjects show preference to left hemisphere-sequential processing or right hemisphere-simultaneous or parallel processing of information (Ashman, 1982; Hartley, 1982; Elliot et al, 1987). This line of research has proceeded on the understanding that right hand-left hemispheric individuals show relative superiority on sequential tasks as left hand-right hemispheric individuals show relative superiority on tasks of spatial nature, such as, tactile discrimination, reproduction of spatial location, etc. (Witelson, 1974; Roy and Mc Kenzie, 1978).

The results of sequential-simultaneous processing models have been correlated with other experimental paradigms, such as, dual task studies (Kinsbourne and Hiscock, 1983; Carnahan, Elliot and Lee, 1986), Manual Asymmetry studies (Elliot, 1985), event related brain potentials (ERPs) (Straumanis, Shagas and Overton, 1973a; 1973b; Gliddon, Busk and Galbraith, 1975; Dustman and Callner, 1979; Yellin, Lodwig and Jerison, 1979; Schafer and Peeke, 1982). The general consensus of these studies have been that although dichotic listening strategies strongly support the claim for reversed cerebral specialisation in Downs Syndrome subjects, evidence from other experimental paradigms indicate that the model of simple reversed cerebral specialisation for this population is untenable. Research using manual asymmetry paradigms indicate Downs Syndrome individuals are left hemisphere dominant for movement sequencing (Elliott, 1985; Edwards and Elliott, 1986; Elliott, Weeks and Jones, 1986) and speech production (Harris and Gibson, 1986; Elliott et al, 1987). The latter finding seems to be more damaging for models advocating a reversal in cerebral specialisation in Downs Syndrome subjects based on dichotic listening techniques (Elliott, Weeks and Elliott, 1987).

Another line of research in the application of neuropsychological strategies relevant to the field of mental handicap has attempted to use various test batteries to delineate functional profiles of specific diagnostic groups/conditions. Koff, Boyle and Pueschel (1977) studied perceptual motor functioning of children with phenylketonuria (PKU). Extending further, Brunner, Jordon and Berry (1983) profiled the neuropsychological consequences of early treated PKU children and found that these subjects performed significantly worse than matched non-PKU controls on HRNTB. They also found that the degree of neuropsychological impairment correlated significantly with subject's concurrent phenylanine levels. However, they made no attempt to lateralise or localise the neuropsychological deficits, nor compare early treated PKU children with other children with brain dysfunction. These issues were taken up later and found that PKU children consistently showed neuropsychological deficits in two domains-conceptual and visuospataial respectively (Pennington et al, 1985). However, this study could not elicit any consistent pattern of lateralisation. Clarke et al (1987) found specific neuropsychological deficits in PKU individuals which were at least, partially reversible by returning PKU adolescents on unrestricted diets to dietary phe-restriction, despite years of hyperphenylaninemia.

A series of neuropsychological studies have been conducted on patients with Multiple Sclerosis-which, in early years may manifest with mental retardation. Most of these studies show typical cognitive and behavioural deficits charecteristic of MS patients, such as, poor motivation or concentration, irritability, lack of insight, perseveration, poor planning, difficulty in learning or benifitting from training skills, etc. Besides, they make errors over and over again and forget materials learnt previously (Walsh, 1978; Damasio, 1979; Miles, 1979; Peyser et al, 1980). It is proposed that the profile of behavioural and cognitive deficits shown by MS patients resemble the kind of changes shown by patients with frontal lobe damage (Canter, 1951; Surridge, 1969; Weinstein, 1970; Ivnik, 1978; Vowels and Gates, 1984). These findings have direct or indirect implications for training and rehabilitation of persons with mental handicap. Vowels and Gates (1984) profile the pattern of neuropsychological impairments in MS patients into three components:

1. serious deficits in "dynamic", cognitive frontal lobe functions, such as, ability to organise, plan and solve problems in a variety of unfamiliar situations;

2. moderate deterioration of memory and learning processes; and,

3. preservation of automatic, long standing and verbal skills respectively.

It is hypothesised that cerebral demyelinisation and plaque formation of MS patients especially in frontal regions is responsible for the cognitive, affective and behavioural changes (Ikuta and Zimmerman, 1976; Mastaglia and Cala, 1980; Morarity, Wlkins and Patel, 1980)

Another condition, associated with mental handicap that has been investigated from the stand point of neuropsychology is "hyperactivity". It has been postulated that damage to frontal lobe produces behavioural and cognitive changes akin to children with hyperkinesis. The commonly listed features include lack of resistance, distractability, restlessness, hypermotility, lack of initiation, etc. Some neuropsychologists view hyperkinesis as a developmental disorder or "maturational lag" (Kinsbourne 1973; 1979) owing to late onset myelination of neurons (Yakovler and Lesours, 1967). Conners and Wells (1986) attempted a neuropsychological profile of performance and derived five clusters of deficits in children with hyperkinesis, viz., frontal lobe dysfunction, attention deficits, difficulty in following directions, visual spatial difficulties and perceptual difficulties respectively.

CHAPTER THREE:

THE MAIN STUDY

INTRODUCTICN

The need and context for the present study emerged from the overall considerations presented in forgoing chapters. Obviously, the field of psychological assessment in mental retardation is very broad with diverse aims, approaches, assumptions and techniques. No single or specific approach is self sufficient to answer all sorts of decisions about mentally handicapped individuals. If at all, to be realistic, specific approaches or techniques need to be evolved or espoused for different purposes of psychological assessment.

As we have seen, neuropsychology offers an excellent theoretical framework to work in the care and rehabilitation of an heterogeneous population such as individuals with mental handicap. The ideometric approaches to neuropsychological assessment involve an intensive analysis of single cases with an attempt to formulate lawful and interpretative statements pertaining to that case or class of individuals being assessed (Denizen, 1978). In contrast, normative approaches formulate laws or principles through analysis of large number of typically random cases (Lundberg, 1926; Campbell, 1970). Normative assessments are based on a strict cause and effect model of inferences about behavioural phenomena. They pursue a rigid procedure for quantification of mental and behavioural processes or phenomena. It is held that the causal propositions or formulations of behavioural phenomena can be inferred from a careful but random study of select subjects so as to enable generalisation about larger unseen population. Ideographic observations are used for explanatory, descriptive or illustrative purposes about behavioural phenomena. Ideometric approaches have recent origins in the history of psychological assessment (Hall and Lindzey, 1957). This approach proceeds on the basic assumption, which recognises wide individual differences in behavioural phenomena even as it emphasises evaluation of single case trends inspite of all its intrinsic complexity and tedium of time for research (Hall and Lindzey, 1957; Denizen, 1984). Being individual oriented rather then group oriented, ideometric approaches permit each individual to speak or express himself in his or her own language. The assessments following these approaches are, necessarily phenomenological, i.e., they try to capture world meanings as held from within by the individual. Therefore, the specific techniques used under this approach are relatively unstructured, open ended, slightly interpretative and, at an extreme, even projective (Campbell, 1970; Denizen, 1984). In a sense, normative approaches or theories are deductive and probabilistic. They offer cause-effect or functional explanations of behavioural phenomena (Nager, 1961). They begin from a theoretical standpoint and inductively generate hypothesis which would eventually contribute to the theoretical understanding of behavioural phenomena (Denizen, 1984).

The differences between nomothetic and ideometric approaches are analogous to "etic" and "emic" approaches propagated in the field of human anthropology (Pelto, 1977). In anthropological theory, etic investigations are external, comparative and cross cultural attempts to understand behavioural phenomena. Emic investigations are seen from inside and make particular observations within a behavioural phenomena. Geertz (1973) named these two approaches as "thick" and "thin" observations, while 0'Flaherty (1987) calls them as "hard" versus "soft" descriptions about behavioural phenomena. The "thick" or "hard" descriptions are emic or ideometric approaches, and the "thin" or "soft" descriptions are etic or nomothetic approaches towards understanding psychological phenomena.

The purpose of ideometric approaches to neuropsychological assessment in individuals with mental handicap may not be actually to localise or lateralise structural brain damage. Indeed, this can never be done considering that most mental retardation is not a structural disability. Rather, mental retardation is a developmental, biochemical, genetic or even environmental disability.

Agreeably, there are inherent differences in the assumptions; and also, there are merits as well as demerits in ideometric versus nomothetic approaches to psychological assessment (Golden, 1979). Psychologists have taken sides by aligning themselves to one approach rather than the other. However, recently, there has been a revived interest in exploring idiometric approaches to psychological assessment (Sahakian, 1977; Secord, 1982) particularly in the field of mental retardation (Nizamie et al, 1989; Venkatesan and Reddy, 1990). The few neuropsychological studies in the psychological assessment have only attempted to ideometrically draw specific profiles of functional assets and/or deficits in groups or sub groups of population, such as, learning disabled, hyperkinetic children, etc. Occasionally, attempts have been made to deduce structural dysfunctions in the CNS or other cortical areas relevant to particular dysfunctions elicited in populations or sub populations of individuals. However, more often, efforts have been made to draw functional, rather then structural profile of specific assets and/or deficits in neuropsychological functioning in given groups of individuals.

LEVELS OF ANALYSIS MODEL

At this junction, it is apt to consider the Levels of Analysis Model for assessment of human behavioural phenomena (Berninger and Thalberg, 1988). This model summarises and explains the complementary rather than contradictory nature of various approaches to psychological assessment. According to this model, it is assumed that any mental or behavioural phenomena can be analysed at multiple levels ranging from a molecular-structural event with brain system, to molar levels of cognitive-behavioural functional events within the broad matrix of neuro-sociology (Bogen, 1977). For example, a simple behavioural act, such as, assembly of shapes on a form board maybe analysed and understood as a cellular, physiological, biochemical, endocrine activity; or at other levels, as a cognitive, motoric or even a socio-cultural activity (Beery and Spectar, 1986; Squire, 1986). Besides, a given individual might show assets and/or deficits related to this behavioural act at any of the above levels. The nature, kind, extent or amount of assessment information that can or need be elicited from the individual or groups of individual performing this behavioural act depends on the specific level at which analysis is sought, and also, for what particular purpose it is sought. In our earlier example, if aetiological diagnosis is the purpose of assessment, analysis at the level of a biochemical investigation may be required. However, the same information would be useless or meaningless in the context of planning an intervention programme. For planning intervention, the level of analysis for assessment would be to drawn psychological profile of assets/deficits in cognitive-behavioural domain of the individual. In sum, there are specific levels of analysis in assessment that must be determined relevant to the nature or amount of meaningful decisions that has to be undertaken for a given individual or group of individuals.

A characteristic feature in Levels of Analysis Model is their attempt to describe behavioural phenomena in the absence of assigning any static labels upon the individual/s being assessed. Even if labels are used, they are meant to screen, identify and isolate specific patterns of behavioural phenomena and not individuals per set. The emphasis is on describing current status of a behavioural phenomena at various levels of analysis, and periodically following up assessments to monitor changes in the status of behavioural phenomena as a function of learning. Posner (1979) declared, "We should not get into the habit of thinking that the organisation of brain is something innate and fixed in time. Teaching does reprogram the brain. It provides new organisation, information flow and temporal patterns. The fact that individuals differ in brain processes should not be necessarily thought to imply such differences as immutable".

NEED FOR THE STUDY

A study using ideometric approaches to functional assessment in mentally handicapped individuals would be most relevant for the following reasons:

1. There is a dearth of research on application of ideometric approaches to functional assessment in individuals with mental retardation;

2. In a heterogeneous group of population, such as the mentally retarded, each person can himself be the best measure of comparison for performance on specific functions or aspects of a behavioural phenomena rather than a group norm of a non comparable normal population;

3. There is a possibility for identifying specific psychological functions that come into regular use in day-to-day activities of mentally handicapped individuals. This being identified, specific ideometric measures can be devised to profile the pattern of specific neuropsychological assets and/or deficits in individual cases. This profile pattern could well become the basis for undertaking specific training or educational instructions in the deficit areas. It can even guide specific instructional modes to be adopted in specific cases or groups of cases.

4. Ideometric approaches to functional assessment can also facilitate inter-individual and intra-individual comparisons on various measures of psychological phenomena. Intra-individual comparisions can be made to see if there are any changes over time in the profile of functional assets/deficits recorded currently;

5. In view of the inconclusive evidence for or against various patterns of cerebral organisation of brain-behaviour arousal functions, (such as, sequential-simultaneous processing, process-product events, etc.) an exploratory investigation in this direction may throw light on related issues in individuals with mental handicap; and.

6. Studies undertaken in this direction can become a pilot attempt for undertaking large scale studies depending upon the kinds of hypothesis generated in the present study.

RESEARCH DESIGN

The present study has to be, necessarily, exploratory in its research design. There are hardly any studies in the area of ideometric approaches to functional assessment in mental retardation. Hence, no coherent or meaningful hypothesis can be formulated for testing in this area. It would be, both, modest as well as fruitful to design the present study humbly enough to generate hypothesis in the area of neuropsychology of mental retardation and with special focus on a try out of possibilities for developing idiometric approaches, as supplementary to conventional psychometric or nomothetic approaches used in the assessment of mentally handicapped persons. By following idiometric traditions, the study must be based on an operational, empirical and atheoretical framework. The study cannot attempt nor claim to prove an alleged theory or system of understanding brain-behaviour relationships in the field of neuropsychology. Rather, the attempt has to be for exploring the technical utility, if any, of these approaches to psychological assessment in individuals with mental handicap.

AIMS OF THE STUDY

Specific to the exploratory characteristic of the present study, the following aims were delineated:

1. To identify specific set of narrow band neuropsychological functions that come to use in activities of daily living of individuals with mental handicap;

2. To develop idiometric neuropsychological assessment tool to assess the identified functions;

3. To administer the developed neuropsychological Functional Assessment Battery on a select target group of persons with mental handicap;

4. To chart a functional neuropsychological profile of specific assets and deficits of individual groups of the tested persons with mental handicap;

5. To generate an inductive hypothesis of functional profile patterns of brain behaviour relationships in mentally handicapped persons;

6. To establish the validity of these idiometric approaches to functional assessments in mentally handicapped persons;

7. To explore the possibility of using the derived neuropsychological profiles as baseline before exposure to generalised training or education on a small sub sample of the population;

8. To chart a functional neuropsychological profile of specific assets gained over time by the experimental group against a matched control group in a sub sample of individuals with mental handicap.

METHODOLOGY

Sample

The study was proposed on a sample of adults with mental handicap. The sample was to comprise of individuals above sixteen years and already diagnosed as "mental retardation" according to ICD-9 criteria (WHO, 1978) of including persons falling within the -2.00 SD to -4.33 SD units of IQ range in the Gaussian distribution (See Table 2). All the individuals were diagnosed by a team of mental health professionals including psychiatrist, clinical psychologist, special educationist, etc., independent of the present researcher and prior to the beginning of this investigation. There was no attempt to restrict the sample to a particular severity of the diagnostic category as long as the subjects met the following inclusion/exclusion criteria:

INCLUSION CRITERIA:

1. Individuals who manifest a condition discernable by competent mental health professionals as Mental Retardation, according to ICD-9 criteria (WHO, 197g).

2. Individuals aged more than sixteen.

3. Individuals who are co-operative for psychological assessment.

EXCLUSION CRITERIA:

1. Individuals aged less than sixteen years.

2. Individuals having mental retardation alongwith secondary diagnosis of infantile autism, hyperkinetic syndrome, disintegrative psychosis, major physical illness, epilepsy, cerebral palsy, sensory impairments, etc.

3. Individuals who were not cooperative for testing.

4. Individuals who were not on any medication at the time of testing.

All cases included in this study were drawn from Vocational Rehabilitation Centre, D.G.E.&.T., Ministry of Labour, Hyderabad; "Shikshana", Parents Association for Adult Mentally Handicapped Persons, Hyderabad; and the General Services of National Institute for the Mentally Handicapped, Secunderabad.

The Vocational Rehabilitation Centre is a regional unit of Directorate General of Employment and Training, under Ministry of Labour, situated at Hyderabad. It imparts vocational training to adults with a variety of handicaps or impairments, including visually or auditory impaired, physically handicapped, mentally retarded, etc. The Centre has several sections or trades for training, such as, tailoring embroidery, carpentry, book binding, tailoring, draughtsmanship, typewriting, etc. The Centre admits only adults with mental retardation, apart from other categories of handicaps or impairments mentioned above. The staff in the Centre comprise of qualified professionals, including, clinical psychologist, occupational therapist, vocational supervisors/instructors, etc. The students are admitted in the Centre following referrals from other points in the city and based on their admission criteria. The students with different types of disabilities are trained together within each section, manned by a vocational supervisor/instructor. The number of students in each section vary from 15-20 out of which there may be 3-5 adults with mental handicap. The centre works for five days in a week for eight hours in a day.

The "Shikshana", Parents Association for Adult Mentally Handicapped Persons, is a registered parents' self help group for welfare of mentally handicapped persons. It comprises of elected parent members, who contribute their mite to the care and rehabilitation of their own children with mental retardation. They carry on vocational training services in trades like, running a canteen, detergent making, phenyl making, envelope making, etc.

The National Institute for the Mentally Handicapped, Secunderabad, is an autonomous body under Ministry of Welfare, Government of India. The Institute organises and promotes training, research, teaching and management services in the field of mental handicap. More specifically, NIMH as an apex body to undertake human resource development for delivery of services, to develop appropriate models of care, to identify, conduct and coordinate research and serve as a documentation and information centre for individuals with mental handicap.

The service programmes provided at NIMH include general services for screening/diagnoses of individuals with mental handicap. Besides, the Institute offers special services comprising off service programmes in the form of interventions from specialists in the area of medicine, special education, clinical psychology, speech pathology and audiology, physiotherapy, etc.

PROCEDURE

The following steps were used to answer each of the questions raised by the aims of the study:

Step One

Identification of specific set of narrow band neuropsychological functions that come to use in the activities of daily living of individuals with mental handicap.

Step Two

Construction of a provisional list of relatively culture free idiometric neuropsychological assessment tools to assess the identified functions.

Step Three

Initial try out of the identified functions and/or its related test procedures on a small sample to work out the feasibility for their use on larger sample of the main study.

Step Four

Final revision of tests included/excluded in Functional Assessment Battery, and the procedures of test administration, scoring, etc., for each of the selected functional neuropsychological categories.

Step Five

Administration of the developed Functional Assessment Battery on a large scale sample of persons with mental handicap.

Step Six

External validation of the developed neuropsychological Functional Assessment Battery against perceived ratings of work behaviours by vocational instructors in a subsample of individuals with mental handicap.

Step Seven

Exposure of a sub sample of the assessed individuals with mental handicap to a generalised education or training programme within a vocational setting.

Step Eight

Evaluation of gains in functional neuropsychological deficits, if any, as against their baseline scores in a select sub sample of the population. In other words, this involves establishing sensitivity of FAB.

The above mentioned steps followed in this research study are discussed in the following pages.

Step One: Identification of Specific Neuropsychological Functions

The first step in this study involved identification of specific neuropsychological functional categories to be included in the Functional Assessment Battery (FAB). A review of literature suggest a remarkable consensus in defining functional categories of behaviour, even though the writers come from divergent theoretical (or even atheoretical) orientations. For example, Adams, Rennick and Rosenbaum (1975) use an ability approach to structure neuropsychological batteries amenable to computerised interpretations. Lezak (1988) formulated neuropsychological categories for systematic testing. Swiercinsky (1978b) noted ten functional categories of test behaviour, viz., organisation, spatial-perceptual organisation, tactile perceptual organisation, language skills, general information processing, memory processes, attention concentration, and education experience. Christensen (1975) provides a lucid translation of Luria's functional categories. Golden (1980) quantified Luria's investigation to describe a profile of skills, such as, motor, rythm, receptive and expressive speech, writing, reading, arithmetic, memory and intellectual process. Rourke (1981) summarise commonly accepted areas of neuropsychological functioning like motor, auditory-perceptual, tactile perceptual, visuo-spatial, language ability, memory processes, higher cognitive process (comprehension, intelligence, abstract thinking, problem solving, planning functions, etc.) and personality organisation. Based on a review of existing literature on test battery approaches as well as empirical observations of mentally retarded subjects, the following range of neuropsychological functions were selected for inclusion in FAB. The major guiding principle in selection of these functions was not any theoretical system of understanding brain-behaviour relationships. Indeed, the selection was guided on an atheoretical framework for its technical utility than anything else (Lazarus, 1981). However, the general considerations for inclusion of specific functions to the present Battery **were:**

1. The functions were to necessarily cover a wide range of areas related to day-to-day activities of the individuals with mental handicap;

2. As far as possible, the functions were to be psychometrically valid, and even mutually exclusive and exhaustive (Boll, 1978);

3. No function or group of functions were to be overly dominant on other assessed functional categories;

4. An operational and empirical approach to determining specific functions in the Battery was preferred to a strong theoretically based understanding of brain-behaviour relationships;

5. Priority was given to selection of tests or functional categories which did not require high expenditure on time or energy. In other words, they were to be cost effective (Kazdin and Geesey, 1980);

6. The functional categories or its tests were not to require special storage conditions, high portability costs, etc.;

7. A general preference was given to widely used, or available tests, so that functional categories could be devised thereof.

8. A general flexibility in usage of selected tests was preferred.

By following these guidelines, a broad range of neuropsychological functional categories were selected for preliminary inclusion in the present battery (See Table 4).

Table 4.

Nueropsychological Functional Categories Selected for Preliminary Inclusion in FAB

I. Attention-Concentration

II. Motor functions
- a) Fine Finger Dexterity
- H fine Motor Speed
- c) Cross Motor Dexterity
- d) Cross Motor Speed
- e) Fine Motor Readiness
- f) Eye hand Coordination
- g) Fine Motor Strength
- h) Cross Motor Strength*

III. Visual Functions
- a) Visual Scanning
- b) Visual Matching:
  - i) Object Matching
  - ii) Picture Matching
  - iii) Object Shape Matching
  - iv) Picture Shape Matching
  - v) Object Size Matching
  - vi) Picture Size Matching
  - vii) Object Color Matching
  - viii) Picture Color Matching
  - ix) Object Number Matching
  - x) Picture Number
- C) Visual Discrimination:
  - i) Object Discrimination
  - ii) Picture Discrimination
  - iii) Figure Ground Discrimination
- d) Yisual Naming, such as,
  - i)_ Object Naming
  - ii) Picture Naming
  - iii) Color Naming
- e) Visuo-construction
  - i) Vertical Assembly
  - ii) Horizontal Assembly
  - iii) Graphomotor

IV.. Auditory Functions
- a) Auditory Discrimination
- b) Sound Syllable Production

V. Tactile Functions
- a) Tactile Perception,' such as,
  - i) Tactile Object Matching
  - ii) Tactile Shape Matching
  - iii! Tactile Size Matching
  - iv) Tactile Number Matching
- b) Tactile Discrimination*, such as,
  - i) Tactile Object Naming
  - ii) Tactile Shape Naning
  - iii) Tactile Number Naming
  - iv) Two-point Threshold

VI. Memory Functions
- a) Immediate Auditory Memory
- b) Recent Auditory Memory
- c) Imediate Visual Memory
- d) Recent Visual Memory

VII. Other Cognitive Functions
- a) Ideationa! Fluency
- b) Learning Functions*:
  - i) Visual Learning
  - ii) Auditory Leaning
  - iii) Tactile Learning

Indicates functional categories, which were eventually excluded after a pilot trial

Step Two: Provisional Construction of Ideometrically Based Functional Assessment Tools

After identification of neuropsychological functional categories this step attempted to design provisional measures for seven broad domains of neuropsychological functions. Several sources in literature were consulted to develop appropriate measures for each function slated for inclusion during initial tryout of FAB (See Table 5).

Table 5.
Provisional List of Functional Assessment Tools
Identified for Initial Try Out

Function	Test Selected
I. Attention-Concentration	Knox Cube Imitation Test
	Eysencks Test of Concentration
II. Motor Functions	Finger Dexterity Test
	Minnesota Rate of Manipulation Test
	Pattern Tracing Test
	Steadiness Test
	Finger Tapping Test
	Hand Dynaaometer
	Imitative Action Sequences Test
III. Visual Functions	Test of Visual Scanning
	Visual Matching Tests
	Visual Discrimination Tests
	Visual Naming Tests
	Visuo Construction Tests
IV. Auditory Functions	Auditory Discrimination Test
	Sound Syllable Production Test
	Sound Rythm Test

Cont'd

V. Tactile Functions	Test for Localisation of Tactile functions Two point Threshold Graphesthesia Test of Tactile Identification
VI. Memry Functions	Test of Auditory Meaory Test of Visual Memry
VII. Other Cognitive Functions	Test of Ideational Fluency Walton-Black Modified New Word Learning Test Test of Visual Learning Test of Auditory Learning Test of Tactile Learning

Step Three: Initial Try Out of the Identified Function Based Assessment Tools

After provisional construction of idiometrically based functional assessment tools, the third step aimed at an initial try out of these tools on a small sample of five mentally handicapped subjects. The main objectives of this try out was:

1. to ascertain operational difficulties in use of specific measures or tools which were provisionally identified for inclusion in the Battery;

2. to consider modifications, changes or revisions, if any, in administration, scoring and/or interpretation of any test measure;

3. to consider elimination of those test measures, which pose difficulties in terms of cost, expenditure on time, portability, etc.; and,

4. to consider any additions to existing procedures in test administration, scoring, interpretation, etc., if required.

The initial try out proved useful in refining the test measures, altering administration procedures in some tests, dropping some other tests, etc. The specific alterations made in each test/measure is discussed along with the description of each test in the following.

Step Four: Final Revision of Tests Included/Excluded in the FAB

The details of neuropsychological functions, tests and measures considered for final inclusion/exclusion in FAB is described below:

I. ATTENTION-CONCENTRATION

As understood loosely in this study, attention is the process of selection of specific stimuli from various other stimuli impinging on the organism at any given moment. Concentration refers to the dynamic process of sustaining attention over a length of time on a selected stimuli. All tests of attention emphasise on eliciting or measuring selectivity of the individual organism. In contrast, tests of concentration emphasise on measuring ability to sustain attention over a length of time. Undeniably, in actual practice, the two theoretical constructs are intricately interwoven and no test measure can elicit one alone specifically or purely. At best, test measures devised to elicit them have to be judged from the standpoint of their relative emphasis on attention or concentration. There are various aspects in the composite function of attention-concentration, including, span of attention, arousal, activation, vigilance, habituation, fatiguability, insight, etc. Besides, this function can operate with relative independence in each sense modality or sometimes in integration between all the senses. Further, idiometric analysis of the twin functions of attention-concentration permits its classification into several stages, such as, arousal, habituation, orienting response, phasic and tonic attention, vigilance, etc. Admittedly, the following tests devised or modified for inclusion in the present Battery do not purport to measure all these aspects of attention-concentration sequence.

1. Knox Cube Imitation Test (modified)

The Knox Cube Imitation Test, Modified, compreses of five one inch wooden cubes of the same color. Four cubes are placed in a row, one inch apart in front of the subject. Each cube in the row has a designated number ranging from 1,2,3 and 4 from right to the left of examiner. The instructions involve asking the subject to do as the examiner does. The examiner takes the fifth cube and taps gently on the cubes in a specified order. The subject is to imitate the same order of tapping. Cattell (1953) gives a list of twelve trials. The number of taps to be imitated by the subject in the specified order varies from 4-6. Cattell's norms for mean number of correct tappings on this Test for normal adults is 6.35 (SD : 0.94). Pinter and Patterson (1926) produced norms for mean number of correct tappings on this test for children between chronological ages of 5-10 years as 2.5 to 6. Assuming our population of mentally retarded adults to be in the mental age range of anywhere below ten/eleven years, the uppermost expected score can be less than six.

During the initial try-out, it was seen that mentally handicapped subjects can attend and imitate the sequence of tappings shown by the examiner. However, the lower and upper ceilings of four to six tappings (as seen in normals) within a trial was reduced to between three to five tappings only.

The proposed order of presentation was also revised (see Table 6). Two sample demonstrations were included at the beginning of test administration to facilitate comprehension of test procedure by mentally handicapped subjects.

There are ten trials in this test. Scoring is done on a all or none correct basis. One mark is given for each order correctly performed in a given trial. The maximum score possible on this test is ten. The approximate time taken for administration of this test is around five minutes. The function being assessed on this test is visual attention.

Table 6.

Order of Presentation for Knox Cube Imitation Test

(Modified)

ORDER OF PRESENTATION		
Simple 1 : 123	Sample 2 : 213	
TA 234	TE 1432	TI 31421
TB232	TF 13124	TI 42213
TC142	TG142	
ID 1324	TH 14231	

2. Eysenck's Test of Concentration (Visual, Modified):

In the original version of this test (Cattell, 1953), the examiner reads aloud a sequence of digits at the rate of one per second. The subject is asked to concentrate on all the numbers or digits being read out. The examiner stops reading at a digit without forewarning. The subject is asked to repeat the last four numbers in the same order as it was presented by the examiner. There are ten trials on this test, excluding two sample trials at the begining of test administration. The scoring is done on the basis of the correct number of digits identified by the subject in each trial. The maximum score possible on this test is 4 x 10, i.e., forty.

During the initial try-out of this test, it was observed that mentally retarded subjects had difficulty in negotiating numerals. Besides, their digit span was so low that they could not repeat all four numbers. Hence, a modification in content as well as evaluation of the test performance was introduced by having them to negotiate concrete objects, instead of numbers as items in this test. A kit comprising of concrete objects was devised for presentation in a specific, but increasing order of complexity (See Table 7). Two sample demonstrations were included at the begining of the test administration to facilitate comprehension of the test procedures. There are ten trials in this test. Scoring is done on all-or-none correct basis. One mark is given for each correct order of identifying the last two items. This modification into correct identification of the last two objects, instead of four (as in the original version) was done to accomodate for the lower span of attention in mentally handicapped subjects. The maximum score possible on

Table 7 .
Materials and Order of Presentation on Eysencks Test of Concentration, Modified

OBJECTS USED) EYSENCKS TEST Of CONCENTRATION

1. Pencil	2. Cloth	3. Comb
4. Key	5. Rupee coin	6. Bangle
7. Lock	8. Needle	9. Button
10. Pin		

ORDER OF PRESENTATION

Sample: 123	Sample:1234
A. 14238	B. 13752
C. 36512	D. 285617
E. 149326	f. 265189
G. 1392564	E. 2856419
I.71842935	J. 31498526

this test is ten. The approximate time taken for administration of this test is around five minutes. The function being assessed on this test is concentration. Even though the possibility of assessing auditory attention and auditory concentration of the mentally handicapped subjects through a sound span test and a modified version of Eysenck's Test of Concentration in aural modality was initially considered, no try-out of the same was attempted in this study for want of time.

In sum, only tests of attention-concentration were selected for final inclusion in FAB (See Table 8).

Table 8.
Summary List of Tests of Attention-Concentration for final Inclusion in FAB

Functions	Test	Maximum Score	Time
Visual attention	Knox Cube Imitation Test, modified	10	5m
Visual concentration	Eysenck's Test of Concentration, visual fom, modified	10	5m

II. MOTOR FUNCTIONS

The idiometric analysis of motor domain reveals two broad aspects, viz., fine motor and gross motor functions. In the context of mental retardation, these two functions can be further analysed into three aspects, viz., dexterity, speed and strength. Besides, eye hand coordination is a common function to all motor activities (See Table 9).

Table 9
flat Chart of Idiatetric Analysis of Motor Functions

MOTOR	
Fine Motor	GROSS MOTOR
-Fine Motor Dexterity	Gross Motor Dexterity
-Fine motor Speed	Gross Motor Speed-
-Fine Motor Strength	Gross Motor Strength-
EYE HAND COORDINATION	

Motor functions can include activities performed by an individual using upper limbs as well as lower limbs. In the present paradigm for idiometric analysis of motor domain, all measures are related to use of upper limbs only. The specific tests for assessment of motor functions in FAB were,

1. Finger Dexterity Test (FDT)

The Finger Dexterity Test consists of a tray with hundred small holes in rows of ten each. The subject uses a tweezer to pick up small metal pins and place them inside the holes of the tray. In the present study, the tweezer was dispensed. Instead, the subjects were instructed to use their fingers to pick up metal pins and insert them into the holes as quickly as possible. The scoring is based on the total time taken (in seconds) by subjects to fill in all the hundred holes in the tray. Also, the usual procedure of asking subjects to fill in the holes in a prescribed order was not insisted in the present study. The performance of subject/s were recorded for three conditions, viz., using PH, NPH and BH. The hand preference of a subject was determined by using a modified version of Laterality Preference Schedule (Dean, 1982) (See Appendix One).

2. Minnesota Rate of Manipulation Test (MRMT)

The Minnesota Rate of Manipulation Test (Ziegler, 1946) consists of a wooden board with three rows and ten columns of circular slots. The subject is required to insert circular wooden pegs into the slots as quickly as possible. The usual procedure of administration on this test is carried out under two conditions, viz., direct insertion of the pegs into slots, and turning to place the pegs into slots. The former procedure attempts to assess gross upper limb speed, while the latter attempts to measure gross upper limb dexterity and speed. In this study, the procedure of direct placement of blocks alone was used. The scoring of test performance involves recording total time (in seconds) taken by subjects to fill in all slots in the Board. The subjects were free to select their own order of filling slots in the Board as long as they completed the task in quick time. The subject's performance is recorded for three conditions, viz., using PH, NPH and BH respectively.

3. Pattern Tracing Test (Modified) (PTT)

This test apparatus consists of a Board with a grooved star design etched on it. The subject is required to trace the grooved design as quickly as possible by using a stylus and without touching the edges of the design. If the sides of the groove are touched, it is counted as an error by the error counter that is electrically attached to the main board. This test measures fine motor steadiness and eye hand coordination of the subject. The scoring of test performance is the unit time taken (in seconds) to trace the star design once in each trial, and also, number of errors made in that trial. In all, two trials each with PH and NPH was computed for each subject. In the initial try out, it was discovered that some individuals with mental handicap show errors in performance owing to the newness and novelty of the gadgets they were to operate. Therefore, it was decided to allow the subjects to acquaint themselves about the operation of the apparatus for one to two times before the actual scoring of performance was started.

4. Steadiness Test

This test apparatus consists of a propped up board with nine holes arranged in two rows of decreasing order in sizes. The biggest hole measures no more than one inch diameter as the smmallest hole measures less than a centimetre in diameter. The subject is required to insert and hold a sharp pointed stylus inside each hole for thirty seconds. He is instructed not to touch the sides of the hole. Even a slight contact with the edges of the hole gets recorded as an error in error counter that is electrically attached to it. This test is a measure of subjects fine motor steadiness and eye hand coordination. The scoring of test performance is recorded as the average number of errors by the subject for each thirty second duration for nine holes.

5. Finger Tapping Test

The apparatus for this test consists of a mechanical device with a tapping key for recording the number of taps made by the subject in a given unit of time. The subject is instructed to tap as quickly as possible using the index finger of PH, and then NPH. The number of taps made within a ten second trial gets automatically recorded in a counter. Five consequetive trials are to be taken with each hand. A pause or rest period of twenty seconds is allowed between each trial. Scoring of subjects performance on this test is taken as the mean number of taps for five consequetive trials of a hand. After an initial try out in this present study, this test was discarded due to problems in portability of the instrument.

5. Hand Dynamometer

This is a measure of gross motor strength. The test consists of an apparatus which has to be gripped by the subject to determine strength of grip in kilograms. The measurements are recorded for a minimum of three trials each using PH, NPH and BH. Owing to high portability costs, this test was excluded from the main battery in this study.

6. Imitative Action Sequences Test

This test is a measure of gross motor coordination, kinetic melody (sequencing of motor acts), immediate kineasthetic memory and gestural imitation. This test consists of a checklist of listed sequences of actions taken from day to day living. The examiner must record whether the subject can perform these actions on his own, or upon demonstration, in imitation (See Table 10). This test was eventually excluded from this study for want of time.

Table 10.

Imtitation Action Sequences Test

Specify whether the subject perforas the following actions on his own or on imitation

Items	On Own	On imitation
Gross Limb Gestures		
1. Samaste/Adaab		
2. Salute in attention		
3. Beckon 'Come Here!'		
4. Beckon 'Go Out!'		
5. Sign 'Stop or Enough!'		
6. Sign'Sit Own!'		
7. Sign 'Want Water!'		
8. Sign to go for toilet		
9. Sign to ask 'What?'		
10. Sign 'Stand up!'		
Gross Limb Manipulation		
11. Open the latch of door		
12. Light a matchstick		
13. Out with a pair of scissors		
14. Use a hammer		
15. Open a lock with key		
16. Opena bottle cork/lid		
17. Toss a coin		
18. Hurl a ball		
19. Screw/unscrew large size nut or bolt		
20. Paste an envelope or cover		

Cont'd

Bucco-facial Gesture

21. Open mouth and close mouth alternatively
22. font an '0' with lips
23. Stick out tongue
24. Blow out air
25. Suck in air

Bucco-facial Manipulation

26. Blow out a match
27. Suck through straw
28. Whistle
29. Clicking sounds with tongue
30. Cut thread with teeth

Serial Acts

31. Fold letter, put inside an envelope, paste it and affix stamps
32. Riase right hand, riase left hand, touch nose with right hand, then with left hand
33. Tie a slip knot
34. Make a papaer boat/aeroplane
35. Pull nose and simultaneously protrude tongue. Pull both ears and similtaneously withdraw tongue inside. Repeat the sate sequence at least three times.

The above mentioned tests do not include assessment of fine and gross motor strength. The possibility of measuring these dimensions of motor functions by means of Digital Pulley and/or Hand Dynamometer was initially considered. But, they were eventually rejected owing to constraints on cost and portability. It leaves room for later research to explore the possibilities for inclusion of such tests in the Battery. All the above mentioned tests are not "pure" measures of the functions they claim to assess. For example, the Finger Dexterity Test measures, both, fine motor speed and dexterity. Similarly, the MRMT measures, both, gross motor speed and dexterity. The possibility of devising relatively more "pure" tests can be explored. Further, there is scope for inclusion of motor tests to measure additional related functions, such as, reaction time, motor precision, rythm, manipulation, etc. The present battery of psychomotor tests does not claim to be exhaustive. Only four tests were considered for final inclusion in the battery after initial try-outs (See Table 11).

Table 11.

Summary Lists of Tests Assessing Motor Functions for Final Inclusion in FAB

Functions	Test	Max mat score	Tine
MOTOR			
a) Fine Finger Dexterity b) Fine Motor Speed c) Eye hand coordination	Finger Dexterity Test, Modified	'	20m
a) Gross Motor Dexterity b) Gross Motor Speed c) Eye hand coordination	Minnesota Rateof Manipulation Test, modified	'	5m
a) Fine Motor Steadiness b) Eye hand coordination	Pattern Tracing Test, Modified	*	5m
a) Fine Motor Steadiness	Steadiness Test	*	5m

* Indicates that the maximum score on these subtests depend on subject's functional abilities

III .VISUAL FUNCTIONS

An analysis of functions in the visual modality that come into daily use of individuals with mental handicap can include visual scanning (search), visual fixation, visual pursuit, visual localization, visual matching, visual discrimination, analysis of three dimensional pictures, visual identification, visual description, visuo-spatial perception, visual naming, visuo construction, etc. Indeed this list is not exhaustive. Any proposal for developing tests to measure visual functions must include at least some of these core functions. Further, in case of individuals with mental handicap, these visual functions may come into play at a concrete level (such as, in their manipulation of material objects), or at an abstract level (such as, in their negotiation of pictures or non-tangible spatial elements). In view of these broad guidelines and rationale, the present Battery attempts to measure most of these visual sub-functions in individuals with mental handicap.

1. Test of Visual Scanning (Search)

At an abstract or non-concrete level, customary visual scanning tests include procedures asking subjects to scan or search for specific numbers and/or alphabets from a written document. These test procedures cannot be applied in toto for the assessment of similar functions with mentally handicapped persons because most of them may not have acquired concepts like numbers or alphabets, etc. It may be worthwhile to atttempt a test of visual scanning for specific pictures of objects drawn on a stimulus card containing many other pictures of other objects. In the final inclusion of this battery, this measure was also excluded for want of appropriate stimulus cards.

At concrete level, visual scanning can be measured by introducing a test situation wherein subjects have to negotiate with physical materials. The test situation involves a uniform display of specific number of concrete objects within the visual field of the subject. The test procedure necessitates asking subjects to scan a particular stimulus (object), and consequently measuring the time taken to conduct the visual search. The objects included in the test should be necessiraly familiar to subjects in order to eliminate extraneous factors, such as, novelty or unfamiliarity influencing performance. During the initial try-out, this exercise was attempted. But, owing to practical difficuluties in test administration, this measure was eventually abandoned.

2. Visual Matching Tests

By taking a cue from Reitan Indiana Neuropsychological Test Battery for Children (5-8 years) (Reitan, 1969), Visual Matching Tests were designed at two levels in concrete mode and non concrete mode.

i) Visual Object Matching Tests:

This test consists of 15 pairs of concrete objects (See Table 13). The test procedure involves the subject to match identical pairs of concrete objects. Scoring involves awarding one mark each for correct object matching by the subject. The maximum possible score on this sub-test is 15.

At an abstract level or non-concrete level, visual matching functions were assessed by asking the subject to match pairs of pictures. The procedure of test administration requires the subject to match identical pairs of pictures (See Table 13) from a model card to test cards. The scoring procedure and maximum score on Visual Picture Matching Test is same as in Visual Object Matching Test.

Table 12.
Objects in Visual Object Matching and naming Tests

Items	Hatching	Naming
Pencil		
Cloth		
Sottle		
Knife		
Pen		
Key		
Money		
Needle		
Lid		
Lock		
Bangle		
Eraser		
Button		
Comb		
Thread		
Total Score	15	15

Table 13.
Pictures in Visual Picture Matching and Hannq Tests

Rats	Matching	Naming
Table		
Bird		
Sun		
Cycle		
cow		
Boy Brushing Teeth		
Eye		
Moon		
Bus		
Chair		
Elephant		
Girl Writing		
Jug		
Cock		
Dog		
Total Score		

ii) Visual Shape Matching Tests

At a concrete level, this test procedure involves asking the subject to match conrete cut-outs of different shapes arranged in a relative heirarchy of form difficulty (See Table 14). The cut-out shapes are displayed in front of the subject and he is asked to match another given shape with each of them. One mark is given for each correct performance. The maximum score on this sub test is 15.

Table 14.
Rets in Visul Shape Matching Test

Shapes	Right/Wrong
Circle	
Rectangle	
Triangle	
Plus	
Semi Circle	
Square	
Quadrant of circle	
Diamond	
Flag	
Rectangle with circular ends	
Hexagon	
Star	
Rectangle with curved ends	
C shape	
Cone	

At non-concrete level, visual shape matching is assessed by asking subjects to match pictures of four regular geometric forms (including circle, triangle, rectangle and square) and eleven

irregular shapes arranged in an increasing order of difficulty. The picture formats of the 15 items in this test were bound into a booklet/flip chart to facilitate easy presentation. One mark is given for each correct response. The maximum score on this subtest is 15. The approximate time required for administration of these two sub tests is five minutes.

iii) Visual Size Matching Test

At a concrete level, this test requires the subject to match objects of various sizes. The target object of a specific size alongwith similar object of the same size as well as different sizes (See Table 16) is presented before the subject. For example, he is presented a pencil of three inches length, alongwith similar pencils of varying lengths, such as, one inch, two inches, four inches, etc. The subject must match the size of the target object to identical sizes in the group. Score one for each successful matching. The maximum score on this subtest is 15.

Table 15.
Items in Visual Size Matching Test

Objects	Ratio of Presentation		Maximum Score	Subject' Score
Buttons	1	4	1	
Cross	1	3	1	
Circles	1	5	1	
Bangles	1	6	1	
Wails	1	7	1	
Rings	1	3	1	
Pencils	2	10	2	
Triangles	3	10	3	
Squares	4	10	4	
Total score			15	

At non-concrete level, visual size matching is measured by asking subjects to match pictures of specific sizes against identical pictures of similar as well as other sizes. The 15 items in this subtest are arranged in an increasing order of difficulty and bound into a booklet to facilitate quick and easy administration. A score of one mark is given for each correct matching. The maximum score on this subtest is 15. The approximate time required for administration of Visual Size Matching subtests is around five minutes.

iv) Visual Color Matching Test

At a concrete level, this is designed as Visual Object Color Matching Test. This test taps matching functions of subjects for primary colors as well as certain combinations thereof (See Table 16). The test procedure involves display of a variety of brightly colored objects in front of the subject. The subject is then shown a card of specific color and is asked

Table 16.
Materials in Visual Object Color Matching Test

Red Bangles	Blue Pen cap	Green Buttons
Red Pencil	Blue Plastic Spoon	Black diary
Red Ball	Red Star	Green Pencils
Green Chocolates	Green Ring	Yellow Crayon
White Thread	Red Lids	Blue Pens
White Cloth	White Chalk	Black Boxes
Blue Plastic Cup		

to match it against similar colored objects kept in front of him. A score of one is given for every correct color matching. The maximum score on this sub-test is 15.

At non concrete level, visual picture color matching schemes require the subject to match a model color to a range of five to fifteen similar as well as other colored patches of rectangles on a page. There were fifteen pages in all, meaning to be fifteen trials on this test (See Table 17). Every correct match is given half score. The maximum score on this test is 15. The first item is a sample.

Table 17.
Visual Picture Hatching Test

Color	Number of alternatives to choose from	Number of correct Mtchings	Maximum Score
Blue (sample)	5	1	-
Red	5	2	1
Brown	5	1	1/2
Pink	5	1	1/2
Green	5	2	1
Green	10	4	2
Yellow	10	3	11/2
Red	10	2	1
Blue	10	1	1/2
Orange	15	4	2
White	15	2	1
Black	15	4	2
Green	15	1	1/2
Pink	20	2	1
Blue	20	1	1/2
Total			15

v) Visual Number Matching Test

Actually, number concepts can constitute varying levels for functional assessment, viz., numeration, computation, measurement and arithmetic process. Further, at the basic level of numeration itself it involves acquisition of pre-math skills, serialisation, number sequencing, rote counting,

Table 18.
Visual Object Number Matching Test

Trial	Presentation	Maximum Score
	2-1	Sazple
1	2-2	1
2	2-7	1
3	3-3	1
4	2-3	1
5	7-9	1
6	6-6	1
7	8-8	1
8	9-8	1
9	13-15	1
10	12-13	1
11	11-11	1
12	21-21	1
13	19-19	1
14	5-9	1
15	14-14	1
		15

object/picture counting, number recognition, number ordinals, etc. In this Battery, visual number matching at a concrete and non concrete or pictorial level alone is considered for inclusion. At a concrete level, a Visual Object Number Matching Test is designed. This test comprises of several small, but similar sized objects (example, buttons). The examiner places two heaps of the object in specified quantity for each trial (See Table 18) in front of the subject. The subject must indicate whether or not the two heaps are identical in numbers or not. A score of one mark is given for each correct matching response. The maximum score on this test is 15.

At non-concrete level, the 15 item Visual Picture Number Matching Test comprises of a specific number of model pictures, such as, birds, socks, shoes, etc., which are to be matched against the same

Table 19.
Visual Picture Number Matching Test

Item Nos.	Model numbers to match	Maximm score
1	11 flowers	1
2	7 socks	1
3	13 butterflies	1
4	6 birds	1
5	6 socks	1
6	Digit one	1
7	Digit nine	1
8	Digit seven	1
9	Digit three	1
10	Digit fifteen	1
11	3 circles	1
12	8 circles	1
13	9 squares	1
14	6 squares	1
15	5 squares	1
		15

or varying numbers of similar pictures. There are five items in this scheme. In the next five items of this test, written numerals are to be matched against the same or different digits given as alternatives below. The last five items of this test require the subject to match a specific number of model shapes (such as, circles or squares) against the same or different number of the similar shapes given as alternatives below (See Table 19). There is a score of one for every correct match. The maximum score on this test is 15. The approximate time required for administration of the number matching tests is around five minutes

3. Visual Discrimination Tests

There are three aspects of visual discrimination that are included for assessment in this Battery. They are, visual discrimination at the concrete level by means of Visual Object Discrimination Test, visual discrimination at non concrete level by means of Visual Picture Discrimination Test and figure ground discrimination by means of Rnbedded Figures Test respectively.

The Visual Object Discrimination Test consists of seven types of objects (See Table 20) presented in pairs. The subject is required to indicate, either verbally or gesturally, the differentiating characteristic between the pairs of objects. There are 15 differentiating characteristics that need to be identified from all the seven pairs of objects presented in this test. Each correct identification is given a score of one. The maximum score possible on this sub test is 15.

Table 20.
Visual Object Discrimination Test

Items	Differentiating Charecter	Maximm score
Button	Color, size and Number of holes	3
Pencils	Color and size	2
Spoons	Color, shape, size and mterial	4
Bangles	Color and size	2
Coins	Size and value	2
Beads	Color	1
Lids	Color	1
Total		

The Visual Picture Discrimination Test consists of 15 pairs of pictures (including two samples) presented in an increasing order of diffficulty. The subject is required to spot the difference between the pairs of pictures presented page after page in a booklet form (See

Table 21). A score of one mark is given for every correct response. The maximum score on this sub test is 15.

Table 21.
Visul Picture Discrimination Test

Stimulus Picture	Maximum Score
Cup (sample)	
Door (sample)	
1. Screw	1
2. Girl	1
3. Man's fact	1
4. Cat	1
5. Hand	1
6. Scissors	1
7. Man's face and truck	1
8. Bouse	1
9. Umbrella	1
10. Belt	1
11. Coat	1
12. Elephant	1
13. Lock	1
14. fruits	1
15. Woman with baby in arms	1

The Enbedded Figures Test is a test of figure ground discrimination. It consists of a series of five plates. Each plate shows overlapping pictures of familiar objects or animals. The subject is required to discriminate the figures against the background of other pictures. The number of figures/pictures to be discriminated against a ratio of other pictures in its background varies from one plate to the next in an increasing order of complexity (See Table 22). A score of one mark is given for each correct discrimination. The maximum score on this test is 15. The approximate time needed to administer all the visual discrimination tests is around five minutes.

Table 22.
Embedded Figures Test

Stimulus Figures	Maximum Score
1. Cycle, aeroplane	2
2. Elephant, cock, dog	3
3. Book, pen, spectacles	3
4. Eye, leg, hand	3
5. conb, scissors, shoe, Umbrella	4

4. Visual Naming Tests

Visual naming functions are a level over and above the sequence of visual matching and/or discrimination functions. As in visual matching and discrimination functions, visual naming functions are also assessed at two levels, viz., concrete and non concrete (pictorial) levels.

The Visual Object Naming Test attemps to measure visual naming functions at a concrete level. The items included in this test are the same as in Visual Object Matching Test (See Tables 12 and 13). The procedure for administration of this test requires the subject to name each item in that list. Every correct naming earns a score of one. The maximum score on this test is 15.

The Visual Color Naming Test involves the procedure of asking the subject to name all the ten colors included in the Visual Color Matching Tests (See Table 17). A score of 1.5 marks is given for each color named correctly. The maximum score on this test is 15.

5. Tests of Visual Construction

The three sub-tests included under visuo constructive functions are vertical assembly, horizontal assembly and graphomotor functions. Indeed, there is an element of integration between visual modality and motor functions when it comes to assessment of visuo constructive functions.

The Vertical Block Assembly Test is a measure of visuo construction in vertical fashion. This test requires subjects to build specific models of construction using one inch cubes. The nine trials are presented in increasing order of difficulty. The examiner must build the blocks behind a screen and then present it in front of the subject. The maximum score for each item varies according to the complexity of the task to be performed in that trial. The maximum score for items 1-3 is 1 and for items 4-9 is 2. The maximum score on this test is 15.

The Sticks Test is a measure of Horizontal Assembly, wherein the subject is required to build models of horizontal assemblies using match sticks. There are 15 patterns of increasing complexity to be built by the subject using match sticks. Each correct performance gets a score of one. The maximum score on this subtest is 15.

The Figure Drawing Test taps graphomotor construction by asking subjects to copy a series of 15 designs on a A4 size paper. The instructions to the subject are to "Copy the designs as you see it!". The scoring is done on a all-or-none basis, i.e., on every exact copy is given a score of one. In case of doubt regarding any specific copy, the subject may be asked to copy again for a maximum of three times. The best of the reproductions is considered for scoring. The maximum score on this test is 15.

A total of 17 tests for assessing visual functions were considered for final inclusion in FAB (See Table 23).

Table 23.
Visual Functions for Fual Inclusion in MB.

Function	Test	Maxmimum test Score	
VISUAL			
a) Visual Matching	Visual Object Hatching Test	15	
	Visual Picture Matching Test	15	5m
	Visual Object Shape Matching Test	15	
	Visual Picture Shape Matching Test	15	
	Visual Object Size Matching Test	15	
	Visual Picture Size Matching Test	15	5m
	Visual Object Number Matching Test	15	
	Visual Picture Number Matching Test	15	5m
b) Visual Discriz-ination	Visual Object Oiscriaination Test	15	
	Visual Picture Discrimination Test	15	
	Ehbedded Figures Test	15	5m
c) Visual Hating	Visual Object Mazing Test	15	
	Visual Picture Haning Test	15	
	Visual Colour Warning Test	15	5m
d) Visuo Constru-ction	Vertical Block Assembly Test	15	
	Horizontal Assetbly (Sticks Test)	15	
	Grapho Motor (Design Copying Test)	15	5m

IV. AUDITORY FUNCTIONS

An idiometric analysis of auditory functions include auditory localisation, auditory search or tracking, auditory perception, auditory discrimination, sound syllable production, etc. This list is by no means exhaustive. The measures for some of these functions relevant to assessment of individuals with mental handicap is given below.

1. Auditory Discrimination Test

The Auditory Discrimination Test consists of 30 pairs of sound syllables. The sound stimuli are presented on a tape recorder. The subject is required to discriminate between them as same or different. A taped version of the test was used during initial try out. However, owing to practical difficulties in administration and portability constraints, this test was eventually eliminated from the final Battery.

2. Sound Syllable Production Test

This test screens articulation difficulties, and was designed in consultation with two speech therapists. Thirty basic sound syllables (including five vowel sounds, two diphthongs or combination of two vowels and twenty two consonants) were identified and arranged in an increasing order of complexity. The inter rater agreement between the two speech therapists for arrangement of the identified sound syllables in an hierarchy was computed to be 0.96 per cent. The specific items which were disagreed upon for their location in the hierarchy were later reallocated on a consensus between the two specialists. The test procedure involves presenting each sound syllable to the subject, and asking him to repeat it thereafter. Every correct reproduction by the subject is given half score. The maximum score on this test is 15.

3. Sound Rythm Test

This is a measure of sound rythm. The test comprises of a series of 30 pairs of taps or drum beats pre recorded in an audio cassette. Some of these rythm beats are identical, while others are dissimilar. The subject is required to identify, whether the beats are similar or dissimilar. The pattern of presentation is predetermined (See Table 24). Every correct identification gets half score. The maximum score on this subtest is 15. This subtest was eventually excluded from the battery because of practical difficulties in carrying tape recorders. In sum, therefore, only the Sound Syllable Product]or Test was considered for final inclusion within auditory domain of FAB (See Table 25).

Table 24.
Somd Rythm Test

Trials	A	B	C
1	S	S	D
2	D	D	S
3	S	S	S
4	D	D	D
5	S	D	S
6	D	D	D
7	S	S	S
8	D	D	D
9	D	S	D
10	S	S	S

iS denotes similar; D denotes dissimilar)

Table 25.
Auditory Functions for Final Inclusion in FAB

Functions	Test	Maximm Score	Time
AUDITORY			
Sound Syllable Production	Sound Syllable Production Test	15	5m

V. TACTILE FUNCTIONS

The idiometric analysis of tactile functions include tactile perception, tactile matching (of objects, sizes, shapes and/or numbers), tactile discrimination, tactile naming, two point discrimination, etc. This assessment may throw light on modality specific preferences in given individuals with mental retardation. Before the initial try out, specific tests to assess various tactile functions were designed. Most of these test procedures were similar to the ones used for visual modality. However, the main difference was that in these tests the subject was blindfolded before being given specific tasks involving matching, discrimination, naming, etc. In the initial try out of these procedures, it was found that there are practical difficulties in test administration by keeping the subjects blind folded. Therefore, the inclusion of this function in this Battery was witheld. However, tests that were designed to assess the various components of tactile functions for the initial try out are described for consideration by later research.

1. Test for Localisation of Tactile Sensation

This test involves the procedure of touching various parts of body (See Table 26) in a blindfolded subject using a light tactile stimuli, such as, cotton ball. The subject is required to correctly identify the specific part of his or her body that was touched by the examiner. Each correct identification is given a numerical score of three. The maximum score on this sub test is 15.

Table 26.
Test for Localisation of Tactile Sensation

1. Left Cheek
2. Thumb of right hand
3. forehead
4. Pala of left hand
5. Little finger of left hand

2. Two-Point Threshold

This test is a measure of tactile discrimination. By using an aesthesiometer, the examiner touches the blindfolded subjects forearm over five trials. The pattern of tactile contact may vary randomly for each trial between a single point stimulation to two point stimulation. The subject must correctly identify whether the tactile contact in a given trial is a single point stimulation or two point stimulation. Every correct identification is given a score of three. The maximum score on this subtest is 15 (See Table 27).

Table 27.
Two Point Threshold Test

1. One point stimulation
2. Two point stimulation
3. Two point stimulation
4. One point stimulation
5. Two point stimulation

3. Graphasthesia

This test is a measure of subjects ability to identify various forms or patterns drawn on a subjects body using tactile sense. The blindfolded subject is seated with his arms extended before the table. The examiner draws five simple forms, such as, straight line, circle, cross, triangle and square on the subjects forearm by using light contact of the other end of a pencil. The subject must correctly identify, match or reproduce the same form drawn on the forearm. Each correct matching or identification gets a score of three. The maximum score on this subtest is 15.

4. Test of Tactile Identification

The same list of objects (See Table 12) included in Visual Object Matching or Naming Tests are given to the blindfolded subject in this test for their identification, either by naming or matching them. Each correct identification or naming through the tactile modality is given a score of one. The maximum score on this subtest is 15.

VI. MEMORY FUNCTIONS

The idiometric analysis of memory functions can be, indeed, very complex and minute or simple and generic. In this study, at a preliminary phase, a simple and generic function wise analysis related to memory was identified. They are, recent vs immediate auditory memory and recent vs inmediate visual memory. The possibility of measuring other components of memory, such as, modality specific-visual memory, kineasthetic memory; content specific-numerical memory, semantic memory; operation specific-verbal memory, performance memory; process specific-sequential memory, paired associate memory, logical memory, etc., maybe considered by later research.

1. Test of Auditory Memory

In auditory modality, both, immediate and recent memory measures were included. This test consists of a list of ten words (See Table 28) presented vocally to the subject. During test administration, it must be confirmed whether the subject has really heard the words presented by asking him to repeat every word after their presentation. This confirms that the subject has attended or heard the specific word spoken aloud to him. The scoring of subjects performance is measured as the number of words recalled immediately following the presentation of the list; and delayed (i.e., after a lapse of ten minutes following initial presentation). The maximum possible score for the Immediate Auditory Memory Test and Recent Auditory Memory Tests is ten each.

There is a negative mark of minus one for every incorrect or confabulated response. However, the minus score on this test is never below zero.

Table M.
Test of Auditory Heaory

Table	Door	Towel	Doctor	Cycle
Black	Tree	Cat	Banana	Rose

2. Tests of Visual Memory

The Test of Visual Memory is measured immediately following presentation of the optic stimuli as well as delayed (i.e., after a lapse of ten minutes following initial presentation). The test procedure comprises of a foolscape sized card with figures of various objects drawn on it (See Table 29). The card is presented to the subject for thirty seconds, Immediate Visual Memory is measured following withdrawal of the card by asking the subject to recall as many of the pictures as possible. In order to ensure that the subject has scanned all the ten pictures in the card, it is better to ask the subject to read the picture within thirty seconds of presentation. The number of objects correctly recalled immediately by the subject is Immediate Visual Memory Score, and the number of objects recalled after a lapse of ten minutes is Recent Visual Memory score. There is a negative mark of -1 for every incorrect or confabulated response. However, minimum score on this test should never reduce below zero. A confabulation score maybe also calculated as differential index between number of incorrect responses and number of correct responses. This differential index will have a meaning only if the number of incorrect responses are greater than the number of correct responses, either in the tests of auditory and/or visual memory.

Table 29.
Test of Visual Memory

Doll	Comb	Book	Knife	Cot
Almirah	Pen	Lock & Key	Chair	Fan

In sum, only four subtests for assessing memory functions were considered for final inclusion in FAB (See Table 30).

Table 30.
Henry Functions for Final Inclusion in FAB.

Functions	Test	Maxmimum Score	Time
Memory			
Imediate Auditory Memory	IAM Test	10	
Recent Auditory Memory	RAM Test	10	
Imediate Visual Memory	LVM est	10	
Recent Visual Memory	RVM Test	10	10M

VII. OTHER COGNITIVE FUNCTIONS

There is a possibility for developing or designing specific test procedures to measure allied cognitive functions, such as, learning (auditory, visual), ideational fluency, comprehension, abstraction, conceptualisation, thinking, etc., in individuals with mental handicap. The initial consideration for a visual as well as auditory learning tests as extension to the memory tests was later excluded even from an initial try out owing to the length of time in test administration. A test of Ideational Fluency and Language Learning was given an initial try out.

1. Test of Ideational Fluency

A list of five basic concepts were identified, such as, "green", "round", "wood", "animals" and "fruits". The subject was to list as many names of items, things or objects which is somehow related to these specified concepts. For example, the subject is asked to list as many things or objects he knows or has seen to be round in shape (or green, etc.). The maximum time for each item is three minutes. The ideational fluency score is taken as average number of items or words listed by the subject for single trial. This is computed by adding all the list of objects or items named for five concepts and dividing it by five to get the Ideational Fluency Score as an average number of items denoted for a single trial.

2. Walton-Black New Word Learning Test, Modified:

This test is a measure of linguistic learning and vocabulary. It consists of a series of words arranged in an ascending order of meaning complexity. The test administration involves presenting each word to the subject and asking him to tell its meaning. The administration is stopped when the subject fails to give the meanings of five consecutive words in the list (See Table 31). Thereafter, the meanings of these five words are given to the subject. He is again asked the meaning of the same five words in a random order. If the subject fails to give the meaning of even one of these five words, the meanings are explained to him again. The administration of the repeat trials continue until the subject learns the meanings of all five words correctly. The Vocabulary Learning Score of the subject is taken as the number of trials to learn the meanings of all the five new words correctly. The words selected for inclusion in this test were adapted from Intelligence Scale of Indian Children (Kamat 1967) and Malins Intelligence Scale for Indian Children (Malin, 1969).

During initial try-out, it was found that this subtest is time consuming. Therefore, it was rejected from final inclusion in FAB.

Table 31.
Walton-Black New Word Learning Test, Modified

1 Key	2 Watch	3 Pencil
4 Chair	5 Horse (Cow)	6 spoon
7 Boll	8 Blanket	9 Ball
10) Cycle	11 Shoe	12 Knife
13 Umbrella	14 Pillow	15 Letter
16 Nail	17 Tiger	18Hammer
19 Soldier	20 Gold	21 Clever
22 Brave	23 Editor	24 Injustice
25 Poor	26 Revenge	27 Charity
28 Envy	29 Pride	30 Lazy

In sum, only the Test of Ideational Fluency was considered for final inclusion in the domain of other cognitive functions of FAB (See Table 32).

Table 32.
Other Cognitive Functions for Final Inclusion in FAB

Functions	Test	Maximmum Score	Time
OTHER COGNITIVE FUNCTIONS			
ideatioNAL Fluency	Test of IF	*	10M

* Denotes that the MAXIMUM score on this sub test depends on the subjects functional abilities.

STEP FOUR: FINAL INCLUSION OF TESTS IN FAB

The initial tryout culminated in the design and development of complete list of tests for final inclusion in FAB (See Table 33).

Table 33.
Finai List of Tests Included in FAB

Functions	Test
Attention-concentration	
a) Attention-concentration	Knox Cube Imitation Test, (modified)
	Eysencks Test of Concentration (Visual, Modified)
HOME	
a) fine finger Dexterity	finger Dexterity Test
b) Fine Motor Speed	
c) Eye hand coordination	
a) Cross Motor Dexterity	Minnesota Rate of
b) Cross Motor Speed	Manipulation Test,
c) Eye hand coordination	Modified
a) fine Motor Steadiness	Pattern Tracing Test,
b) Eyehand coordination	Modified
c) fine Motor Steadiness	Steadiness Test
VISUAL	
a) Visual Matching	Visual Object Matching Test
	Visual Picture Matching Test
	Visual Object Shape Matching Test
	Visual Picture Shape Matching Test
	Visual Object Size Matching Test
	Visual Picture Size Matching Test
	Visual Object Number Matching Test
	Visual Picture Number Matching Test

b) Visual Discriaination	Visual Object Discrimination Test Visual Picture Discrimination Test Embedded Figures Test
c) Visual Naming	Visual Object Hatting Test Visuai Picture Haaing Test Visual Colour Naming Test
d) Visuo Construction	Vertical Block Assembly Test Horizontal Assetubly (Sticks Test) Grapho Motor (Design Copying Test)

AUDITORY

Sound Syllable Production Sound Syllable Production Test

MEMORY

Lmediate Auditory Metnory 1AM Test
Recent Auditory Meaory RAM Test
lmediate Visual Meaory IVM Test
Recent Visual Meaory RVH Test

OTHER COGNITIVE FUNCTIONS

Ideational fluency Test of IF

STEP FIVE: ADMINISTRATION OF FAB ON LARGE SAMPLE

The main study commenced only after the initial try-out confirmed the tests to be used in FAB. The main study involved administration of the developed FAB on a sample of 94 subjects (See Table 34). The procedure of test administration was followed uniformly for all subjects as per the design of each test. The emphasis of test administration was not so much on rigidity of procedure as on eliciting neuropsychological functional data base for adults with mental handicap. The Battery of tests were administered on a one to one basis. The approximate time taken for administration of whole Battery per case came around two hours. Owing to variety of tasks involved and the short duration for administration of each sub-test, most of the subjects were cooperative and could sit throughout the testing period, with permitted breaks wherever necessary.

Table 34.
Distribution of Sample for Main Study

Severity	Maie	Feiale	Total
Mild MR	56	11	67
Moderate MR	19	8	27
Total	75	19	94

STEP SIX: EXTERNAL VALIDATION OF FAB

An important aspect of any test construction is its validity. There are two general types of validity: internal and external. The internal validity of an instrument refers to the intrinsic characteristic of the tool that contributes towards measuring what it purports to measure, such as, its content, construct, etc. The external validation of instrument refers to procedures by means of which it can be generalised to facilitate certain decisions even outside the actual testing situation. For example, an intelligence test can be externally validated against teachers rating of academic performance by the same students.

There is an element of prediction involved in this procedure. The individuals' expected future performance in a related area is predicted based on present scores of a test. In this study, efforts were directed towards validating the subjects scores on FAB against perceived ratings of work behaviours by vocational instructors in the assessed individuals with mental handicap. In our case, supervisors ratings of work behaviours of individuals with mental handicap is being considered as an external criterion for validating the performance of these subjects on FAB.

The assessment of work behaviours have been frequently used as an external criterion for validation of many tests or tools developed for adults with mental handicap (Rusch, 1983). Work behaviours are "general work attributes" (Roessler and Greenwood, 1987) or the "lowest common denominators" in any work situation irrespective of the type of job undertaken (Hutchinson, 1982). The specific elements of work behaviour have been described variedly (Bitter and Bolanovich, 1970; Halpern et al, 1975; Malls et al, 1978; Botterbusch, 1982; Roessler and Bolton, 1985). The most frequently included components of work behaviour are acceptance of work role, ability to profit from instruction or correction, work persistance, speed or quality of work, interpersonal relationships at work, etc.

In order to validate the FAB, it was necessary to identify a suitable measure of work behaviour for use by vocational instructors. A review of literature shows that some of the related measures of work behaviours, are Work Personality Profile (Roessler and Bolton, 1985), Social and Prevocational Information Battery (Halpern et al, 1975), Work Adjustment Rating Form (Bitter and Bolanovich, 1970), Vocational Behaviour Checklist (Walls et al, 1978), Scale of Employability for Handicapped Persons (Gellman et al, 1963), Revised Scale of Employability (Bolton, 1987) and others. By drawing from these Western sources, as well as from some Indian experiences (Arya, 1990) a indigenous Work Behaviour Rating Scale (WBRS) was devised comprising of a list of twenty behavioural components. These behavioural components were carefully worded into specific statements to be rated on a six point Likert Scale by vocational instructors for each individual with mental handicap (Appendix 2). The six points for rating each statement of WBRS are, viz., not applicable (0), unacceptable (1), poor (2), satisfactory (3), good (4) or excellent (5). Only the last item on the Scale is to be rated as not applicable (0), fewly dependent (1), needs physical guidance (2), needs visual instructions (3), needs hints (4) or independent (5).

The WBRS yields a minimum score of zero and a maximum score of hundred for each subject, with maximum of five points on each item. The final score is denoted as a "Work Behaviour Index" for the given individual being rated by the vocational instructors. The administration of the Scale for each subject by a vocational instructor does not take more than five minutes. In this study, the raters had an opportunity to observe their subjects for at least a period of four weeks before they were asked to rate their students with mental handicap.

The present validational study involving concurrent administration of FAB and WBRS was conducted on a sub sample of 34 adults with mental retardation undergoing training at Vocational Rehabilitation Centre, D.G.&. E.T., Ministry of Labour, Hyderabad. The sample included 18 males and 16 females in the age range of 16 to 34 years (Mean age: 22.9 years; SD: 4.5). A correlational analysis was undertaken on the derived raw data to determine the validity of FAB against perceived ratings of work behaviours by vocational instructors in adults with mental handicap.

STEP SEVEN: EXPOSURE OF ASSESSED SUBSAMPLE TO AN EDUCATIONAL OR TRAINING PROGRAM

After the development and validation of FAB, the next step in this research was to expose a subsample of the assessed individuals with mental handicap to a generic training programme before reevaluating them for any functional gains over earlier recorded deficits. Admittedly, it has not been ensured that the chosen training curriculum at VRC is appropriately tailor made to overcome the identified deficits in FAB. In this phase of the study, only a small sub sample of five subjects were included to evaluate intervention effects on neuropsychological functional profile of individuals with mental handicap.

A randomised two group pretest-posttest design was opted. A sub sample of five subjects each, matched for their age, sex, severity and mean overall scores on FAB were assigned at random to a experimental and control group. The male-female ratio in each group was 2:3. The age of subjects in experimental group ranged from 16-27 years (Mean: 20.6; SD: 4.03) and in control group ranged from 21-34 years (Mean: 26.2; SD: 4.99). The scores attained during initial/baseline assessment was taken for comparison with the final scores after treatment or intervention. The treatment or intervention programme for experimental group involved their admission and continuation of a vocational training programme for a period of six months. On the other hand, the control group was not exposed to any systematic treatment effects.

The actual training programme for mentally handicapped adults in VRC involves job analysis and training in related sub skills as well as the specific trades in which they are being trained. The duration of vocational training in any given section runs through a period of six months. After the training, they are given a certificate, which can be used as a minimum qualification for later job placements.

STEP EIGHT: SENSITIVITY OF FAB

In order to establish the sensitivity of FAB, a posttest reassessment of subjects in experimental group (N:5) as well as control group (N: 5) was carried out. The male female ratio in each group was 2:3. The ages of subjets in experimental group ranged from 16-27 years (Mean: 20.6; SD: 4.03) and control group ranged from 21-34 years (Mean:26.2; SD: 4.99). A two group pretest-posttest design was adopted to determine the sensitivity of FAB to changes in neuropsychological functioning over time in the group of adults with mental handicap. The steps used to generate data on **sensitivity of FAB were:**

1. Baseline evaluation (pretest) scores of subjects in experimental and control group for various functional domains in FAB;

2. Exposure of subjects in experimental group alone to a generalised education or training programme within a v vocational setting for a period of six months;

3. Terminal evaluation (posttest) scores of subjects in experimental and control groups for various functional domains in FAB

4. Comparison of pre and post tests scores of subjects in experimental and control groups to determine sensitivity of FAB in measuring gains in nueropsychological functions for adults with mental handicap.

CHAPTER FOUR:

RESULTS

The results of main study are discussed below:

1. Step One:

Summary details of identified functions and the related neuropsychological test battery developed for use in the present study on a sample of adults with mental handicap;

2. Step Two

Baseline profile of functional assets and/or deficits recorded on FAB for overall/subsample of persons with mental retardation included in this study;

3. Step Three

Validation of FAB against perceived ratings of work behaviour by vocational supervisors/instructors on a sub sample of mentally handicapped adults;

4. Step Four

Sensitivity of FAB to changes in profile of neuropsychological functioning over time in a group of adults with mental handicap.

STEP ONE: IDENTIFICATION OF FUNCTIONS FOR FINAL INCLUSION IN FAB

To recapitulate, a list of neuropsychological functions were identified (See Table 33) for final inclusion in FAB. The appropriate tests designed to elicit specific functions, procedure of administration, scoring and interpretation, maximum scores, approximate time required for administration, etc., are already described in the previous chapter.

STEP TWO: BASELINE ADMINISTRATION OF FAB ON OVERALL SAMPLE

The results of scores attained by subjects in the various domains of FAB are discussed below:

I. ATTENTION-CONCENTRATION

The results of baseline assessment for attention concentration domain on FAB were derived from scores on two sub tests, viz., Knox Cube Imitation Test (Modified) and Eysencks Test of Concentration (Visual, Modified).

1. Knox Cube Imitation Test, Modified:

The mean score on Knox Cube Imitation Test, Modified, for overall sample (N: 94) is 4.25 (SD: 1.22). Further, there is no statistically significant difference ($p: > 0.05$) between scores of males (N: 75;

Mean: 4.33; SD: 1.36) and females (N: 19; Mean: 4.32; SD: 1.13) on this test (See Table 35).

Table 35.
Results on Knox Cube Imitation Test, Modified

Test Procedure	Mean Score	SD	't' value
Overall «: 94)	4.25	1.22	
Male (M:94)	4.23	1.36	0.38
Female (N:19))	4.32	1.13	

(*p: <0.05; "p: (0.01; ***p: <0.001)

2. Eysencks Test of Concentration (Visual, Modified)

The mean score on Eysencks Test of Concentration (Visual, Modified) for overall sample (N: 94) is 3.94 (SD: 1.17). Further, there is no statistically significant difference (p: > 0.05) between scores of males (N: 75; Mean: 3.88; SD: 1.20) and females (N: 19; Mean: 4.16; SD: 1.04) on this test (See Table 36).

Table 36.
Results on Eysencks Test of Concentration
(Visual, Modified)

Test Procedure	Mean Score	SD	't' value
Overall (M: 90	3.94	1.17	
Hale {N): 75)	3.88	1.20	1.32
Female (N: 19)	4.16	1.04	

Analysis of Inter correlations within Assessed Attention-Concentration Domain of FAB

In order to determine covariance between subtests within attention-concentration domain of FAB, inter correlation matrix was drawn between mean scores on Knox Cube Imitation Test, Modified and Eysencks Test of Concentration (Visual, Modified) for overall sample. The correlation coefficient was found to 0.529 (p: < 0.001). These results suggests that the two tests are covarying and identifying two discrete functional categories on FAB.

II. MOT0R FUNCTIONS

Each subject was assesed on a modified version of Laterality Preference Schedule (Dean, 1982) to ascertain laterality preference, before administration of the motor tests in FAB.

Table 37.
Literality Prefereaoe of the Sample

Males (N:75)		Females (N:19)	
Left Preference	Right Preference	Left Preference	Right Preference
6 (6.4)	69 (73.4)	2 (2.1)	17 (18.1)

0 indicate percentages

The results on Laterality Preference (See Table 37) shows that a majority of the cases included in this sample are males with right preference (N: 69; 73.4%), followed by females with right preference (N:17; 18.1 %) , males with left preference (N:6; 6.4 %) and females with left preference (N: 2; 2.1 %) . The results of baseline assessment for motor domain on FAB were derived from scores on four sub tests, viz, Finger Dexterity Test, Minnesota Rate of Manipulation Test, Pattern Tracing Test, Modified and Steadiness Test.

1. Finger Dexterity Test (FDT)

On Finger Dexterity Test (FDT), used as a measure of fine motor speed, finger dexterity and eye hand coordination, the performance of subjects were recorded for three conditions, viz., using PH, NPH and

BH. The scores of each subject denote the overall time taken (in seconds) to fill in the one hundred holes in FDT apparatus. The mean scores attained by different procedures on FDT by overall sample (See Table 38), and the sub sample of males (See Table 39) and females (See Table 40) are deliniated.

Table 38.
Results on FDT for Overall Sample

Test Procedure	Wean Score (H:94)	SD	't' value
OVERALL			
Preferred Band	427.33	128.99	2.77**
Non preferred Band	603.33	602.58	
Preferred Band	427.33	128.99	3.16"
Both Bands	365.41	139.55	
Eon preferred Band	603.33	602.58	3.73"*
Both Hands	365.41	139.55	

(*p:<0.05; **p:<0.01; ***p: <0.001)

Table 39

Results on FDT for Male Sub Sample

Test Procedure	Hean Score (N: 75)	SD	't' value
MALE Preferred Band	423.25	109.92	
Non preferred Hand	610.89	663.61	
Preferred Hand	423.25	109.92	.3.50***
Both Hands	358.31	117.34	
Non preferred Hand	610.89	663.61	3.25"
Both Hands	358.31	117.34	

(*p: <0.05; **p: <0.01; ***p: <0.001)

Table 40.

Results on FDT for Female Sub Sample

Test Procedure	Mean Score (EM)	SD	't'value
Preferred Hand	443.42	185.22	1.84
Non preferred Hand	573.90	247.07	
Preferred Hand	443.42	185.22	0.00
Both Hands	393.05	201.84	
Non preferred Hand	573.90	247.07	2.47*
Both Hands	393.05	201.84	

(*p:<0.05; **p:<0.01; ***p:<0.001)

Besides, a cross modal analysis of mean scores by different procedures on FDT was also attempted to ascertain the influence of sex variables (See Table 41)

Table 41.
Cross modal Analysis of Perfomance on FDT between Sex Groups

Test Procedure	Mean Score (H:75)	SD	't'value
PREFERRED HAND			
Hale (n: 75)	423.25	109.92	0.61
fEMALE(n: 19)	443.42	185.22	
PREFERRED HAND			
Hale (n: 75)	610.89	663.61	0.24
femle t<: 19)	573.90	247.07	
BOTH HANDS			
Hale (n: 75)	358.31	117.34	0.98
female (N: 19)	393.05	201.84	

*p: (0.05; **p: (0.01;***p:(0.001

The results of performance on EDT reveals:

i) For overall sample (N:94), the mean PH score on FDT is 427.33 (SD: 128.99), NPH score is 603.33 (SD: 602.58) and BH score is 365.41 (SD: 139.55). There is statistically significant difference in mean scores for various hand procedures (PH vs NPH, PH vs BH, NPH vs BH) on FDT for overall sample (See Table 38).

ii) For male sub sample (N:75), the mean PH score on FDT is 423.25 (SD: 109.92), NPH score is 610.89 (SD: 663.61) and BH score is 358.31 (SD: 117.34). There is statistically significant difference (p: < 0.05) in mean scores for various hand procedures (PH vs NPH, PH vs BH, NPH vs BH) on FDT for male sub sample (See Table 39).

iii) For female sub sample (N:19), the mean PH score on FDT is 443.42 (SD: 185.22), NPH score is 573.90 (SD: 247.07) and BH score is 393.05 (SD: 201.84). There is statistically significant difference (p: < 0.05) in mean score only with respect to use NPH vs BH (See Table 40).

iv) In relation to sex variable, use of PH reveals a mean score of 423.25 (SD: 109.92) and for females is 443.42 (SD: 185.22). For use of NPH, the mean score for males is 610.89 (SD: 663.61) and females is 573.90 (SD: 247.07). For use of BH, mean score for males is 358.31 (SD: 117.34) and females is 393.05 (SD: 201.84). There is no statistically significant difference (p: < 0.05) between mean scores of males and females for all the above procedures.

2. Minnesota Rate of Manipulation Test (MRMT)

The MRMT is a measure of gross motor dexterity, motor speed and eye hand coordination. The subject's performance on this test is measured as the overall time taken (in seconds) to place the pegs into the slots under three conditions, viz., PH, NPH and BH. The mean scores attained by different hand procedures on MRMT for overall sample (See Table 42) and sub samples of males (See Table 43) and females (See Table 44) are deliniated.

Table 42.
Results on MRMT for Overall sample

Test Procedure	Mean Score (N:94)	SD	't'value
OVERALL			
Preferred Hand	98.96	20.17	2.34*
Non preferred hand	115.76	66.67	
Preferred Band	98.96	20.17	5.4r**
Both hands	79.28	28.46	
Non preferred Hand	115.76	66.67	
Both Hands	79.28	28.46	

(*p:<0.05; **p:<0.01; ***p:<0.001)

The mean scores by different hand procedures on the MRMT for male and female sub samples are also deliniated (See Tables 43 and 44).

Bible 43.
Remits on HHT for Ale

Test Procedure	Mean Score (H:75)	SD	't' value
MM			
Preferred Hand	99.08	17.26	2.15*
Htm preferred Band	117.73	73.17	
Preferred Band	99.08	17.26	5.33*"
Both Hands	79.24	27.20	
Eon preferred Hand	117.73	73.17	4.27*"
Both Hands	79.24	27.20	

(*p:<0.05; **p:<0.01; ***p:<0.001)

Table 44.
Results on HUT for female Sample

Test Procedure	Mean Score ()):19)	SD	't' value
Preferred Hand	98.47	29.04	1.02
Non preferred Hand	107.95	28.02	
Preferred Hand	98.47	29.04	1.89
Both Hants	79.42	32.98	
Non preferred Hand	107.95	28.02	2.87"
Both Hands	79.42	32.98	

(*p:<0.05; **p<0.01; ***p:<0.001)

Besides, a cross nodal analysis of mean scores by different hand preferences on MRMT in relation to sex variable was attempted (See Table 45).

Table 6.
Cross Modal Analysis of Perfonance on MRMT between Sex Groups

Test Procedure	Mean Score	SD	't' value
PREFERED HAND			
Male (M: 75)	99.08	17.26	0.12
Female (N: 19)	98.47	29.04	
NON PREFERED HAND			
Male (N: 75)	117.73	73.17	2.22*
Femle (N: 19)	107.95	28.02	
BOTH HANDS			
Male (t): 75)	79.24	27.20	0.25
Fmakle (N: 19)	79.42	32.98	

(*p: <0.05; **p: <0.01; ***p: <0.001)

The results of performance on MRMT reveals:

i) For overall sample (N: 94), the mean PH score is 98.96 (SD: 20.17), NPH score is 115.76 (SD: 66.67) and BH score is 79.28 (SD: 28.46). There is statistically significant difference (p: < 0.05) in mean score for various hand procedures (PH vs NPH, PH vs BH, NPH vs BH) on MRMT for overall sample (See Table 42).

ii) For male sub sample (N:75), the mean PH score on MRMT is 99.08 (SD: 17.26), NPH score is 115.76 (SD: 66.67) and BH score is 79.28 (SD: 28.46). There is statistically significant difference (p: < 0.05) in mean scores for various hand prrocedures (PH vs NPH, PH vs BH, NPH vs BH) on MRMT for male sub sample (See Table 43).

iii) For female sub sample (N;19), the mean PH score on MRMT is 98.47 (SD:29.04), NPH score is 107.95 (SD: 28.02) and BH score is 79.42 (SD: 32.98). There is statistically significant difference (p: < 0.05) in mean score of females only with respect to use of NPH vs BH (See Table 44).

iv) In relation to sex variable, use of PH by males reveal mean score of 99.08 (SD: 17.26) and for females is 98.47 (SD: 29.04). For use of NPH, mean score for males is 117.73 (SD: 73.17) and females is 107.95 (SD: 28.02). For use of BH, mean score for males is 79.24 (SD: 27.20) and females is 79.42 (SD: 32.98). There is statistically significant difference (p: < 0.05) between mean scores of males versus females only on use of NPH in MRMT. There is no difference with regard to their use of PH and/or BH (See Table 45).

3. Pattern Tracing Test, Modified (PTT)

The PTT, Modified, is a measure of fine motor steadiness and eye hand coordination. The scores derived on this test is the unit time taken (in seconds) by a subject to trace the star design once in each trial; and also, the number of errors made in that trial. In all, two trials each with PH and NPH were computed for each subject. The mean scores obtained on PTT in terms of time taken as well as errors made with PH and NPH for overall sample (See Table 46) and in relation sex variable (See Table 47) were calculated.

Table 46
Remits on **FIT**

Test Procedure OVERALL	Mean Score	SD	'T'value
PH - Average TiMe	25.33	10.37	1.29
NPH- Average TiMe	23.20	12.77	
PB - Average Errors	12.41	9.81	2.15*
HPH- Average Errors	15.39	9.63	

(*p:<0.05;**p:<0.01;***p:<0.001)

Table 47.
Remits on PTT in Relation to SeX Variable

Test Procedure	Mean Score	SD	't' value
MALE vs FEMALE			
PH - Average Time	26.26	10.32	1.75
PB - Average Time	21.68	9.73	
MALE vs FEMALE			
PH - Average Errors	11.21	7.62	2.43*
PH - Average Errors	17.15	15.00	
NPH- Average Time	23.68	12.72	0.72
NPH- Average Time	21.33	12.80	
MALE vs FEMALE			
NPH- Average Errors	14.62	8.52	1.56
NPH- Average Errors	18.43	12.67	

(*p: <0.05; **p: <0.01; ***p: <0.001)

The results of performance on PTT, modified reveals:

i) For overall sample (N: 94), mean time score on PTT, Modified using PH is 25.33 (SD: 10.37) and NPH is 23.20 (SD: 12.77) and mean error score using PH is 12.41 (SD: 9.81) and NPH is 15.39 (SD: 9.63). There is no statistically significant difference (p: < 0.05) mean time scores of subjects using PH versus NPH. However, there is statistically significant difference (p: < 0.05) between mean error scores of subjects on the PTT, Modified, using PH vs NPH (See Table 46).

ii) In relation to sex variable (See Table 47) males in this sample appear bo take more time using PH (Mean: 26.26; SD: 10.32) or NPH (Mean: 23.68; SD: 12.72) than females using PH (Mean: 21.68; SD: 9.73) or NPH (Mean: 21.33; SD: 12.80). However, these differences are not statistically significant (p: < 0.05). There is a significant difference (p: < 0.05) in number of errors by females using PH (Mean: 17.15; SD: 15.00 and males using PH (Mean: 11.21; SD: 7.62).

4. Steadiness Test

This test is a measure of fine motor steadiness. The scores on this test is the mean number of errors made by a subject over each thirty second duration within the nine holes. The higher score on this test, indicates lower steadiness in the subject. The mean errors obtained by overall sample as well as in relation to sex variable was computed (See Table 48).

Table 48.
Results on Steadiness Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	19.40	10.06	
SEX			
Male (N: 75)	20.88	10.58	2.95**
female)N: 19)	13.58	3.97	

*p:<0.05;**p: <0.01; ***p: <0.001)

The results on Steadiness Test reveals:

i) For overall sample (N: 94), the mean Steadiness Score is 19.40 (SD: 10.06). In relation to sex variable, females (N: 19) in this sample show fewer errors (Mean 13.58; SD: 3.97), hence greater fine motor steadiness than their male counterparts (Mean: 20.88; SD: 10.58). These differences are even found to be statistically significant (p: <0.01) (See Table 48).

Analysis of Composite Motor Functions

A second level analysis of results in motor domain of FAB was carried out to discover overall patterns of hand preferences in the mentally handicapped subjects. The motor speed composite using PH on FDT, MRMT and PTT, Modified were averaged to derive a mean Preferred Hand Motor Score

(PHMS). For example, if a subject took 259 seconds using PH on FDT, 73 seconds using PH on MRMT and 19.3 seconds using PH on PIT, modified; the mean PHMS was calculated as 259+73+19.3 divided by 3 117.10.

Similarly, motor speed components using NPH on FDT, MRMT and PTT, Modified, were averaged to derive mean Non Preferred Hand Motor Score (NPHMS). For example, if a subject scored 304 seconds using NPH on FDT, 69 seconds using NPH on MRMT and 19.6 seconds using NPH on PTT, Modified, the mean NPHMS was calculated as 304+69+19.6 divided by 3: 130.9.

Nextly, motor speed components using BH on FDT and MRMT was averaged to derived Mean Both Hands Motor Score (BHMS). For example, if a subject scored 222 seconds using BH on FDT and 43 seconds using BH on MRMT; the Mean BHMS was calculated as 222+43 divided by 2: 132.5. The PTT, Modified, was not included in this composite mean because this test does not involve the procedure of using BH.

The scores on Motor Steadiness Test (MO_ST) were taken in isolation as it does not involve the component of motor speed. The overall mean and SD scores on the PHMS, NPHMS, BHMS and MO ST were calculated (See Table 49).

Table 49

Results of Composite Motor functions on FAB

Sub Domain	Mean (N:94)	SD	't' value
PBMS	181.99	50.64	2.93**
	246.67	208.10	
BMS	221.86	80.10	24.33***
MOST	19.30	9.87	
PBMS	181.99.	50.64	4.08***
BMS	221.86	80.10	
PBMS	181.99	50.64	30.58***
MOST	l9.30	9.87	
BMS	221.86	80.10	9.17***
HOST	l9.30	9.87	
NPBMS	246.67	208.10	10.58***
MOST	19.30	9.87	

*p: < 0.05; **p: < 0.01; ***p: < 0.001)

The analysis of composite motor function wise result reveals:

i) The composite motor speed scores (averaged from FDT, MRMT and PTT) for PH (Mean: 181.99; SD: 50.64) is lower than NPH (Mean: 246.67; SD: 208.10) as well as BHMS (Mean: 221.86; SD: 80.10).

ii) The composite motor steadiness score is 19.30 and SD is 9.87.

iii) There is statistically significant difference (p: < 0.001) between mean composite scores of PHMS (Mean: 181.99; SD: 50.64), NPHMS (Mean: 246.67; SD: 208.10), BMS (Mean: 221.86; SD: 80.10) and MO_ST (Mean: 19.30; SD: 9.87) respectively in all combinations (See Table 49).

Analysis of Intercorrelations within Assessed Motor Domain of FAB

In order to determine covariance between tests within motor domain of FAB, a intercorrelation matrix was drawn between mean PHMS, mean NPHMS, mean BHMS and mean MO ST (See Table 50).

Table 50.
Intercorrelation within Motor Domain

correlation	PBMS	NPHMS	ME
CMS	.327**		
HE	.906**	.3!3**	
HOST	.126	-.116	.066

fp: < 0.05; **p: < 0.01; ***p: (M M)

The analysis of intercorrelations between tests within motor domain of FAB reveals:

i) There is statistically significant degree of correlation between mean scores on PHMS vis a visNPHMS (r: 0.327; p: < 0.01) or BUMS (r: 0.906; p: < 0.01).

ii) There is statistically significant degree of correlation between mean scores on NPHMS vis a vis scores on PHMS (r: 0.328; p: < 0.05) or BHMS (r: 0.393; p: < 0.05).

iii) There is statistically significant degree of correlation between mean scores o BUMS vis a vis scores on PHMS (r: 0.906; p: < 0.05), NPHMS (r: 0.392; p; < 0.001).

iv) There is no statistically significant degree of correlation between mean MOJST scores and the other mean scores including PHMS, NPHMS and BHMS. These findings are suggestive of the empirical validity for the various motor sub domains (except motor steadiness) as discrete categories identified within FAB.

III. VISUAL FUNCTIONS

The results of baseline assessment for visual functions on FAB were derived from scores on sub tests, such as, visual matching, naming, discrimination and visuo construction.

1. Visual Object Matching Test:

The mean Visual Object Matching f<ir nwrall sample (N:94) is 14.55 (SD: 0.87). Further, there is no statistically significant difference (p: > 0.05) between scores for males (N: 75; Mean: 14.57; SD: 0.91) and females (N: 19; Mean: 14.47; SD: 0.68) (See Table 51).

Table 51.
Remits of Visa! Object etching Test

Test Procedure	Mean Score	SD	't' value
Overall (K: 94)	14.55	0.!7	
Hale (H: 75)	14.57	6.91	f!.45
Femle (!: 19)	14.47	0.H	

(*p: (0.05; "p: (Ml; "*p: (!.M1!

2. Visual Picture Matching Test:

The mean Visual Picture Matching Score for overall sample (N: 94) is 14.63 (SD: 1.06). Further, the difference in means on this test scores between males (N: 75; Mean: 14.63; SD: 1.09) and females (N: 19; Mean: 14.58; SD: 0.94) is not found to be statistically significant (p; > 0.05) (See Table 52).

Table 52.
Beanita of Viand hctare Matching Test

Test Procedure	Ham Score	SD	't' value
Overall «: 94)	14.63	1.06	
Male (H: 75)	14.63	1.09	0.76
Fatale (H: 1!)	14.5!	0.94	

fp: (0.05; "p: (0.M; *"p: (0.001!

3. Object Shape Matching Test:

The mean Object Shape Matching Score for overall sample (N; 94) is 10.52 (SD: 3.69). Further, the difference in means on this tast scores between males (N:75; Mean: 10.69; SD: 3.62) and females (N: 19; Mean: 9.84; SD: 3.87) is not found to be statistically significant (p: > 0.05) (See Table 53).

Table 53.
Besalta of Visual Object Shape Matching Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	10.52	3.69	
Hale (H: 75)	10.69	3.62	0.90
Fenle (H: 19)	9.!4	3.S7	

Cp: <0.05; "p: (0.01; "*p: (0.001)

4. Picture Shape Matching Test:

The Picture Shape Matching Scores for overall sample (N:94) is 10.15 (SD: 3.96). Further, the difference between means on this test scores for males (N:75; Mean: 10.24; SD: 3.88) and females (N: 19; Mean: 9.79; SD: 4.21) is not found to be statistically significant (p: > 0.05) (See Table 54).

Table M.
Remits on Pictme Shape Hat&ux) Test

Test Procedure	MeanSoore		't'value
Overall (H: 94)	10.15	3.96	
Hale (!: 75)	10.24	3.8	0.44
Fettle (H: 19)	9.79	4.21	

Cp: <M5; "p: (0.01; *"p: (0.M1)

5. Object Size Matching Test:

The mean Object Size Matching Score for overall sample (N: 94) is 8.35 (SD: 4.42). Further, the difference between means on this test for males (N: 75; Mean: 8.6; SD: 4.31) and females (N: 19; Mean: 7.37; SD: 4.69) is not found to be statistically significant (p: > 0.05) (See Table 55).

Hesolts on Viand (tjcet Sue Hatching Test

Test Procedure	Mean Scare	SD	't' value
Overall ()): 94)	8.3S	4.42	
Hale (H: 75)	!.M	4.31	1.09
fenle (t!: 19)	7.37	4.69	

fp: (C.C5; **p: <0.M;

6. Picture Size Matching Test:

The mean Picture Size Matching Score for overall sample (N:94) is 9.37 (SD: 4.59). Further, * the difference between means on this test for males (N: 75; Mean: 9.32; SD: 4.54) and females (N: 19; Mean: 9.58; SD: 4.98) is not found to be statistically significant (p: > 0.05) (See Table 56).

Table 56.
Hesalts on Visual Picture Size Matching Test

Test Procedure	Hean Soore	SD	't' value
Overall (H: 94)	9.37	4.59	
Hale [<: 75)	9.32	4.54	0.22
femle (!: 1!)	9.5!	4.9	

t*p: <0.05; "p: <C.C1; "*p: Ot.Ml)

7. Object Color Matching Test:

The mean Object Color Matching Score for overall sample (N: 94) is 9.72 (SD: 4.91). Further, the difference between means on this test for males (N:75; Mean: 9.74; SD: 4.93) and females (N: 19; Mean: 9.66; SD: 4.82) is not found to be statistically significant (p: > 0.05) (See Table 57).

Table 57.
Results on Visual Object Color Matching Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	9.72	4.91	
Male (N: 75)	9.74	4.93	0.06
Female(N:19)	9.66	4.82	

(*p:<0.05;**p:<0.01;***p:<0.001)

8. Picture Color Matching Test:

The mean Picture Color Matching Score for overall sample (N:94) is 11.34 (SD: 4.47). Further, the difference between means on this test for males (N: 75; Mean: 11.29; SD: 4.51) and females (N: 19; Mean: 11.53; SD: 4.32) is not found to be statistically significant (p: > 0.05) (See Table 58).

Table 58.
Results on Visual Picture Color Hatching Test

Test Procedure	Hean Score	SD	't'value
Overall (N: 94)	11.34	4.47	
Male (N: 75)	11.29	4.51	0.21
Female (N: 19)	11.53	4.32	

(*p:<0.05;**p:<0.01; ***p: <0.001)

9. Object Number Matching Test:

The mean Object Number Matching Score for overall sample (N: 94) is 8.15 (SD: 6.47). Further, the difference between means on this test for males (N: 75; Mean: 8.45; SD: 6.27) and females (N: 19; Mean: 6.97; SD: 7.09) is not found to be statistically significant (p: > 0.05) (See Table 59).

Table 59
Results on Visual Object Number Hatching Test

Test Procedure	Mean Score	SD	't' value
Overall (N): 94)	S.15	6.47	
Hale (N: 75)	S.45	6.27	l.08
Femae (N: 19)	6.97	7.09	

(*p:<0.05;**p:<0.01;***p: <0.001)

10. Picture Number Matching Test:

The mean Picture Matching Score for overall sample (N:94) is 8.63 (SD: 6.39). Further, the difference between means on this tests scores for males (N: 75; Mean: 8.99; SD: 6.20) and females (N: 19; Mean: 7.21; SD: 6.91) is not found to be statistically significant (p: > 0.05) (See Table 60).

Table 60.
Results on Visual Picture Number Hatching Test

Test Procedure	Mean Score	SD	't'value
Overall (N: 94)	8.63	6.39	
Male (N: 75)	8.99	6.20	1.09
Female (N: 19)	7.21	6.91	

(*p:<0.05;**p:<0.01; ***p <0.001)

11. Object Naming Test:

The mean Object Naming Score for overall sample (N: 94) is 13.28 (SD: 2.81). Further, the difference between means on this test for males (N: 75; Mean: 13.25; SD: 3.06) and females (N: 19; Mean: 13.37; SD: 1.46) is not found to be statistically significant (p: > 0.05) (See Table 61).

Table 61

Results on Viand Cbject haing Test

Test Procedure	Mean Score	SD	't'value
Overall (N:94	13.28	2.81	
Male (N: 75)	13.25	3.06	0.17
Female (N: 19)	13.37	1.46	

(*p:<0.05;**p:<0.01; ***p: <0.001)

12. Picture Naming Test:

The mean Picture Naming Score for overall sample (N:94) is 12.11 (SD: 2.98). Further, the difference between means on this test for males (N: 75; Mean: 12.27; SD: 3.07) and females (N: 19; Mean: 11.47; SD: 2.52) is not found to be statistically significant (p: > 0.05) (See Table 62).

Table 62.

Results on Visual Picture Naming Test

Test Procedure	MeanSoore	$	't' value
Overall (N: 94)	12.11	2.98	
Male (N: 75)	12.27	3.07	1.05
female(N:19)	11.47	2.52	

(*p:<0.05;**p:<0.01l;***p: <0.001)

13. Color Naming Test:

The mean Color Naming Score for overall sample (N: 94) is 3.73 (SD: 2.80). Further, the difference between means on this test for males (N: 75; Mean: 3.60; SD: 2.66) and females (N: 19; Mean: 4.26; SD: 3.21) does not show any statistically significant difference (p: > 0.05) (See Table 63).

Table 63.
Results on Visual Oolor Naming Test

Test Procedure	Mean Score	SD	't' value
Overall (M: 94)	3.73	2.80	
Hale (N: 75)	3.60	2.66	0.92
Female (N: 19)	4.26	3.21	

(*p:<0.05;**p:<0.01; ***p: <0.001)

14. Object Discrimination Test

The mean Object Discrimination Score for overall sample (N: 94) is 6.08 (SD: 4.64). Further, the difference between means in scores on this test for males (N: 75; Mean: 6.25; SD: 4.74) and females (N: 19; Mean: 5.37; SD: 4.13) is not found to be statistically significant (p: > 0.05) (See Table 64).

Table 64.
Remits on Visaal Object Discrinination Test

Test Procedure	Mean Score	SD	't' value
Overall(N:94	6.08	4.64	
Male (N: 75)	6.25	4.74	0.774
Female(N:19)	5.37	4.13	

(*p:<0.05;**p:<0.01; ***p: <0.001)

15. Picture Discrimination Test

The mean Visual Picture Discrimination Score for overall sample (N: 94) is 4.75 (SD: 4.82). Further, the difference between means in scores on this test for males (N:75; Mean: 5.28; SD: 4.92) and females (N: 19; Mean: 2.63; SD: 3.70) is found to be statistically significant (p: < 0.05) (See Table 65).

Table 65.
Results on Visaal Picture Discrimination Test

Test Procedure	Mean Score	SD	't'value
Overall (N: 94)	4.75	4.82	
Male(N:75)	5.28	4.92	2.19*
Female(N:19)	2.63	3.70	

(*p:<0.05;**p:0.01; ***p: <0.001)

16. Figure Ground Discrimination Test:

The mean Figure Ground Discrimination Score for overall sample (N: 94) is 10.39 (SD: 10.31). Further, the difference between means in scores on this test for males (N:75; Mean: 10.65; SD: 3.40) and females (N: 19; Mean: 9.05; SD: 4.05) is not found to be statistically significant (p: > 0.05) (See Table 66).

Table 66.
Remits on Figure Ground Discrimination Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	10.32	3.51	
Hale (N: 75)	10.65	3.40	1.76
Female (N: 19)	9.05	4.05	

(*p:<0.05;**p:<0.01; ***p: <0.001)

17. Vertical Block Assembly Test:

The mean Vertical Block Assembly Score for overall sample (N: 94) is 4.75 (SD: 3.59). Further, the difference between means in scores on this test for males (N: 75; Mean: 4.99; SD: 3.85) and females (N: 19; Mean: 3.79; SD: 1.99) is not found to be statistically significant (p: > 0.05) (See Table 67).

Table 67.
Results on Vertixcal Assembly Test

Test Procedure	Mean Score	SD	't' value
Overall {N: 94)	4.75	3.59	
Male (N: 75)	4.99	3.85	1.31
Female (N: 19)	3.79	1.99	

(*p:<0.05;**p:<0.01; ***p: <0.001)

18. Horizontal Block Assembly Test:

The mean Horizontal Block Assembly Score for overall sample (N: 94) is 6.05 (SD: 5.24). Further, the difference between means in scores on this test for males (N: 75; Mean: 6.17; SD: 5.18) and females (N: 19; Mean: 5.58; SD: 5.45) is not found to be statistically significant (p: > 0.05) (See Table 68).

Table 68.
Results on Horizontal Assembly Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	6.05	5.24	
Male{N:75)	6.17	5.18	0.44
Famale (N: 19)	5.5S	5.45	

(*p:<0.05;**p:<0.01;***p: <0.00l)

19. Design Copying Test:

The mean Design Copying Score for overall sample (N: 94) is 4.37 (SD: 3.75). Further, the difference between means in scores on this for males (N: 75; Mean: 4.39; SD: 3.76) and females (N: 19; Mean: 4.32; SD: 3.71) is not found to be statistically significant (p: > 0.05) (See Table 69).

Table 69.
Results on Design Copying Test

Test Procedure	Mean Score	SD	't' value
Overall (N:94)	4.37	3.75	
Male (N: 75)	4.39	3.76	0.07
Female (N:19)	4.32	3.71	

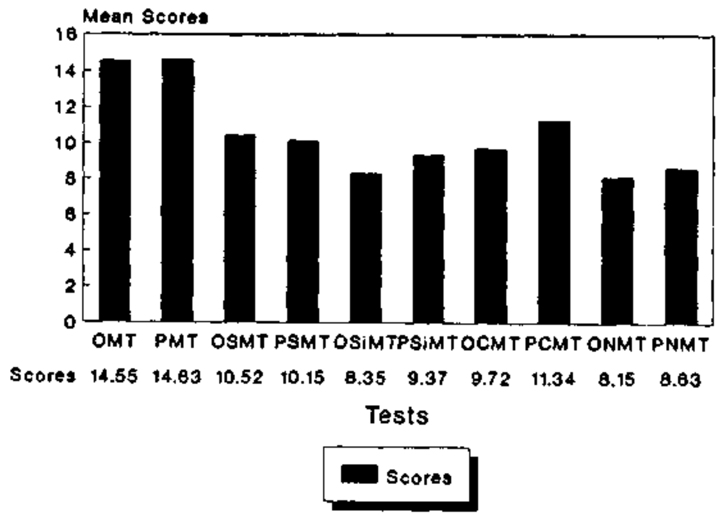
(*p:<0.05; **p: <0.01;***p: <0.001)

To summarise, analysis on individual test performances in visual domain of FAB reveals:

1. The maximum possible on all sub tests in visual domain of FAB is 15. The mean score distribution obtained by overall sample varies (See Table 70). The profile distribution of mean scores for the various sub tests in visual domain of FAB for overall sample is given in Graph One.

Graph One.

Visual Functions in FAB



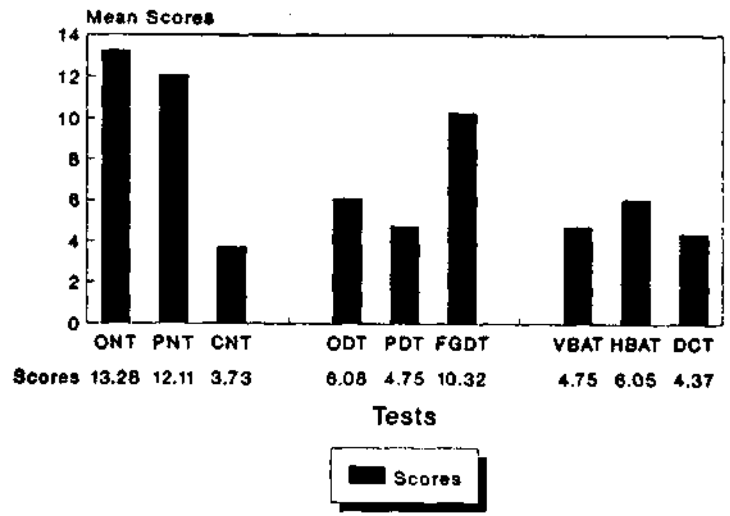


Table 70.

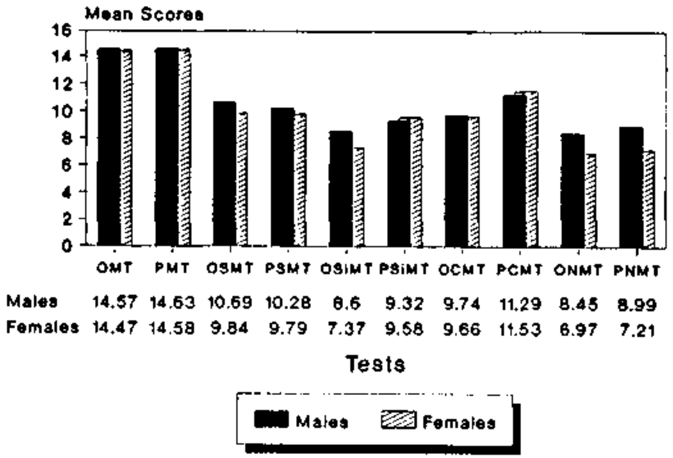
Study Besults on Teats of Visual Function in FAB

Tests	Mean	SD
Object Matching Test	14.55	0.87
Picture Hatching Test	14.63	1.06
Object Shape Hatching Test	10.52	3.69
Picture Shape Hatching Test	10.15	3.%
Object Size Hatching Test	8.35	4.40
Picture Size Hatching Test	9.37	4.59
Object Color Hatching Test	9.72	4.91
Picture Color Hatching Test	11.34	4.47
Object Number Matching Test	8.15	6.47
Picture Number Hatching Test	8.63	6.39
Object Earning Test	13.28	2.81
Picture Naming Test	12.11	2.98
Color Haming Test	3.73	2.80
Object Discrimination Test	6.08	4.64
Picture Discrimination Test	4.75	4.80
Figure Ground Discrimination Test	10.32	3.51
Vertical Block Assembly Test	4.75	3.59
Horizontal Block Assembly Test	6.05	5.20
Design Copying Test	4.37	3.75

2. A comparative profile distribution of mean scores (See Table 71) for various subtests in visual domain of FAB in male and female sub samples is given in Graph Two.

Graph Two.

Scores on Visual Domain in Relation to Sex Variable



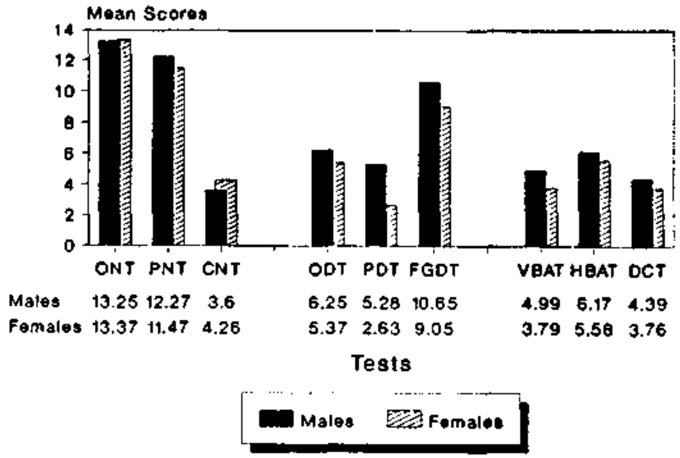


Table 71.
Results on Tests of Visual Runctions in FAB in Relation to So Variable

Sub tests in visual donain	Male (N:75) Mean	SD	Female (N:19) Mean	SD
Object Hatching Test	14.57	0.91	14.47	0.68
Picture Matching Test	14.63	1.09	14.58	0.94
Object Shape Hatching Test	10.69	1.62	9.84	3.87
Picture Shape Matching Test	10.2!	3.88	9.79	4.21
Object Size Matching Test	S.6C	4.31	7.37	4.69
Picture Size Matching Test	9.32	4.50	9.58	4.98
Object Color Matching Test	9.74	4.39	9.66	4.82
Picture Color Matching Test	11.29	4.51	11.53	4.32
Object Number Hatching Test	8.45	6.27	6.97	7.09
Picture Number Matching Test;	8.99	6.20	7.21	6.91
Object Naming Test	13.25	3.06	13.37	1.46
Picture Naming Test	12.27	3.07	11.47	2.52
Color Naming Test	3.60	2.66	4.26	3.21
Object Discrimination Test	6.25	4.74	5.37	4.13
Picture Discrinination Test	5.28	4.92	2.63	3.73
Figure Ground Discrinination Test	10.65	3.40	9.05	4.05
Vertical Block Assembly Test	4.99	3,85	3.79	1.99
Horizontal Block Assembly Test	6.17	5.18	5.58	5.45
Design Copying Test	4.39	3,76	4.32	3.71

Analysis of Composite Visual Functions

The second level analysis of results in visual domain of FAB was carried out to discover patterns of overall performance in mentally retarded subjects. The composites of visual domain in FAB were grouped as visual matching, visual naming, visual discrimination and visuo construction.

1. Visual Matching (VM)

This domain includes mean scores from Visual Object Matching Test, Visual Picture Matching Test, Visual Object Shape Matching Test, Visual Picture Shape Matching Test, Visual Object Size Matching Test, Visual Picture Size Matching Test, Visual Object Color Matching Test, Visual Picture Color Matching Test, Visual Object Number Matching Test and Visual Picture Number Matching Test. The mean Visual Matching Score for overall sample (N: 94) is 10.54 (SD: 3.34) (See Table 72).

2. Visual Naming (VN)

This domain includes mean scores from Visual Object Naming Test, Visual Picture Naming Test and Visual Color Naming Test. The mean Visual Naming Score for overall sample (N: 94) is 9.67 (SD: 2.48) (See Table 72).

3. Visual Discrimination (VD)

This domain includes mean scores from Visual Object Discrimination Test, Visual Picture Discrimination Test and Embedded Figures Test.

The mean Visual Discrimination Score for overall sample (N: 94) is 7.08 (SD: 3.74) (See Table 72).

Table 72.
Results of Opposite Visul Functions on MB

Sub domain	Mean (N:94)	SD	't' value
Visual Hatching	10.54	3.34	2.03*
Visual Naming	9.67	2.48	
Visual Matching	10.54	3.34	6.69***
Visual Discrimination	7.08	3.74	
Visual Matching	10.54	3.34	10.40***
Visual Construction	5.05	3.88	
Visual Naming	9.67	2.48	5.59"*
Visual Discrimination	7.08	3.74	
Visual Naming	9.67	2.48	9.73"*
Visual Construction	5.05	3.88	
Visual Discrimination	AM	3.74	3.65*"
Visual Construction	5.05	3.88	

(*p:0.01; **p:0.05; ***p:0.001)

4. Visuo Construction (VC)

This domain includes mean scores from Vertical Block Assembly Test, Horizontal Block Assembly Test and Design Copying Test. The mean Visuo Construction for overall sample (N: 94) is 5.05 (SD: 3.82) (See Table 72).

There is statistically significant (p: < 0.05) difference between mean composite scores of Visual Matching (Mean: 10.54; SD 14), Visual Naming (Mean: 9.67; SD: 2.48), Visual Discrimination (Mean: 7.08; SD: 3.74) and Visuo Construction (Mean: 5.05; SD: 3.88) domains in all combinations (See Table 71).

Analysis of Intercorrelation within Assessed Visual Domain of FAB

In order to determine covariance between tests within Visual domain of FAB, a intercorrelation matrix was prepared between visual matching, visual naming, visual discrimination and visuo- construction (See Table 73).

Table 73.

Intercorrelations Within Visual Domain

Correaltion	Visual Matching	Visual Naming	Visual Discrimination
Visual Naning	.794**		
Visual Discrimination	.854**	.762**	
Visual Construction	.760**	.503**	.670**

(*p:<0.05;**p:<0.01; ***p:<0.001)

The analysis of intercorrelations between tests within visual domain of FAB reveals:

1. There is statistically significant degree of positive correlation between mean scores on visual matching sub domain and visual naming (r: 0.794; p: < 0.001), visual discrimination (r: 0.854; p: < 0.001) or visuo-construction (r: 0.760; p: < 0.001).

2. There is statistically significant degree of positive correlation between mean scores on visual naming sub domain and visual matching (r: 0.794; p: < 0.001), visual discrimination (r: 0.762; p: < 0.001) or visuo-construction (r: 0.503; p: < 0.001).

3. There is statistically significant degree of positive correlation between mean scores on visual discrimination sub domain and visual matching (r: 0.854; p: < 0.001), visual naming (r: 0.762; p: < 0.001) or visuo-construction (r: 0.670; p: < 0.001).

4. There is statistically significant degree of positive correlation between mean scores on visuo-construction sub domain and visual matching (r: 0.760; p: < 0.001), visual discrimination (r: 0.670; p: < 0.001) or visual naming (r: 0.503; p: < 0.001). These findings are suggestive of the empirical validity for various visual sub-domains (such as, visual matching, visual naming, visual discrimination and visual construction) as discrete categories identified within FAB.

IV. AUDITORY FUNCTIONS

The results of baseline assessment for auditory functions on FAB is derived from scores on only one test, viz., Sound Syllable Production Test.

1. Sound Syllable Production Test (SSPT):

The mean Sound Syllable Production Score for overall sample (N: 94) is 13.54 (SD: 1.83). Further, there is no statistically significant difference (p: > 0.05) between scores for males (N: 75; Mean: 13.63;

SD: 1.80) and females (N: 19; Mean: 13.18; SD: 1.89) on this test (See Table 74). Since auditory domain has only one sub test, no composite analysis/intracorrelational analysis can be attempted.

Table 74.
Results on Auditory Sound Syllable Production Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	13.54	1.83	
Male (N: 75)	13.63	1.80	0.96
Female (N: 19)	13.18	1.89	

(*p:<0.05;**p:<0.01;***p:<0.001)

V. MEMORY FUNCTIONS

The results of baseline assessment for memory functions on FAB is derived from scores from four sub tests, viz., immediate and recent auditory memory, immediate and recent visual memory, given as follows.

1. Immediate Auditory Memory Test:

The mean Immediate Auditory Memory Score for overall sample (N: 94) is 3.31 (SD: 1.23). Further, there is no statistically significant difference (p: > 0.05) between scores of males (N: 75; Mean: 3.40; SD: 1.08) and females (N:19; Mean: 3.16; SD: 1.69) on this test (See Table 75).

Table 75.
Results on Immediate Auditory Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	3.31	1.23	
Hale (N: 75)	3.40	l.M	0.77
Female (N:19)	3.16	1.6!	

(*p:<0.05; **p:<0.01; ***p:<0.001)

2. Recent Auditory Memory Test:

The mean Recent Auditory Memory Score for overall sample (N: 94) is 2.72 (SD: 1.88). Further, there is no statistically significant difference (p; > 0.05) between scores of males (N: 75; Mean: 2.71; SD: 1.92) and females (N: 19; Mean: 2.79; SD: 1.70) on this test (See Table 76).

Table 76.
Results Recent Auditory Memory Test

Test Procedure	Mean Score	SD	't'value
Overall (N: 94)	2.72	1.88	
Hale (N: 75)	2.71	1.92	0.17
Female (N: 19)	2.79	1.70	

(*p:<0.05; **p:<0.01; ***p:<0.001)

3. Immediate Visual Memory Test:

The mean Immediate Visual Memory Score for overall sample (N: 94) is 5.96 (SD: 1.88). Further, there is no statistically significant difference (p; > 0.05) between scores of males (N: 75; Mean: 6.03; SD: 1.78) and females (N: 19; Mean: 5.68; SD: 2.20) on this test (See Table 77).

Table 77.
Results on Immediate Visual Memory Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	5.96	1.88	
Hale (N: 75)	6.03	1.78	0.73
Female (N: 19)	5.68	2.20	

(*p:<0.05; **p:<0.01; ***p:<0.001)

4. Recent Visual Memory Test:

The mean Recent Visual Memory Score for overall sample (N: 94) is 4.06 (SD: 2.00). Further, there is no statistically significant difference (p; > 0.05) between scores of males (N: 75; Mean: 3.88; SD: 1.91) and females (N: 19; Mean: 4.79; SD: 2.19) on this test (See Table 78).

Table 78.
Reult on Recent Visual Memory Test

Test Procedure	Mean Score	SD	't' value
Overall (N: 94)	4.06	2.00	
Male (N: 75)	3.88	1.91	l.80
Female (N: 19)	4.79	2.19	

(*p: <0.05;**p:<0.01;***p:<0.001)

Analysis of Composite Mamory Function

A second level analysis of results in memory domain of FAB was carried out to discover patterns of overall performance in mentally handicapped subjects (See Table 79). The composite memory domain in FAB can be grouped as immediate or recent memory and auditory or visual memory functions. The mean of immediate visual and auditory memory functions is 4.64 (SD: 1.31). The mean of recent visual and auditory memory functions is 3.39 (SD: 1.57). The mean of immediate and recent auditory memory functions is 3.03 (SD: 1.32). The mean of immediate and recent visual memory functions is 5.01 (SD: 1.72).

Table 79.
Results of Ootposite Memry functions

Test Procedure	Mean		't' value
Imediate Memory	4.M	1.31	5.8
Recent Memory	3.39	1.57	
Visual Memory	5.01	1.72	8.85*"
Auditory Memory	3t)3	1.32	

Cp: (0.05; "p: (0.01; **'p: (0.0

Analysis of Intercorrelations within Assessed Memory Domain of FAB

In order to determine covariance between tests within memory domain of FAB, an intercorrelation matrix was drawn between immediate memory, recent memory, visual memory and auditory memory (See Table 80). The results of intercorrelational analysis between tests within memory domain of FAB reveals:

1. There is statistically significant degree of positive correlation (p: < 0.001) between mean scores on composite immediate and recent memory domains against visual and auditory memory domains of FAB in all combinations (See Table 80). These findings are suggestive of the empirical validity for various memory sub domains (such as, inmediate and recent memory, visual and auditory memory) as discrete categories identified within FAB.

Table M.
Intercorrelation Within Memry Domain

Correlation	Immediate memory	Recent memory	Auditory memory
Recent memory	0.587***		
Auditory memory	0.587*"	0.773*"	
Visual memory	0.713'"	0.517"*	0.381···

(*p: (0.05; "p: (0.01; '"p: (0.0

VI. OTHER COGNITIVE FUNCTIONS

The results of baseline assessment for other cognitive functions on FAB is derived from scores on the Test of Ideational Fluency.

1. Test of Ideational Fluency

The mean Ideational Fluency Score for overall sample (N: 94) is 3.86 (SD: 2.44). Further, there is no statistically significant difference (p: > 0.05) between scores of males (N: 75; Mean: 3.83; SD: 2.46) and females (N: 19; Mean: 3.99; SD: 2.33) on this test (See Table 81). Since the "other cognitive tests" domain has only one subtest, no composite analysis/intracorrelational analysis of scores can be attempted.

Table 81
Results on Test of Ideational Fluency

Test Procedure	Mean Score	SD	't' value
Overall (M: 94)	3.86	2.44	
Hale (M: 75)	3.83	2.46	0.26
Female (N: 19)	99	2.33	

'p: (0.05; "p: (0.01; '"p: <0.0

STEP III: EXTERNAL VALIDATION OF FAB

The raw data generated from the procedures adopted to validate FAB for adults with mental handicap were as follows:

1. the composite FAB score for sub sample of 34 adults with mental handicap;

2. the individual domain wise scores on FAB for sub sample of 34 adults with mental handicap; and,

3. the overall quantitative rating scores on Work Behaviour Rating Scale (WBRS) for sub sample of 34 adults with mental handicap.

The results show that the mean composite score for the sub sample (N: 34) on FAB is 184.70 (SD: 70.24). The mean composite scores for subjects on FAB was calculated only from scores on visual, auditory and memory domains. The other functional domains, viz., attention-concentration, motor and other cognitive functions were excluded for calculation of mean composite scores on FAB, because the maximum scores on these sub tests are not fixed and vary in individual cases. Pearsons Product Moment Correlation Coefficient was calculated to determine statistically significant degree of agreement/disagreement between scores on FAB and perceived ratings of vocational instructors on WBRS was found to be in the order of 0.78 ($p < 0.001$).

The anlysis of domain wise scores on FAB, i.e., between memory sub domains (Mean: 15.50; SD: 5.72) as against perceived ratings for memory items alone on WBRS (Mean: 3.09; SD: 0.69) shows correlational coefficient of 0.84 ($p < 0.01$) (Venkatesan and Reddy, 1991).

Therefore, the results of validation confirm FAB as a useful and valid instilment for functional assessment of adults with mental retardation. Incidentally the preliminary data of this study highlights the need to conduct more detailed research on work behaviours in adults with mental handicap.

STEP IV: SENSITIVITY OF FAB

The raw data generated from the procedures adopted to determine sensitivity of FAB in individuals with mental handicap are as follows:

1. Baseline (pre test) scores of subjects in experimental and control groups in various functional domains of FAB.

2. Terminal (post test) scores of subjects in experimental and control groups in various functional domains of FAB.

A domain wise comparative analysis of mean scores for subjects in experimental (N: 5) and control group (N: 5) for various subtests on FAB is presented below

I. ATTENTI0N-CONCENTRATI0N

1. Knox Cube Imitation Test, Modified:

The mean post test scores of subjects in experimental group (N: 5; Mean: 4.20; SD: 0.45) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 3.20; SD: 0.84) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 4.80; SD: 1.30) and post test scores (N: 5; Mean: 3.20; SD: 1.10) in control group for Knox Cube Imitation Test, Modified (See Table 82).

2. Eysencks Test of Concentration (Visual, Modified):

The mean post test scores of subjects in experimental group (N: 5; Mean: 5.00; SD: 1.41) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 3.40; SD: 0.89) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 4.40; SD: 0.89) and post test scores (N: 5; Mean: 3.00; SD: 1.41) in control group for Eysencks Test of Concentration (Visual, Modified) (See Table 82).

Table 82.
Results on Pre and Post Test Measures
in Attention-Concentration Domain

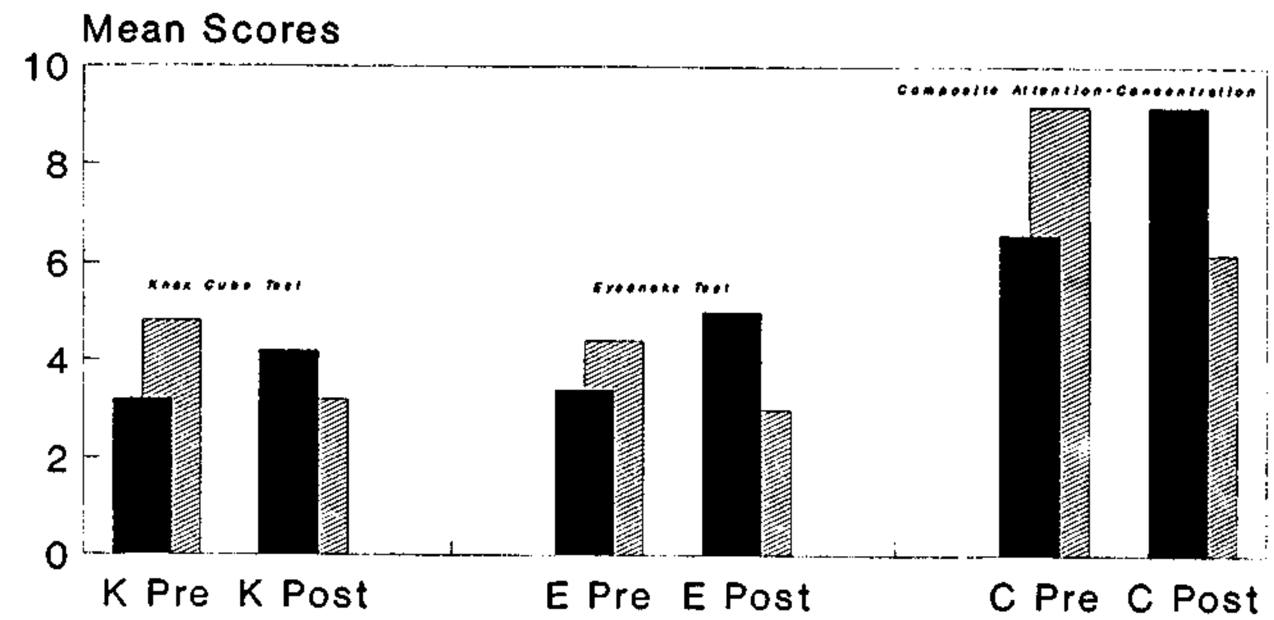
Test	Experimental Group (M:5)			Control Croup (N: 5)		
	Mean	SD	't' value	Mean	SD	't' value
Knox Cube Imitation Test:						
Pretest	3.20	0.84	3.16'	4.80	1.30	2.36
Post test	4.20	0.45		3.20	1.10	
Eysencks Test of Concentration						
Pretest	3.40	0.89	3.14*	4.40	().89	1.72
Post test	5.00	1.41		3.00	1.41	
Composite Attention-Concentration						
Pretest	6.60	1.14	3.47*	9.20	1.79	2.18
Post test	9.20	1.64		6.20	2.,28	

'p: (0.05; "p: (0.01;'"p: (0.001)

3. Composite Attention-Concentration Domain

The mean post test scores of subjects in experimental group (N: 5; Mean: 9.20; SD: 1.64) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 6.60; SD: 1.14) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean:

Graph Three.
Comparitive Scores in Attention-Concentration



	K Pre	K Post	E Pre	E Post	C Pre	C Post
Experimental	3.2	4.2	3.4	5	6.6	9.2
Control	4.8	3.2	4.4	3	9.2	6.2

Tests

Experimental ▪ Control

9.20; SD: 1.79) and post test scores (N: 5; Mean: 6.20; SD: 2.28) in control group for Composite Attention-Concentration Domain (See Table 82). These results are presented graphically (See Graph Three).

II. MOTOR FUNCTIONS

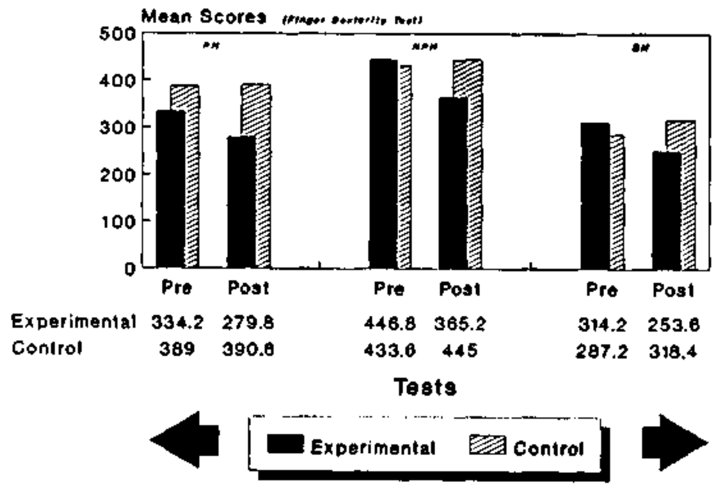
The mean post test scores of subjects in experimental group (N: 5; Mean: 279.8; SD: 17.77) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 334.2; SD: 45.17) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 389.00; SD: 80.07) and post test scores (N: 5; Mean: 390.60; SD: 66.01) in control group for scores obtained by PH on Finger Dexterity Test, Modified (See Table 83).

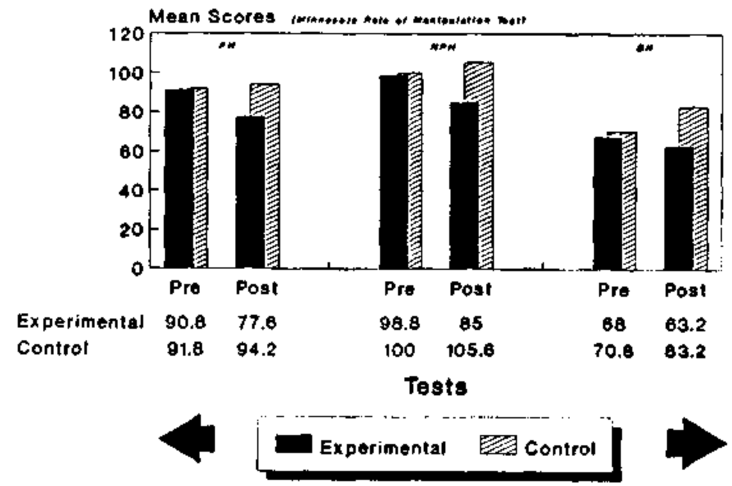
Table 83.
Results on Pre and Post Test Measures in Motor Domain

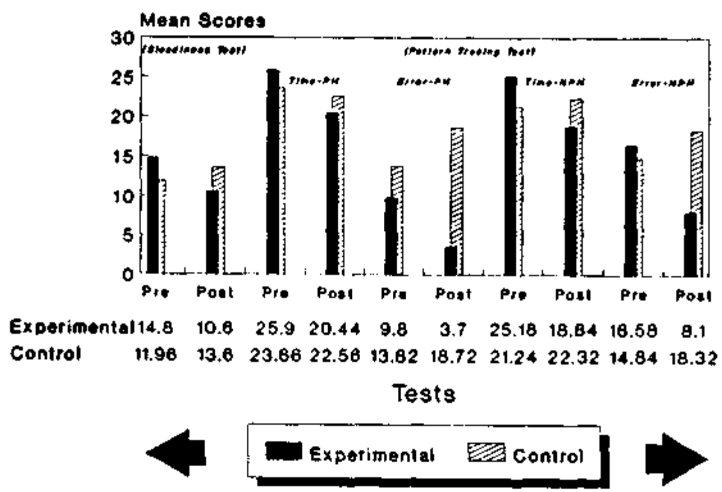
Test	Experimental (Jroup (N; 5) Mean	SD	't'' value	Control Group (N; 5) Mean	SD	''t' value
Finger Dexterity'Test (PH):						
Pretest	334.20	45.17		389.00	80.07	
			2.,51*			0.03
Post test	279.80	17.77		390.60	66.01	
Finger Dexterity Test (NPH)						
Pretest	446.80	58.06		433.60	81.09	
			1.85			0.21
Post test	365.20	38.45		445.00	87.69	
Finger Dexterity Test !BH)						
Pretest	314.20	72.82		287.20	46.32	
			1.65			1.35
Post test	253.60	37.88		318.40	22.90	
Minnesota Rate of Manipulation Test (PH):						
Pretest	90.80	15.07		91.80	11.11	
			1.52			0.35
Post test	77.60	12.29		94.20	10.65	
Minnesota Rate of Manipulation Test (NPH):						
Pretest	98.80	16.50		100.00	12.05	
			1.49			0.73
-Post test	85.00	12.57		105.60	12.29	
Minnesota Rate of Manipulation Test !BH):						
Pretest	68.00	18.82		70.80	9.13	
			0.41			1.75
Post test	63.20	18.53		83.20	12.97	

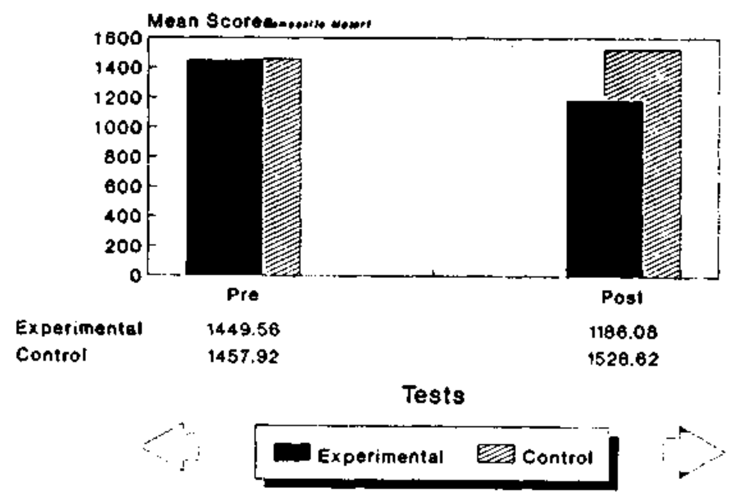
Cont'd

Graph Four.
Comparitive Scores in Motor Domain









Steadiness Test						
Pretest	14.80	3.66		11.96	4.67	
			1.95			0.40
Post test	10.60	3.14		13.60	8.02	
Pattern Tracing Test (Tme-PH):						
Pretest	25.90	8.44		23.66	3.30	
			1.27			0.42
Post test	20.44	4.68		22.56	3.30	
Pattern Tracing Test!Error-PH):						
Pretest	9.80	12.77		13.82	11.21	
			1.03			0.74
Post test	3.70	3.62		18.72	9.64	
Pattern Tracing Test(Time-NPH):						
Pretest	25.18	7.44		21.24	5.29	
			1.60			0.29
Post test	18.84	4.86		22.32	6.36	
Pattern Tracing Test(Error-NPH)						
Pretest	16.58	13.92		14.84	11.84	
			1.26			0.44
Post test	8.10	5.64		18.32	13.07	
Composite Motor:						
Pretest	1449.56	266.23		1457.92	244.77	
			4.38*			1.79
Post test	1186.08	134.02		1526.62	212.61	

t'p:(0.05;"p: (0.01; "'p: (0.001)

However, no statistically significant gains (p; > 0.05) are seen on this test scores in relation to the use of NPH and/or BH for experimental group as well as control group. There are no statistically significant gains (p: > 0.05) from pre to post test scores with use of PH and NPH and/or BH for subjects in experimental group as well as control group on MRMT. There are no statistically significant gains (p: >0.05) from pre to post test scores for subjects in experimental as well as control group on Steadiness Test, Modified. There are no statistically significant gains (p; 7 0.05) from pre to post test scores either in relation to motor speed and/or accuracy, using PH or NPH on PTT, Modified (See Table 83).

From the point of interpretation of test results, it must be clarified that decrease in mean scores of motor domain on FAB or its subtests means a qualitatively improved performance in subjects' motor speed and/or accuracy.

Since the analysis of individual tests in motor domain did not show statistically significant improvement/gains for subjects in experimental group and control group, a composite domain wise analysis was attempted for motor functions on FAB. This was done by taking the mean of individual scores on various subtests. The results show statistically significant gains (p; < 0.05) from pre test scores (N: 5; Mean: 1449.56; SD: 266.23) to post test scores (N; 5; Mean: 1086.08; SD; 134.02) in experimental group as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 1457.92; SD: 244.77) and post test scores (N: 5; Mean: 1526.62; SD:

212.61) in control group for composite motor domain (See Table 83). These results are presented in Graph Four.

III. VISUAL FUNCTIONS

The pre test and post test comparison for visual domain was carried out by averaging scores of subjects within five sub domains, viz., visual matching, visual naming, visual discrimination, visuo-construction and composite visual domain (See Table 84).

The mean post test scores of subjects in experimental group (N: 5; Mean: 124.60; SD: 19.59) show statistically significant gains ($p: < 0.05$) over their pre test scores (N: 5; Mean: 106.50 SD: 28.58) as compared to no such gains ($p: > 0.05$) between mean pre test scores (N: 5; Mean: 103.90; SD: 29.80) and post test scores (N: 5, Mean: 104.40; SD: 32.96) in control group for visual matching functions in FAB (See Table 84).

The mean post test scores of subjects in experimental group (N: 5; Mean: 32.00; SD: 3.54) show statistically significant gains ($p: < 0.05$) over their pre test scores (N: 5; Mean: 27.80; SD: 2.86) as compared to no such gains ($p; > 0.05$) between mean pre test scores (N: 5; Mean: 31.00; SD: 2.24) and post test scores (N: 5; Mean: 31.80; SD: 2.68) in control group for visual naming functions in FAB (See Table 84).

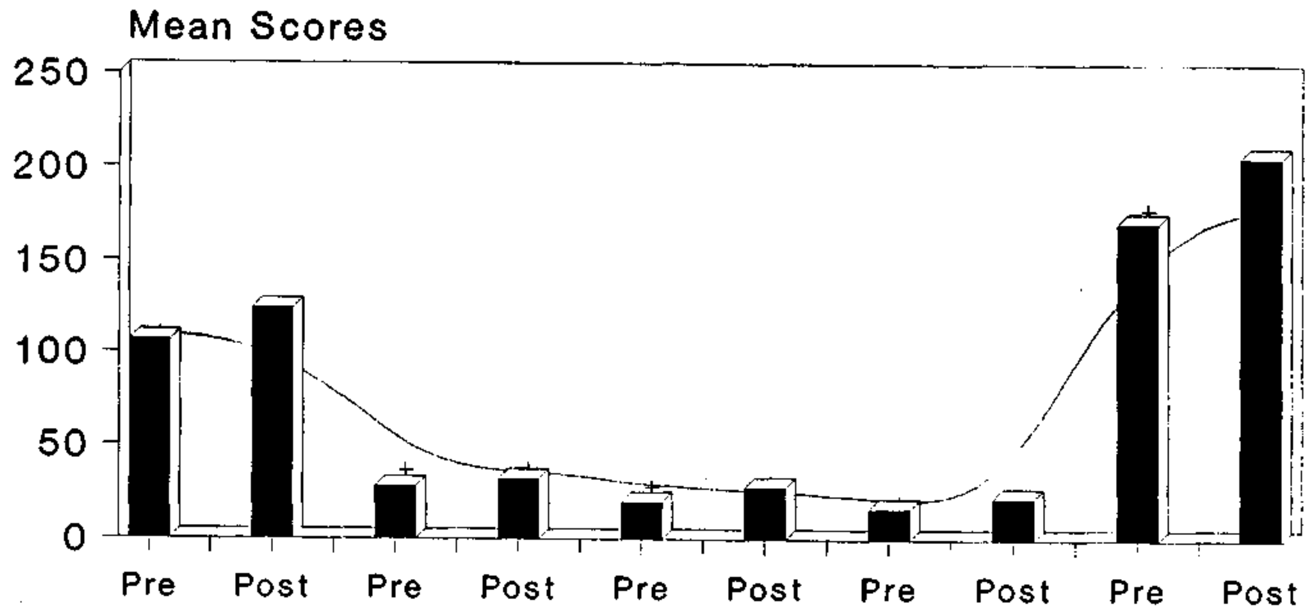
There are statistically significant gains (p: < 0.05) between mean pre test scores (N: 5; Mean: 19.60; SD: 9.50) and post test scores (N: 5; Mean: 27.40; SD: 8.30) for experimental group and between mean pre test scores (N: 5; Mean: 22.40; SD: 7.93) and post test scores (N: 5; Mean: 20.40; SD: 8.44) for control group on visual discrimination function of FAB (See Table 84).

There are statistically no significant gains (p: > 0.05) between the mean pre test scores (N: 5; Mean: 16.40; SD: 11.42) and post test scores (N: 5; Mean: 21.60; SD: 7.44) for experimental group and between mean pre test scores (N: 5; Mean: 14.80; SD: 9.58) and post test scores (N: 5; Mean: 14.80; SD: 8.35) for control group on visuo-construction functions of FAB (See Table 84).

The mean post test scores of subjects in experimental group (N: 5; Mean: 205.60; SD: 29.56) show statistically significant gains (p: 0.05) over their pre test scores (N: 5; Mean: 170.30; SD: 41.15) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 172.10; SD: 47.52) and post test scores (N: 5; Mean: 171.40; SD: 50.39) in control group for composite visual functions of FAB (See Table 84). The results are presented in Graph Five.

Graph Five.

Comparative Scores in Visual Domain



	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Experimental	106.5	124.6	27.8	32	19.6	27.4	16.4	21.6	170.3	205.6
Control	103.9	104.4	31	31.8	22.4	20.4	14.8	14.8	172.1	171.4

Tests

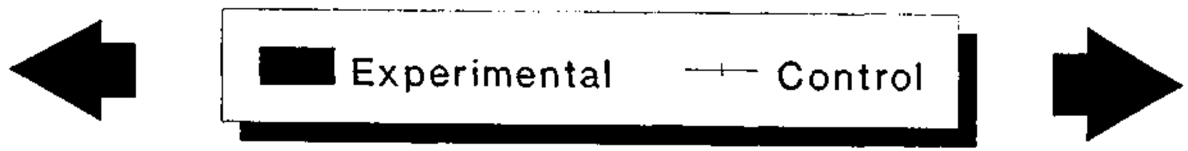
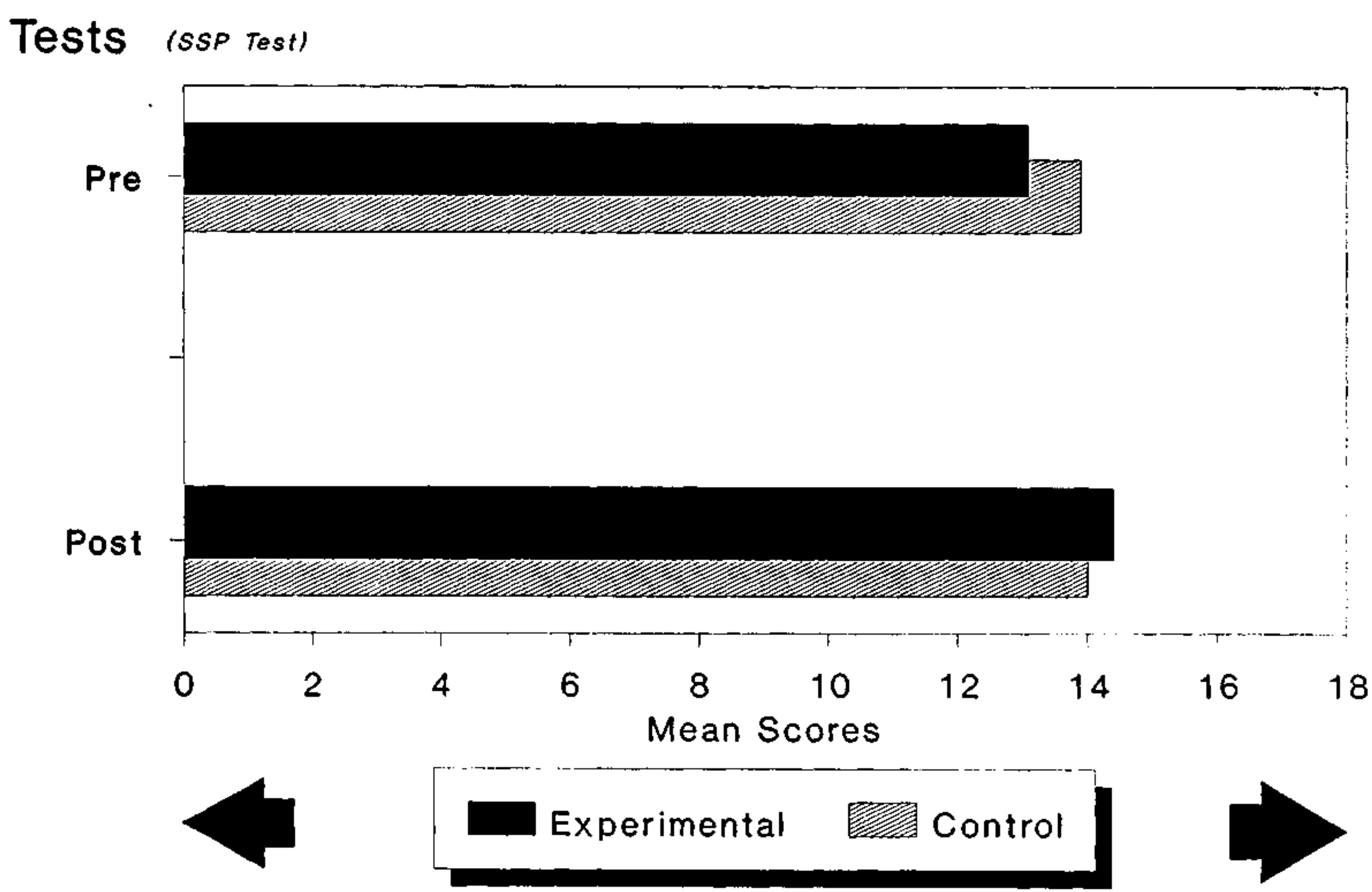


Table 84.
Results on Pre and Post Test Measures of Visual Domain

Test	Experimental Group fN;5)			Control Group (N:5!		
	Mean	SD	't' value	Mean	SD	't' value
Visual Matching:						
Pretest	106.50	28.58	4.38*	103.90	29.80	0.25
Post test	124.60	19059		104.40	32.96	
Visual Naming						
Pretest	27.80	2.86	1.93'	31.0C	2.24	1.37
Post test	32.00	3.54		31.80	2.68	
Visual Discrimination						
Pretest	19.60	9.15	4.55*	22.40	7.93	2.83*
Post test	27.40	8.30		20.40	8.44	
Visuo-Construction:						
Pretest	16.40	11.42	2.29	14.80	9.58	0.00
Post test	21.60	7.44		14.80	8.35	
Composite Visual:						
Pretest	170.30	41.90	5.93"	172.10	47.52	(1.30
Post test	205.60	28.56		171.M	S0.39	

*p:<0.05;"p: <0.01; *"p: <0.001)

Graph Six.
Comparitive Scores in Auditory Domain



IV. AUDITORY FUNCTIONS

The mean post test scores of subjects in experimental group (N: 5; Mean: 14.40; SD: 0.55) show statistically significant gains (p: 0.05) over their pre test scores (N: 5; Mean: 13.10; SD: 1.14) as compared to no such gains (p: > 0.05) between mean pre test scores (N: 5; Mean: 13.90; SD: 1.08) and post test scores (N: 5; Mean: 14.00; SD: 0.71) in control group for sole Sound Syllable Test in auditory domain of FAB (See Table 85). The results are presented in Graph six.

Table 85.
Results on Pre and Post Test Measures of Auditory

Test	Experimental Group (N; 5)			Control Group (N:5)		
	Hean	SD	't' value	Mean	SD	't' value
SSP Test:						
Pretest	13.10	1.14	2.41'	13.90	1,08	0.34
Post test	14.40	0.S5		14.00	0.71	

*p:<0.05;"p: <0.01; ***p:<0.001)

V. MEMORY FUNCTIONS

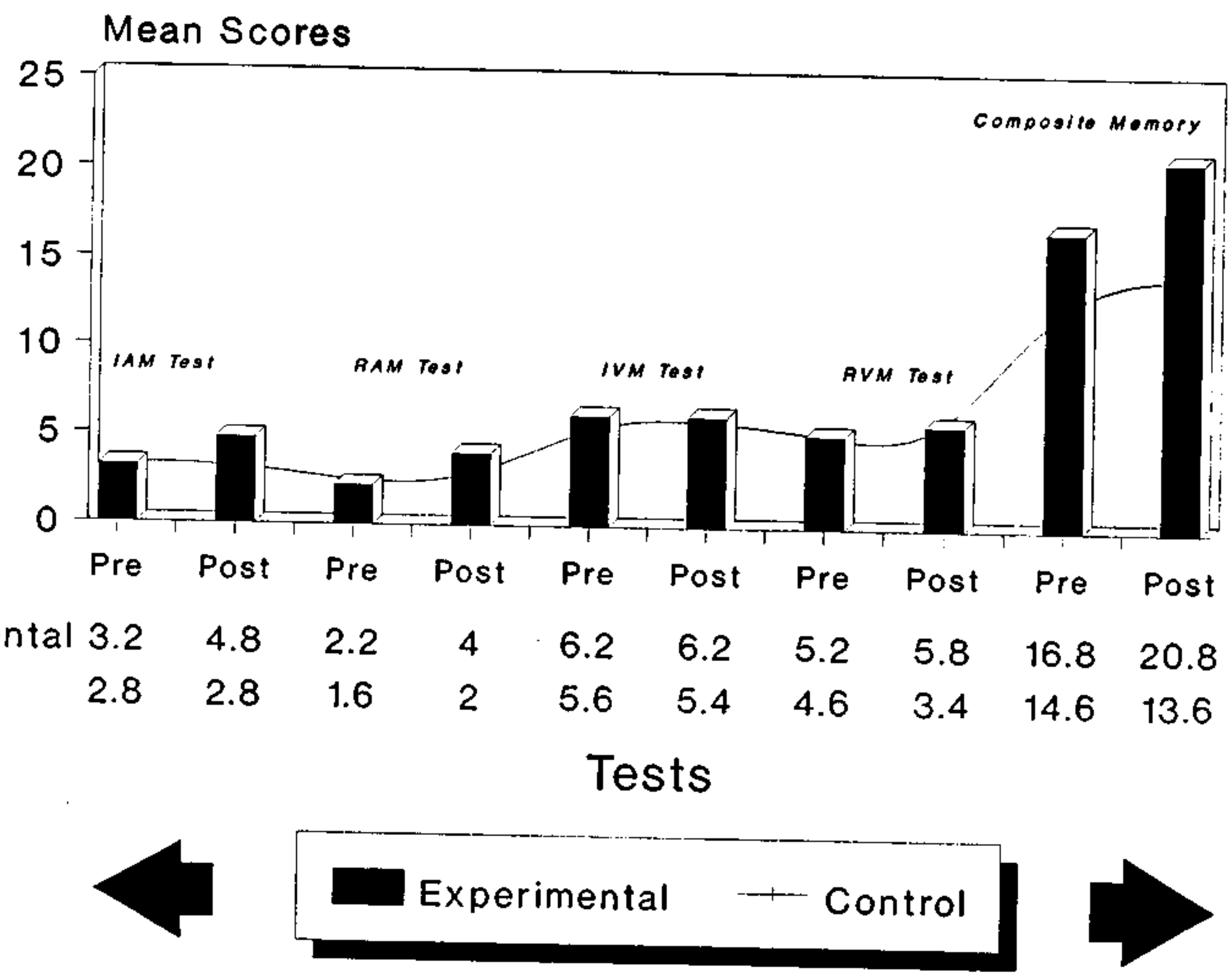
The mean post test scores of subjects in experimental group (N: 5; Mean: 4.80; SD: 0.84) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 3.20; SD: 0.84) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 2.80; SD: 1.48) and post test scores (N: 5; Mean: 2.80; SD: 1.48) in control group for immediate auditory memory functions on FAB (See Table 86).

The mean post test scores of subjects in experimental group (N: 5; Mean: 4.00; SD: 1.73) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 2.20; SD: 2.17) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 1.60; SD: 1.14) and post test scores (N: 5; Mean: 2.00; SD: 1.00) in control group for Recent Auditory Memory functions of FAB (See Table 86).

There are statistically no significant gains (p: 0.05) between mean pre test scores (N: 5; Mean: 6.20; SD: 1.48) and post test scores (N: 5; Mean: 6.20; SD: 1.30) for experimental group as well as between the mean pre test scores (N: 5; Mean: 5.60; SD: 0.89) and post test scores (N: 5; Mean: 5.40; SD: 1.52) for control group on Immediate Visual Memory functions of FAB (See Table 86).

Graph Seven.

Comparitive Scores in Memory Domain



	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Experimental	3.2	4.8	2.2	4	6.2	6.2	5.2	5.8	16.8	20.8
Control	2.8	2.8	1.6	2	5.6	5.4	4.6	3.4	14.6	13.6

Table 86.
Results on Pre and Post Test Measures of Menory Domain

Test	Experimental Group N:5) Mean	SD	't' value	Control Group (N: 5) Mean	SD	't' value
Imediate Auditory Memory:						
Pretest	3.20	0!.84	4.00*	2,.80	1.48	0.00
Post test	4.80	i.84		2,,8C	1.48	
Recent Auditory Memory:						
Pretest	2.20	2.17	4.81"	1,,60	1.14	1.63
Post test	4.00	i.73		2.,00	1.00	
Immediate Visual Memory:						
Pretest	6.20	1.48	0.00	5.60	0.89	0.27
Post test	6.20	1.30		5.40	1.52	
Recent Visua) Memory:						
Pretest	5.20	1.92	2.45*	4.60	1.52	6.00"
Post test	5.80	1.64		3.40	1.14	
Composite Memory:						
Pretest	16.80	3.03	12.65"*	14.60	3.98	0.91
Post test	20.80	2.95		13.60	2.88	

*p:<0.05; "p:<0.01; '"p:<0.001

There are statistically significant gains (p: < 0.05) between mean pre test scores (N: 5; Mean: 5.80; SD: 1.64) and post test scores (N: 5; Mean: 5.20; SD: 1.92) in the experimental group and between mean pre test scores (N: 5;

Mean: 3.40; SD: 1.14) and post test scores (N: 5; Mean: 3.40; SD: 1.14) for control group on recent visual memory functions of FAB (See Table 86).

The mean post test scores of subjects in experimental group (N: 5; Mean: 20.80; SD: 2.95) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 16.80; SD: 3.03) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 14.60; SD: 3.98) and post test scores (N: 5; Mean: 13.60; SD: 2.88) in control group for composite memory functions of FAB (See Table 86). The results are in Graph Seven.

VI. OTHER COGNITIVE FUNCTIONS

The mean post test scores of subjects in experimental group (N: 5; Mean: 5.20; SD: 2.30) show statistically significant gains (p: < 0.05) over their pre test scores (N: 5; Mean: 2.40; SD: 1.59) as compared to no such gains (p; > 0.05) between mean pre test scores (N: 5; Mean: 4.16; SD: 1.93) and post test scores (N: 5; Mean: 4.12; SD: 1.18) in control group for the sole test of Ideational fluency in this domain of FAB (See Table 87). The results are presented in Graph Eight.

Graph Eight
Comparitive Scores in Other Cognitive Functions

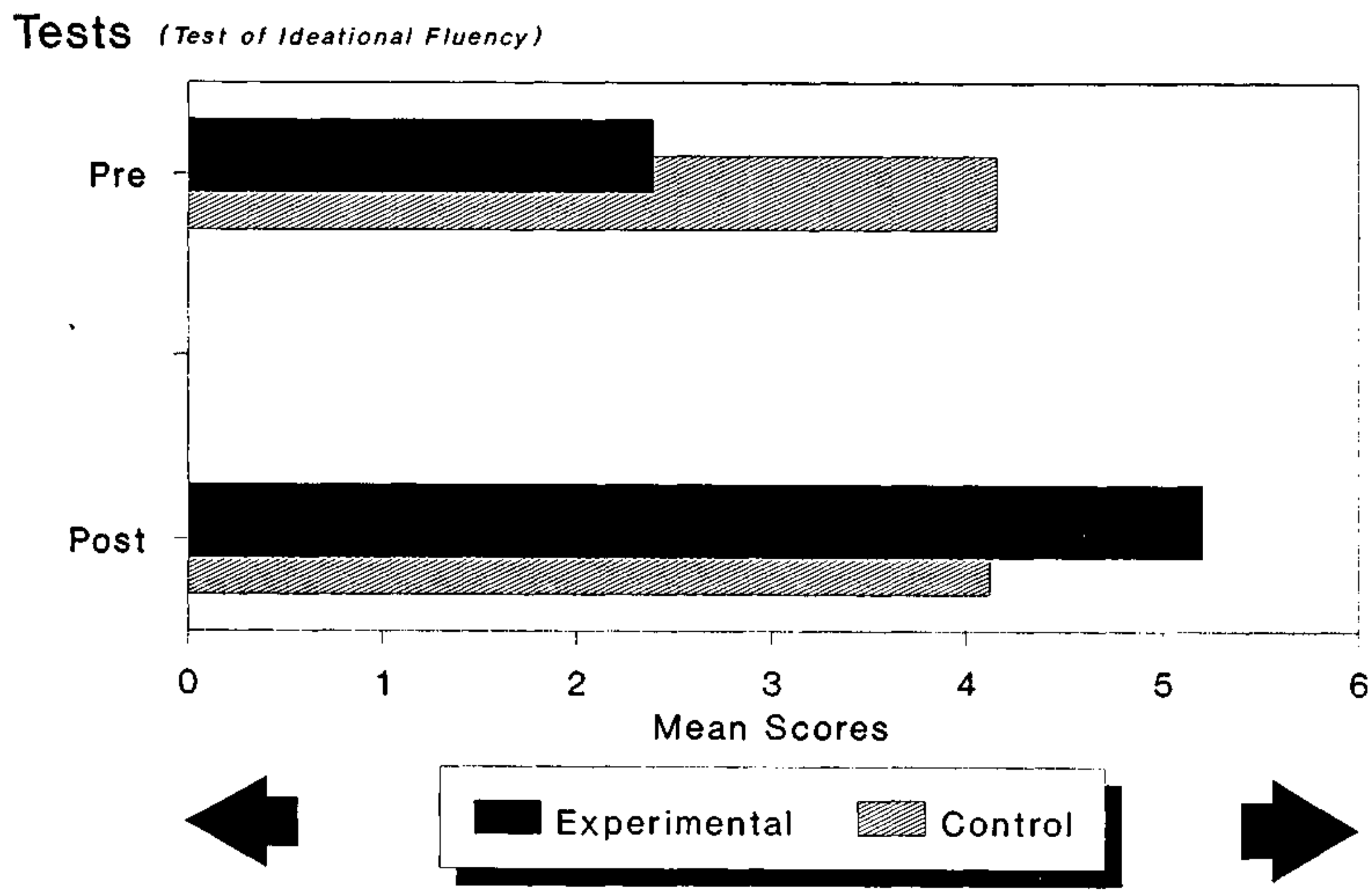


Table 87.
Results on Pre and Post Test Measures of Ideational Fluency

Test	Experimental Group (N;5)			Control Croup (N:5)		
	Mean	SD	't' value	Mean	SD	't' value
Test of Ideational Fluency:						
Pretest	2.4o	1.59	2.94'	4.16	1.93	0,10
Post test	5.20	2.30		4.12	1.18	

*p:<0.05;**p <0.001; ***p;,(00001)

CHAPTER V:

DISCUSSION

Clinical neuropsychology has long ince given up the practice of attributing specific behavioural changes to particular sites or lesions in brain (Teuber, 1964; Benton, 1974; Lurla, 1980). The advent of modem radiological procedures evaporate the need for neurodiagnosis through neuropsychology. Modem clinical neuropsychology treads upon a different path. The recent efforts at neuropsychological assessment aim at clarifying functional brain damage rather than structural brain damage and neurodiagnosis. Therefore, the emphasis is on evaluating the individuals' cognitive, behavioural and psychological strengths or weaknesses (Barth and Mcciocchi, 1985). This shift in focus of neuropsychological assessment has led to its direct use in treatment or rehabilitation of brain damaged individuals (Lezak, 1988).

The specific procedure used in recent neuropsychological assessment strategies for intervention with brain damaged individuals involves the identification of a broad set of brain functions brought into use in the daily lives of these individuals. Thereafter, an idiometric analysis of these identified neuropsychological functions are carried out. A suitable array of neuropsychological tests are then devised specific to the individual or idiosyncratic needs of the population of brain damaged persons under study. These tailor made tests are administered on the given population with enough room for flexibility in selection, administration or interpretation of test performance. A core feature of idiometric approaches to neuropsychological assessment is that they are based on an operational, empirical and atheoretical framework. The battery of neuropsychological tests are built on an atheoretical framework for technical utility rather than for meeting or proving any alleged theoretical system of understanding brain behaviour relationships (Lezak, 1987). The administration of such a battery of tests enables the identification of specific cognitive, behavioural and psychological assets and/or deficits in an individual. The neuropsychological profile pattern of strengths and/or weaknesses of the brain damaged individual then becomes the basis for undertaking specific training or instructional programmes in the identified deficit areas. They even serve as guide to specific instructional modes to be adopted for neuro rehabilitation. Besides, the data generated from such assessments facilitate inter-individual and/or intra individual comparisons over time, with or without intervening training inputs to see if there are any changes in the profile of functional assets/deficits recorded currently. Eventually, if such idiometrically derived tests can be validated against related external criterion, then it can become part of a regular armment of tests for intervention in the given population of individuals with brain damage. This has been the essential spirit behind the conduct of the present study on adults with mental handicap.

Some studies have attempted to use the above mentioned models in bits and pieces on specific populations of brain damaged individuals. For example, isolated research along these lines have been tried on hospitalised chronic schizophrenics (Lewis et al, 1979), jeuvenile delinquents (Vborhees, 1981), alcoholics (Zelazowski et al, 1981), epileptics (Hemann and Melyn, 1985; Berg and Golden, 1986; Dodrill, 1978), old age individuals (Benton, Eslinger and Damasio, 1981), patients with Huntingtons disease (Josiasseh, Curry and Mancall, 1983; Butters et al, 1978), Dementia (Loring and Larger, 1985; Eslinger et al, 1984; Gainott et al, 1980), psychotic disorders (Heaton, Baade and Johnson, 1978), learning disabilities (Oehler-Stinnett et al, 1988; Geary and Gilger, 1984; Nolan, Hemmeke and Barkley, 1983) and others.

The individuals with mental handicap constitute a heterogeneous population of brain damaged individuals with delayed or arrested intellectual development with concurrent deficits in adaptive behaviour and manifesting within the course of their developmental period (Grossman, 1983). The

application of idiometric approaches to neuropsychological assessment of a heterogeneous group of brain damaged individuals, such as, the mentally handicapped, has been meagre if not absent (Lezak, 1983). Indeed, some interest has been evinced in the patterns of neuropsychological functioning for certain syndromal conditions within the mentally retarded or their allied symptoms, such as. Downs syndrome (Reinhart, 1976; Sommers and Starkey, 1977; Zekulin-Hartley, 1978; 1981; 1982; Hartley, 1981; Piope, 1983; Tannock, Kersnner and Oliver, 1984; Ashman, 1982; Elliot, 1985; Harris and Gibson, 1986; Elliott et al, 1987), phenylketonuria (Koff, Boyle and Pueschel, 1977; Brunner, Jordan and Berry, 1983; Pennington et al 1985; Clarke et al, 1987), multiple sclerosis (Benton, 1968; Damasio, 1979; Mastalgia, Black and Collins, 1979; Peyser et al, 1980), hyperactive children (ADHD syndromes) (Conners and Wells, 1986) and others.

However, the essential spirit of these investigations on specific syndromes with associated mental handicaps is still short of a comprehensive model for neuropsychological assessment. Probably, the stage is still premature in this direction. There is a need to explore possibilities for using idiometric approaches to neuropsychological assessment with mentally handicapped individuals, not to localise or lateralise structural brain damage. Indeed, this can be never done since most mental handicap is not a structural disability. Rather, there is scope for idiometric assessments in mental retardation as a developmental, biochemical, genetic, or even, an environmental disability.

Identification of Specific Neuropsychological Functions

The first step in designing a idiometrically based neuropsychological assessment battery for a heterogeneous population of brain damaged individuals, such as, the mentally retarded, involves identification of specific set of cognitive behavioural functions brought into use in the daily lives of these persons. Indeed, the spectrum of neuropsychological functions that come into daily use in the lives of mentally handicapped persons are vast and wide. There can be no unanimity or agreement regarding these specific functions although earlier investigators have broadly classified functional domains for assessment, such as, motor, memory, thinking. sensation. perception. attention-concentration, conceptualisation, imagination, problem solving, etc. Besides, one must recognise the contributions of other behavioural aspects, such as, motivation, interests, aptitudes, emotions, etc.

In spite of these limitations, the present study has been successful in identifying specific cognitive behavioural functions for assessment in adults with mental handicap. The guidelines adopted for inclusion/exclusion of neuropsychological functional categories in the present study were:

1. the identified functions were, by necessity, to be exhaustive enough to cover many areas of daily living;

2. the identified function/s were to be kept psychometrically valid and mutually exclusive, to a lesser or greater degree;

3. no specific function/s were to be unduly dominant or overshadowing on assessment of another function/s;

4. the specific functions were to be empirically existent and operationally definable in more or less clear terms;

5. such functions, which had already standardized tests/tools for assessment, were to be given relatively more preferences in selection than other functions, where new tests/tools were required to be developed;

6. the identified functions, which required tests/tools with specific storage problems or portability difficulties were not preferred and eventually eliminated from the final Battery;

7. a general flexibility in use or administration of selected tests was maintained in the spirit of all idiometric assessments; and,

8. even though specific tests/tools were designed to assess specific neuropsychological functional categories, it is also assumed that there can never be "pure" tests as there can never be "pure" functions.

It is useful think of the selected cognitive behavioural functions as a complex network of interrelated and overlapping interactive
as, motor, visual, memory, etc. For example, the Steadiness Test maybe essentially a test of motor steadiness. However, this does not discount the relative use or interaction of associated functions, such as, attention-concentration, motor fixation, visual fixation, etc., in the successful performance of steadiness test tasks. Besides, it also involves high motivation, interest or favourable mood state for the optimal performance on this test.

The final set of neuropsychological functions included in the pesent Battery is by no means exhaustive but sufficient for a preliminary and exploratary investigation as the present one. Agreebly, there is scope fo inclusion of other funtions, particularly, modality specific-tactile functions and spectfic functions even within the identified and icluded functional domains such as, motor strength and motor sequencing, (in motor domain); visual or auditory scanning (in visual and auditory domains); visual or verbal learnilng (cognitive domain) in a Battery of idiometric tests for adults with mental handicap. An attempt was made in the present study to use these additional measures on a pilot sample of five individuals with mental handicap. But, owing to operational constraints, portability difficulties, cost of equipment or time delays, these measures were eventually eliminated. Possibly, later research in this direction can consider the inclusion of these functional domains.

CONSTRUCTION OF IDIOMETICALLY BASED FAB

After identification of specific neuropsychological functions to be considered for final inclusion in this study, an ideometric analysis was carried out. Ideometric analysis is simply the procedure of splitting or analysis of an identified neuropsychological function into its component sub functions/parts in relation to the specific population needs on whom the tests are intended to be designed (Denizen, 1978). The Ideometric analysis of each functional domains reveal as follows:

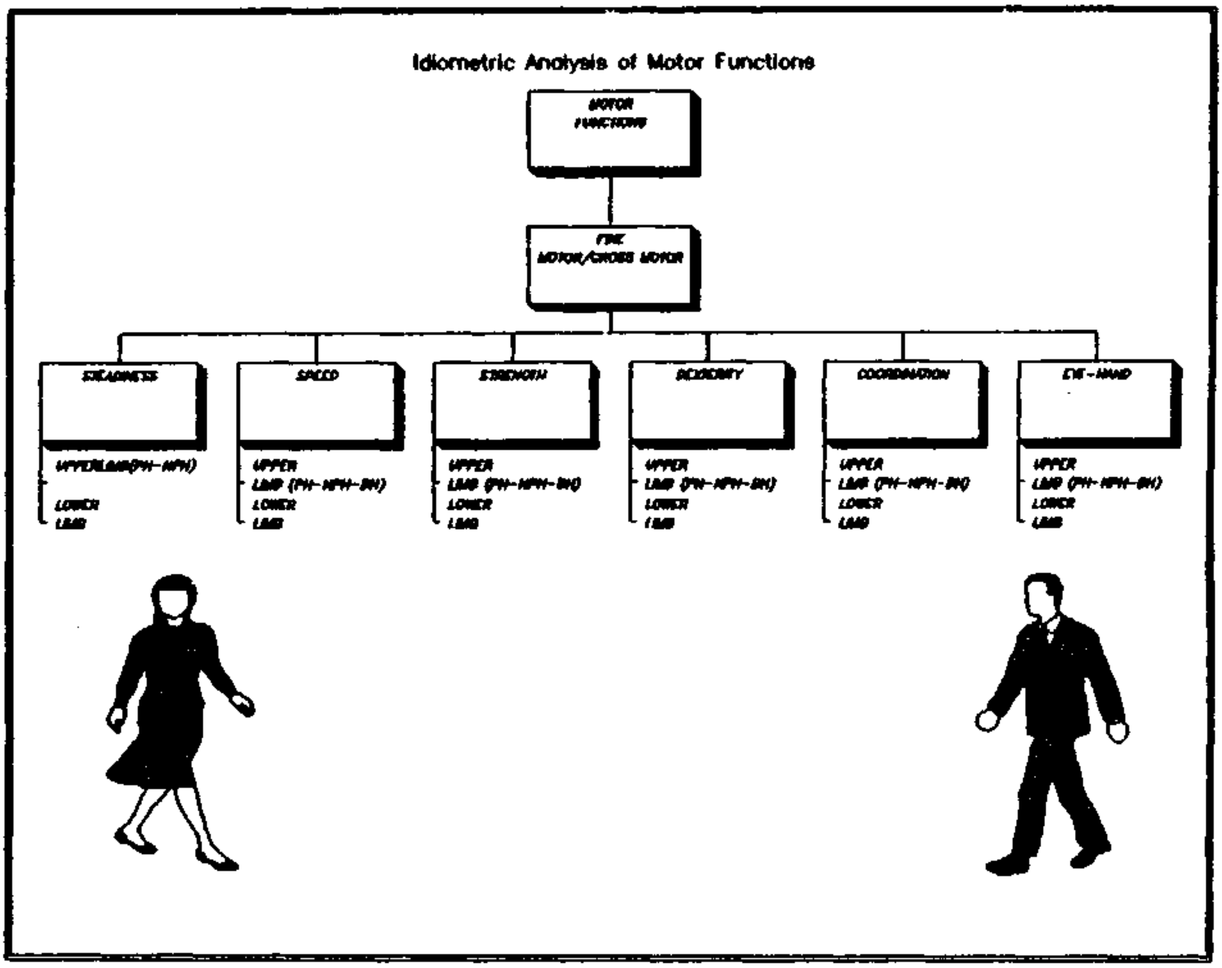
1. Attention-Concentration Domain:

The idiometric analysis of specific functions for attention-concentration can be carried out at various levels to varying degrees of complexity. There can be modality specific: visual, auditory or kinesthetic attention; content specific: verbal or nonverbal attention. Moreover, from the standpoint of neuropsychology, attention can be analysed into various aspects, such as:

1. Arousal of attention;
2. Activation of attention, includes,
    a. Phasic activation or involuntary activation;
    b. Tonic activation or voluntary activation;
3. Habituation
4. Vigilance or shifting of attention
5. Distraction
6. Insight or awareness
7. Span of attention, includes,
    a. Visual span
    b. Auditory span

The present study did not explore all the above mentioned aspects of attention. Rather, a simplistic twin test of attention and concentration was eventually selected for final inclusion in FAB.

FIGURE ONE


Idiometric Analysis of Motor Functions
SPEED
COORDINATION
EYE-HAND
UPPER
LOWER
LIMB

2. Motor Domain:

The ideometric analysis of motor functions involve two broad aspects viz., fine motor and gross motor functions. In the context of their application with mentally handicapped individuals these sub functions can be further analysed into three aspects, viz., motor speed, motor strength, and motor dexterity and motor coordination The cross modal aspects of motor functions, such as, perceptual motor visuo motor functions, etc., were deliberately excluded from the purview of this domain. The sub functions which are not included in the present assessment battery are marked with an asterisk (*) (See Figure One).

3. Visual Domain:

The developmental genesis of visual functions roughly follows a scheme of visual fixation to visual naming functions. A given child may show this function to a lesser or greater degree at any level described in this schema. In the present battery, assessment is restricted only to sub functions such as, visual matching, visual naming, visual discrimination and visuo construction. Even though, during pilot trials an endeavour was made to assess visual location, visual scanning or search and visual identification, these tests were

Figure Two.

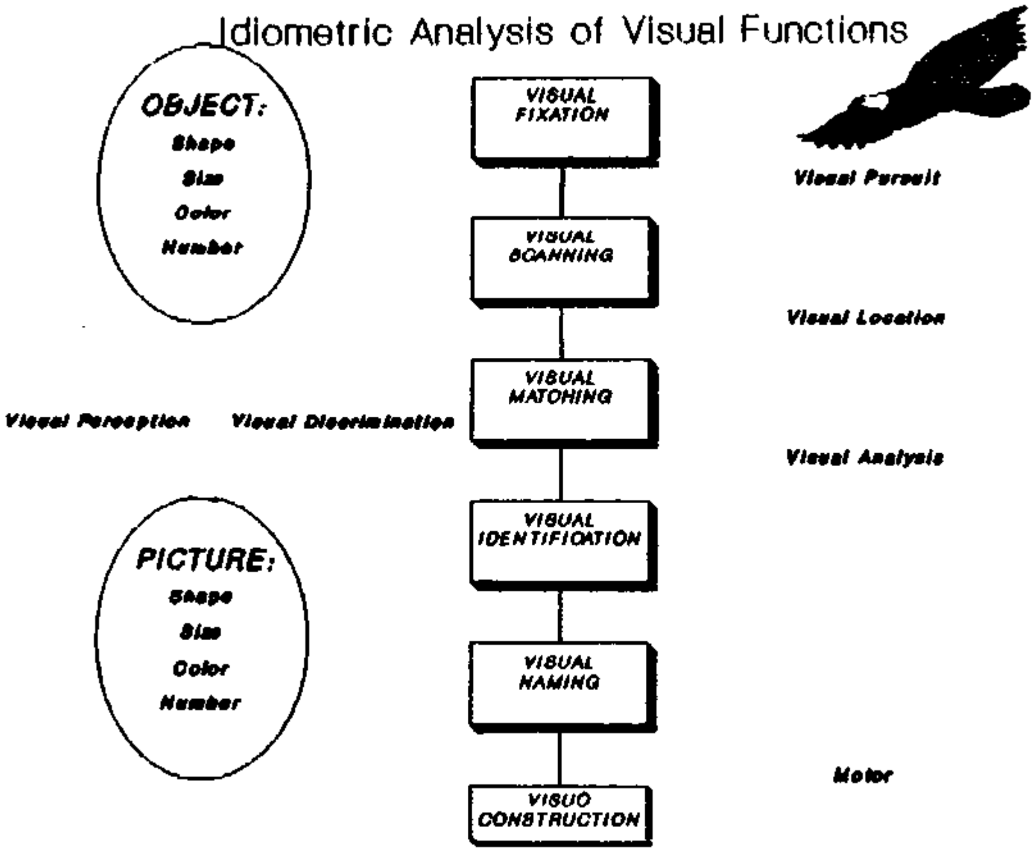
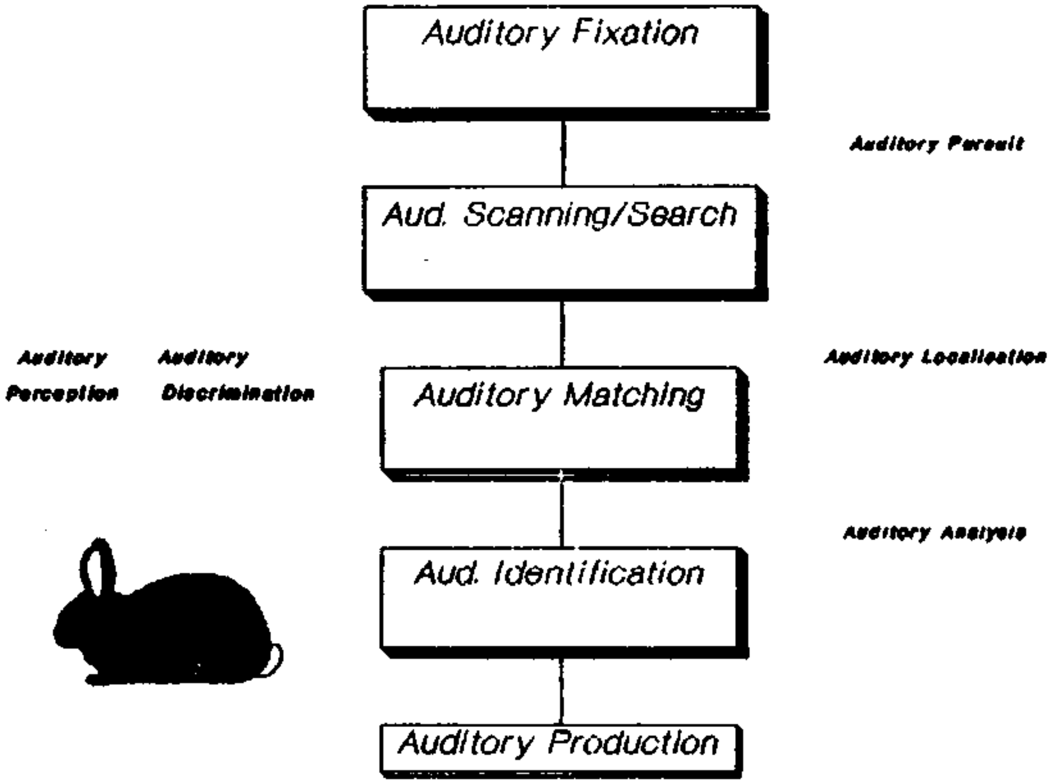

Idiometric Analysis of Visual Functions
OBJECT:
Shape
Size
Color
Number
VISUAL FIXATION
VISUAL SCANNING
VISUAL MATCHING
VISUAL IDENTIFICATION
VISUAL NAMING
VISUO CONSTRUCTION
Visual Pursuit
Visual Location
Visual Analysis
Visual Perception
Visual Discrimination
PICTURE:
Shape
Size
Color
Number
Motor

FIGURE THREE.

Idiomotric Analysis of Auditory Function



abandoned in main study. However, the systematic idicmetric assessment of visual functions (See Figure Two) is important for overall understanding of the neuropsychology of visual functions in individuals with mental handicap. Further, visual functions can be analysed and assessed in terms of content of stimuli or stimulus forms in concrete level/abstract level.

4. Auditory Domain:

The developmental sequence of auditory functions roughly parallels visual functions from the stage of auditory fixation to auditory production (See Figure Three). A given child may show dysfunctions in the auditory domain in any one or more of the shown levels to a lesser or greater degree. Even though, during pilot trials, efforts were made to assess auditory matching (sound rythm test), and auditory discrimination (auditory discrimination test), eventually, they were rejected in the main study.

5. Tactile Domain:

The schema of idiometric analysis of tactile functions (See Figure Four) roughly parallels visual and auditory functions. As in other functions, persons with mental handicap may show neuropsychological

FIGURE FOUR

Idiometric Analysis of Tactile Functions

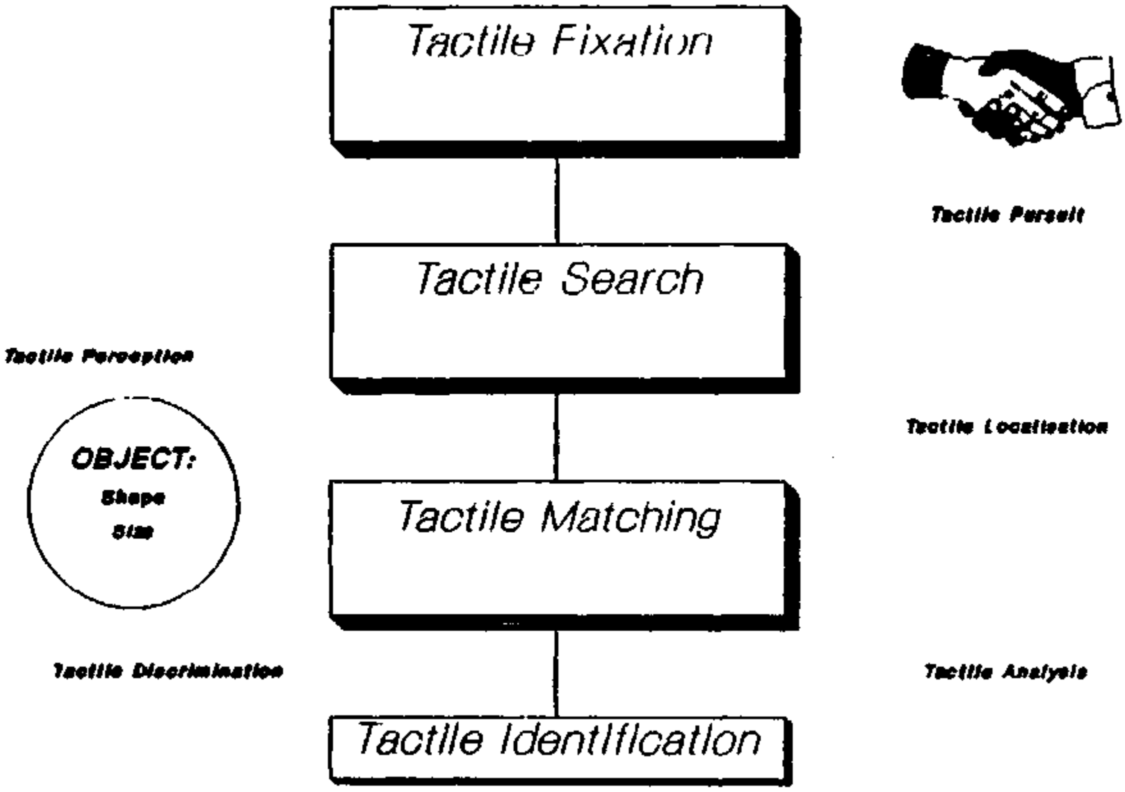
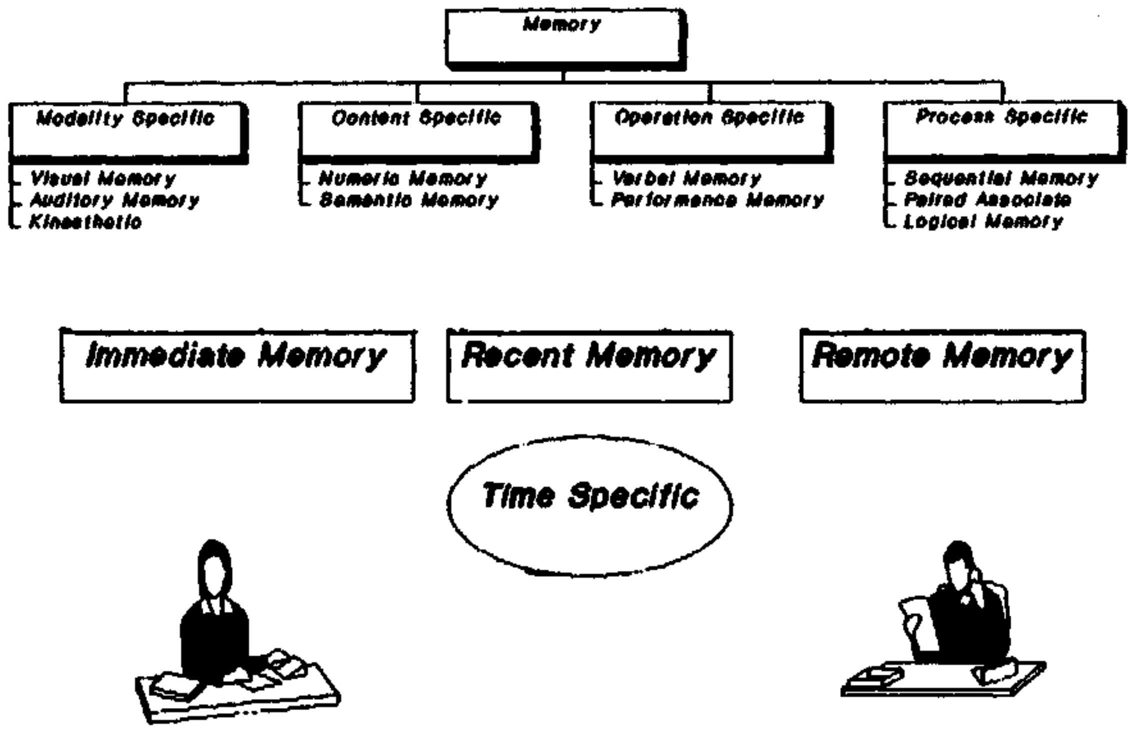


Figure Five.

Idiomotric Analysis of Memory Functions



dysfunctions at any level within tactile domain. During pilot study, specific tactile sub functions, such as, tactile localisation, (test for localisation of tactile sensation), tactile discrimination (two-point threshold), tactile identification (graphesthesia and test of tactile identification) were tried out. But, eventually all these tests were excluded.

6. Memory Domain:

The idiometric analysis of specific functions of memory domain can be, indeed, complex and specific or simple and generic (See Figure). The memory sub functions can be modality specific: visual, auditory, tactile and kinesthetic memory; content specific: numeric, semantic and memory; operation specific: performance and verbal memory; process specific: sequential, paired associate and logical memory, etc. In the present study, a simple 2 x 2 cross modal analysis of memory functions between time specific indices (immediate and recent) and modality specific (visual and auditory) was adopted.

7. Ideational Fluency:

Ideational fluency in itself is a sub function within the broad domain of cognitive functions, and therefore, no analysis is presented herein.

THE MAIN STUDY

The main study involved administration of FAB on a sample of 94 adults with mental handicap. A domain wise discussion of results of main study is given below:

1. Attention-Concentration:

The two subtests included in the FAB under this domain are Knox Cube elmitation Test and Eyesencks Test of Concentration. These tests appear to be appropriate and relevant for the sample under study. Further, males and females with mental handicap show similar or comparable strengths or weaknesses in this function.

Tomporowski (1988) studied sustained attention (concentration) of young adults with mental retardation and those without retardation as assessed on a series of fifty minute tests presented successively on a computer controlled monitor. The target stimuli appeared atleast five per cent of the times during which visual stimuli were presented on the monitor in a random fashion. The results revealed that observers with mental retardation detected significantly fewer target events than non-retarded adults; thereby indicating that mentally retarded adults differ in sustained attention on vigilance tasks that place demands on memory than non-retarded persons. However, vigilance decrement was found to be unrelated to intelligence level.

Green et al (1989) describe observations on a group of children diagnosed as Downs Syndrome. The results reveal that attention deficits are not correlated with mental age or medical diagnosis. There was preponderance of conduct-type disorder and problems of parental control among them.

Mohan (1989) attempted a quantification of differences between mentally retarded, normal and gifted children on simple and choice RT, tapping, backward figure writing, signal detection and fluctuation of attention. The choice RTs clearly showed the effects of intelligence. On psychomotor tasks and tests of vigilance, the gifted performed best, followed by normals and retarded respectively. Non significant differences were observed between the groups on fluctuation of attention.

Tomporowski et al (1990) compared performance of mentally retarded and non-retarded subjects on four, 60 minute visual vigilance tests in which single digits were presented either at a faster or slower rate. The target event was a "skipped" digit. During the tests, the event rate shifted without warning to the alternate event rate after 30 minute vigil. Results show that retarded observers detected fewer targets and made more false alarms than did non-retarded observers in all test conditions. The shifts in event rate influenced the frequency of false alarms made by retarded observers.

Although available research on attention concentration functions in mentally handicapped individuals document their relative inferiority in comparison with normal individuals, the general impression of these findings is that these deficiencies are not accountable to intelligence variables. The present study also highlights the presence of deficits in attention-concentration in adults with mental retardation, even though sex does not appear to be a major differential variable.

Further, the present study highlights the differential influence of training/teaching variables in improving attention-concentration scores for experimental group of mentally retarded subjects exposed to vocational rehabilitation programmes as against no such improvements at all in the unexposed control group (See Graph Three). More research maybe required bo ascertain modality specific preferences in attention-concentration (example, visual attention, auditory attention, etc.) or levels of performance in attention-concentration (example, arousal, activation, habituation, vigilance, etc.) in specific samples or individuals with mental handicap. Such individual preferences/performances may exist within as well as between individuals with mental handicap. If so, curriculum planning and programming must take into account these variables to optimise the limited resources in this population. For that matter, it may require development of an elaborate array of idiometrically based neuropsychological assessment tools to separately assess attention-concentration functions of individuals with mental handicap.

2. Motor:

The quality of motor functioning has long been recognised as a relatively independent measure of neuropsychological functioning that is easily available for observation and is virtually uncontaminated by other cognitive and cultural factors (Scott et al, 1972). Even though studies have attempted to hypothesise different patterns of motor performance/dysfunctions bo structural brain damage, this study attempted to profile only functional patterns of motor performances as follows:

i) Fine Mbtor Dexterity and Speed:

As one might expect, the overall sample shows a better mean performance with PH than with use of NPH. Further, the performance of subjects using BH is better than with use of PH and/or NPH on fine motor speed and dexterity tasks.

When these performances are analysed in relation to sex variable, the results show no significant differences between the two groups. In other words, there is no mean difference between scores of males and females for fine motor tasks.

ii) Gross Motor Speed and Dexterity:

On gross motor speed and dexterity tests, the overall sample shows a better mean with BH followed by use of PH and NPH.

When the performances are analysed in relation to sex variable, it appears that females in this population show no significant difference either in use of PH or BE in the performance of gross motor speed and dexterity tasks. However, there are statistically significant differences in their scores for use of NPH against use of BH in performance of gross motor speed and dexterity tasks. The same differences show up even in the comparison of male vs female performance using NPH on gross motor speed and dexterity tasks. Therefore, these preliminary findings raise further questions:

a) Mentally handicapped individuals show specific patterns of hand preferences;

b) Mentally handicapped individuals must be discouraged from continuously or intermittently using NPH in the performance of gross motor speed and dexterity tasks;

c) The performance on gross motor speed and dexterity tasks weaken further in females using NPH than in their male counterparts;

d) Whereever possible, the subjects must be encouraged to use BE for the quicker performance on gross motor speed and dexterity tasks.

A raised incidence of manifest left handedness among persons with mental retardation was reported long ago of time (Gordon, 1920; Burt, 1937; Hicks and Barton, 1975; Bradshaw etal, 1984).

Gordon (1920) observed 7.3 per cent incidence of manifest ipsilaterality in normal controls against 18.2 per cent incidence of left hand preferences in mentally retarded children.

Wilson and Dolan (1931) used writing hand as criteria for handedness and observed an incidence of 3.7 per cent among normal children as against 11.8 per cent among mentally retarded children.

Burt (1937) used teacher reports to show an incidence of 3.7 % among non-retarded school children and 11.9 per cent among mentally retarded children.

Hicks and Barton (1975) found an incidence of 20.7 % left handed retarded individuals as against 8 per cent within non-retarded population.

Hecaen and Ajuriaguerra (1964) found a relationship between the degree of mental retardation (and, they suggest, probably concomitant brain damage) and the incidence of manifest ipsilaterality within their samples. Among the mildly and moderately retarded groups, the rate of incidence for ipsilaterality is 13 per cent, and among the severely and profoundly retarded groups the rate is 28 per cent. Similar results are reported in a recent study by Bradshaw et al (1984), who found that the rate of right hand preference in mentally retarded individuals varied inversely with their severity.

Gordon (1920) hypothesised that the raised incidence of left handedness in mentally retarded individuals is probably caused by early injury to the dominant (left) hemisphere in persons who otherwise would have developed as natural right handers. He called these cases as "pathological left handers, as contrasting natural right handedness.

Interestingly, there has been eventually no study on whether there exists a "mixed handers" group in mentally retarded individuals. Ambidexterity is seen approximately in about thirty per cent of non retarded population as also an increased incidence of mixed handedness is reported in non-retarded artistic persons (Hauser, De Long and Roseman, 1975; Tsai, 1983; Satz et al, 1978). Soper et al (1987) demonstrated that there exists a significant incidence of mixed handedness in mentally retarded populations, which is of enough neuropsychological significance for later research in this direction.

In this study, 8.5 % of the sample showed left hand preference with a slightly increased prevalence in female sub sample (10.53%) as compared to males (8.00 %) . Although these trends are tentative, they highlight the need for systematic study and regular inclusion of a Laterality Preference Schedule in training or rehabilitation assessment of individuals with mental handicap. From the standpoint of neuropsychology, laterality preference of individuals with mental retardation carries tremendous educational implications. Apart from highlighting patterns of cerebral dominance, laterality preference data can lend to suggestive evidence towards the nature or kinds of processing process in specific individuals or groups of persons with mental handicap. There is, already, accumulated evidence for specific patterns of simultaneous-successive processing strategies in brain systems. It is important to pursue research in these lines to discover the general trends in brain processes of individuals with mental handicap. Further, the development of marker tests bo discover particular processing strategies in these individuals could pave way in the refinement of curriculum content and teaching procedures.

iii).Fine Motor Steadiness:

On this test, performance of females with mental handicap appear to be significantly better than their male counterparts. Does it mean that males with mental handicap show better fine motor steadiness than their male counterparts?

It is is interesting to collate results or trends on steadiness tests alongwith the performance of the subjects on PIT, Modified. This test examines fine motor steadiness in combination with eye hand motor pursuit and coordination. On PTT, the results show additionally that male subjects take more time and commit less errors on fine motor steadiness and coordination tasks than the females with mental handicap, who take less time and commit more errors in these tasks. Thus, the trends imply:

a) Females with mental handicap show better motor steadiness in tasks without additional involvement of motor pursuit and/or coordination?

b) Males with mental handicap show better motor steadiness on tasks with additional involvement of motor pursuit and/or coordination?

Holland (1987) compared motor skill performances of non-handicapped and educable mentally handicapped students. Their results showed that non-handicapped students performed significantly better than educable mentally handicapped students on each of the seven assessed motor skills. A further analysis demonstrated that performances of non-handicapped and educable mentally handicapped students improved with age, and when gender differences were present, the differences were in favour of male students.

In this study, while performance of mentally handicapped subjects fail to show statistically significant improvements on individual tests within motor domain of EAB, both, for experimental as well as control group; the composite motor scores register statistically significant improvements for experimental group of subjects exposed to training inputs than individuals in control group (See Graph 4). Therefore, continuous stimulation of mentally handicapped subjects within a work situation can, indeed, facilitate gains in motor functions of these individuals. The study also highlights the presence of wide inter-individual differences in motor functioning of individuals with mental handicap. Therefore, it calls for an individual based idiometric evaluation of each case before planning specific instructional targets or procedures in this population of individuals.

3. Visual:

i) Visual Matching Functions:

On these tests there is a trend towards higher scores (almost to the ceiling), especially in object and picture matching functions. This may be because, indeed, these functions are quite easy and long acquired before adulthood. It maybe well to consider elimination of these subtests. Instead, their presence maybe suitable especially if a similar battery is to be worked out for children with mental handicaps. All the other sub-tests within the visual matching domain appear to be appropriate and relevant to adults with mental handicap.

Further, there is no statistically significance difference between the performance of males and females with mental handicap in this sample on all sub-tests of visual matching. In other words, males as well as females with mental handicap show comparable and similar strengths or weaknesses on visual matching functions.

McCartney (1987) compared long term recognition for faces (visual recognition task) in a group of mentally retarded and non-retarded teenagers. The subjects initially viewed 255 face pictures with multiple exposures in order to equate immediate memory for a portion of data in the groups. A sample of subjects were then tested immediately and after one day and one week using a forced choice method. The retarded subjects performed at a overall lower level than did the non-retarded subjects. There were significant memory losses in both the groups. A six-month follow up retention test revealed no further memory disturbances. Thus, the results suggest that long term memory for faces is unrelated to intelligence levels. It is vital to study the interaction effects of different sensory modalities too.

Botuck (1987) attempted to study auditory-visual information equivalence in a group of mentally retarded and non-retarded age equal students on intra sensory and inter sensory tasks. The intellectually average subjects were more accurate on, both, intra sensory and inter sensory tasks. However, tasks involving transposition were more difficult for retarded children than those not involving transposition. However, there was no association between IQ and intra or inter sensory performance when data from the two groups were examined separately.

In another study, Crawford and Siegel (1982) asked mentally retarded children to match a series of visual stimuli against a standard (visual matching tasks). With each judgement, the investigator verbalised "right" or "wrong" and provided full feedback of particulars indicating with gesture and words the similarities and differences that supported each correct and each incorrect judgement. Control subjects were either given no training or were asked to make judgments but given no feedback. Attesting to the efficiency of training procedures, the trained subjects exhibited total intradimensional transfer as against no such changes in control subjects.

The accuracy of non-retarded persons in shape matching within and across vision and touch improves with development, and matching by eye is usually better than is matching by hand. This pattern is less clear with mentally retarded children. In a study, Davidson, Pine and Wales-Kettenmann (1980) compared haptic and visual matching of retarded and non-retarded children at different developmental levels, while systematically observing variables known to have developmentally linked effects on task accuracy, including stimulus complexity and haptic exploratory search style. The results showed that accuracy depended on both stimulus complexity, modality and mental age, regardless of whether or not children were retarded. The selection of haptic search styles also depended or these factors but, in addition, was influenced by intellectual status of the children. The replication of these results in our setting can be considered if the rejected tests in tactile domain of prepilot version of faB are considered for use by later research. If their results succeed in throwing up modality specific preferences for tactile, rather than visual or auditory functions, teaching procedures may require appropriate modifications thereof.

b. Visual Naming:

All sub-tests in this domain appear to be appropriate and relevant for this sample of adults with mental handicap although there is a tendency towards upper ceiling effects on object naming functions. Further males and females with mental handicap in this sample show comparable or similar strengths or weaknesses in visual naming functions.

Baroody (1986) examined basic counting competencies difficulties, skill progressions and variations in two groups of children classified as moderately mentally handicapped and mildly mentally handicapped. All subjects were administered individually structured interviews. A qualitative and quantitative analysed of the children's performances indicated deficiencies in basic counting competencies, as well as errors in systematic oral and object counting. Moreover, object counting competence preceded automatic pattern recognition (for written numbers). The results showed that basic counting knowledge, which is acquired before schooling itself in most typical children cannot be taken for granted in mentally handicapped children of school age. Further, error analysis of performance by subjects provided clues to oral and object counting difficulties and direction for remediation. Finally, the study reveals striking individual differences in counting performance even within so called "homogeneous" groups of mild and moderately handicapped children, thereby suggesting that instructional planning should not be based on generic labels, but the identification of specific strengths and weaknesses in a child. In a related study, Venkatesan and Vepuri (1992) highlight the prerequiirement for rudimentary "premath" skills, such as, numeration (including, number matching, number discrimination, knowledge of sets), number concepts (including, rote recitation, one-to-one correspondence) and number usage (including, matching printed numbers, ordinals, digit reversals) etc., before computational arithmetic skills are introduced to children.

Caycho et al (1991) attempted to understand one-to-one stable order and cardinal order through error detection and self-performance counting tasks in children with Downs Syndrome and matched non-retarded controls. The results support the view that counting by children with Downs Syndrome can be guided by counting principles and that developmental levels, rather than the syndrome, is associated with counting behaviours.

Baroody (1988) undertook a training experiment to determine the ability of mentally handicapped children to learn ordinal positions of numbers. After a pretest, subjects were randomly assigned to an experimental and control group. For both immediate and delayed post tests, the experimental group significantly outperformed the subjects in control group on trained number pairs. A modest amount of transfer who also evident.

iii) Visual Discrimination:

All subtests in this domain appear to be appropriate and relevant for this sample of adults with mental handicap. There is statistically significant difference between performance of males and females with mental handicap in this sample on picture discrimination tasks. In other words, females in this sample have shown inferior picture discrimination than their male counterparts.

Meador (1984) investigated the effects of color on visual discrimination of symbols by severely and profoundly mentally retarded individuals. Discrimination training with colors reliably associated with the background of symbols failed to transfer to those same symbols on black backgrounds. However, discrimination training with randomly colored symbols transferred to the same symbols in black. Transfer performance after training with randomly colored symbols was higher than was discriminative responding after identical training with black symbols.

Deb (1987) assessed specific psychological functions, such as, gustatory discrimination, height and weight judgments, height and length discrimination. The results show that severely mentally retarded persons are more deficient in sensory acquisition and discrimination than those at slightly higher levels of intelligence. The study postulates that intellectual level is an important factor in discrimination judgments.

iv) Visuo Construction:

All these subtests in this domain are found to be appropriate and relevant for the sample under study. Further, males as well as females with mental handicap in this sample show comparable or similar strengths or weakness in visuo construction tasks.

In this study, while subjects in experimental group as well as control group (i.e., those who were exposed to a training programme and those who were not exposed to such a programme) show statistically significant changes in their visual discrimination scores, there was a positive change towards improved functioning in subjects of experimental group as there is negative change towards deterioration for subjects in control group. Similarly, there was improvement in mean score performances of subjects in experimental group, rather than subjects in control group, for visuo-construction functions. However, these score improvements in the experimental group was not found to be statistically significant (See Graph 5). The overall composite mean visual function scores of mentally handicapped subjects in experimental group registered statistically significant improvements as compared to no such changes in control group. Thus, the differential effects of training variables in improvement of neuropsychological visual functions of mentally handicapped subjects is clearly demonstrated in this study.

4. Auditory:

On Sound Syllable Production Test included under this domain of FAB, a tendency towards upper ceiling effect is observed. The possibility of additional tests to assess other auditory functions must be considered in further revisions of FAB. However, males as well as females with mental handicap in this sample show comparable or similar strengths/weaknesses in auditory functions.

An important aspect of language functions is auditory sentence processing. Merrill and Mar (1987) compared performance of mentally

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retarded adolescents and MA matched children on sentence/picture verification tasks in order to study auditory sentence processing functions Their results indicated that mentally retarded and non-retarded individuals differ in the speed with which they execute semantic analytic processes, but not necessarily in the phonological encoding processes within language comprehension functions.

Although most Prader Willi Syndrome children perform in the mentally retarded ranges on Standardised IQ tests, it is not known if their cognitive impairments are global in nature or whether they exhibit a particular pattern of strengths and weaknesses in their psychological capacities. This question was examined on a cohort of children with Prader Willi Syndrome by administering a battery of neuropsychological tests (Galiel, 1986). The results indicated that severe deficits are seen in tasks that involved information processing using auditory modality in these children.

Winters et al (1986) compared the production frequency of exemplars between mentally retarded and non-retarded chid adults. The production frequency of exemplars by retarded and non-retarded persons were remarkably similar and varied more as a function of specific category than of mental development. There were a striking similarities in the structure of semantic memory of retarded and non-retarded persons.

Kernan, Salesay and Shinn (1989) tried to elicit the criteria lay people use in judging whether speakers are mentally retarded or not retarded on the basis of speech samples. Two distinct patterns were discerned. In judging speakers as "mentally retarded", a single feature of voice, speech or discourse evaluated as "poor" was cited in majority of the cases. In judging speakers as 'non-retarded', judges invoked multiple reasons in the majority of cases. Some features of voice of speech was the most important single factor incorrect identification of mentally retarded speakers.

In view of these findings, it appears that sound syllable production can become an important component of neuropsychological auditory/language functions in mentally handicapped individuals. Even though auditory reproduction cannot be the sole deficit in these persons, it suggests that speech training needs to necessarily focus on articulation problems seen so frequently in mentally handicapped individuals (Rao and Srinivas, 1990) in comparison with other speech difficulties, such as, dysfluencies. blendings, etc.

5. Memory:

The results of this study indicate a general preference or superiority in the use of memory through auditory than visual mode in this sample. The mean scores of subjects for immediate as well as recent auditory memory tasks are consistently higher than mean scores for immediate or recent visual memory tasks. However, males as well as females with mental handicap in this sample show comparable/similar strengths /weaknesses in all memory functions.

Katz and Ellis (1991) compared performance of a group of college students against mild and moderately retarded persons on item memory and memory for spatial location. The specific test items included semantic as well as non-semantic picture tasks presented from a large book. The subjects were required to recall and relocate test items immediately following presentation of stimuli as well as twenty four hours later (delayed memory). The results showed that mildly retarded persons were deficient in memory for items (semantic memory), but not in memory for location (automatic processing). Moderately retarded persons were deficient in both types of memory. Additionally, there were 1Q related differences in the long term (delayed) memory of location information as well as memory for items (semantic memory)*.

Location memory, as opposed to item memory, was found to be (a) encoding instruction; (b) insensitive to differences in lQs; and, (c) more sensitive to long term forget fulness.

Negro and Roak (1987) compared performance of mentally retarded and non-retarded adults to recall tasks involving spatial location (automatic encoding) and memory for items (semantic memory). The results showed that retarded and non-retarded adults differ in recall of objects/items, but not in recall of spatial location. The findings support evidence that automatic procesing/encoding of spatial location is an area of strength in retarded persons (Hasher and Zacks, 1979).

Varnhagen (1987) examined auditory and visual memory span for letters and component memory processes in a group of trainable mentally retarded adults with Downs Syndrome. The specific memory tasks included long term memory for semantic content (labels) as well as semantic segmental memory. The results indicated poor auditory memory span compared to visual memory span in the Downs Syndrome group. These subjects showed defects in long term as well as short term storage and retrieval of lexical auditory tasks.

Hornstein and Mosley (1987) presented verbal (2 letter words) as well as non-verbal (polygons) stimuli tachistoscopically to groups of ten equal CA matched and ten equal MA matched retarded and non-retarded subjects. A visual masking paradigm involving "monoptic masking", "dichoptic masking" and "varying stimulus onset asynchrony" (SOA) was employed. The mildly retarded subjects were found to be most effective in monoptic mask, followed by dichoptic mask and least effective in varying SOA task.

Barack and Zigler (1990) compared groups of organically mentally retarded, familial retarded and non-retarded subjects on two tasks of intentional memory and one of incidental memory. With covariance of mental ages, the familial group did much better than the organic group on both tasks of intentional memory. However, the performance of both retarded groups was inferior to that of non-retarded children. These findings support the view that etiology (organic or familial retardation) must be considered when studying cognitive functions in mentally retarded persons.

Bowler et al (1990) tested short term recall of lists of four sign and four word labels by severely handicapped children. The results show that the subjects were more efficient at processing words rather than signs in short term memory. The organisation of sign and word lists are affected by the degree for which the material had to be held in short term storage.

Merrill (1990) used cued recall procedures to assess the nature of memory representation underlying the ability of mentally retarded and non-retarded individuals to remember single sentences. Two groups of mentally retarded subjects, viz., MA matched and CA matched, listened to a list of sentences following which their ability to recall object noun of the sentence was assessed under three conditions, viz., (a) when cues of only the subject noun of the original sentence was given; (b) when cues of only verb of the original sentence was given; or (c) when cues of the subject as well as verb was given. As expected, the performance of all the groups was best when both the subject as well as verb cues were given. However, the groups differed in the magnitude of this two-word cue advantage, with the retarded subjects exhibiting smallest advantage, and the equal CA group exhibiting largest advantage.

Winters and Semchuk (1986) studied three groups of non-retarded children, adolescents and mentally retarded adolescents to compare their relative performances on tasks involving retrieval of words from long term store. For uncategorised items, the retarded group exhibited more intermittent forgetting than did the non-retarded groups. But all the groups were similar in reminiscence, spontaneous recovery and subjective organisation of the lists. For categorised items, all the groups were similar.

Marcell (1988) attempted to determine if the failure of Downs Syndrome individuals to show the modality effect as due to the verbal expressive demands of oral responding in memory tasks. Downs Syndrome non-retarded and non-Downs Syndrome mentally retarded subjects listened to or looked at increasingly long sequences of digits and attempted to recall them orally or manually (through placement of items). Analysis suggested that manual responding failed to enhance auditory recall in either Downs Syndrome or any other subjects. Further, the difficulty in recalled auditory stimuli was greatest for Downs Syndrome mentally retarded subjects.

Phillips and Netteibeck (1984) compared performance of mildly mentally retarded adults on recognition memory tasks with that of non-retarded control subjects. The material to be remembered was presented in a fixed set procedure, during which subjects were tested repeatedly on the same well learned set of material; and a varied set procedure, during which they were tested only on a memory set once before having to learn a new set. Mean reaction times in all groups increased linearly as the number of items in the fixed memorised set increased. But, "no" reaction times of retarded adults tested under the varied set procedure show this pattern. There was a gradation of slopes for the linear regression functions of reaction time on memory set size in both procedures, from less steep for non-handicapped adults to increasingly steep values for non-retarded children and retarded adults. These results suggest that retarded adults use different processing strategies in the two procedures and that the rate of processing increases as a function of mental age.

In a related study, Phillips and Nettelbeck (1984) investigated the effects of practice on recognition memory of mildly mentally retarded adults. A similar fixed-set and varied-set procedures, as mentioned above, was used. Since performance of only retarded subjects had not reached asymptote, they were provided additional practice at the same task (varied - set procedures only). After extended practice, the slopes in the retarded group were found to reach those in the non-retarded groups. Therefore, although the generally poorer performance of retarded adults in this task may reflect same structural impairment, the initial level of deficiency is reduced by practice.

Gutowsik and Chechine (1987), assessed the relative importance of encoding, storage and retrieval processes to overall short-term and long-term memory deficits of mildly mentally retarded adults in a continuous paved - associate task. The basic analysis revealed deficits in each process, with storage as the most important and encoding as the least important at all retention intervals. Additional analysis showed that retrieval deficits are present in both short and long term retention, but that storage deficits are primarily short-term in nature. The overall pattern of results suggest that short term storage is the most likely locus of structurally leased limitations of mildly retarded adults.

6. Other Cognitive Functions:

Therefore, to recapitulate, the collection of these studies reveal the following trends:

1. Neuropsychological performance of mentally handicapped subjects on memory functions is probably influenced by their mental ages/severity of handicap;

2. Mentally handicapped subjects show greater difficulties in short term storage and retrieval of stimuli than long term storage and

retrieval. This appears to be particularly true for recognition memory tasks and memory for spatial location.

3. Downs syndrome subjects appear to show poor auditory memory than visual memory, which seems to be somewhat in contrast to the trends derived from non-Downs Syndrome subjects included in this study.

4. There are differential effects in using various memory storage and/or retrieval strategies in mentally handicapped subjects and their non retarded same aged peers.

These above mentioned observations from an assortment of empirical investigations related to memory functions in mentally handicapped individuals do not claim to be exhaustive appraisal of the discussed phenomena. Rather, these sample studies are only presented to highlight the need for more comprehensive researches on memory functions in mentally handicapped subjects.

However, in this study, it is gratifying to note that memory functions in mentally retarded individuals can be influenced by intervening effects of training or rehabilitation as evidenced by increase in memory scores on FAB for experimental group with no concurrent improvements in the same for control group (See Graph Seven).

Bowler (1991) reports an experiment in which eight severely handicapped children were taught to rehearse lists of five manual sign labels or five word labels during the delay periods of a short term free recall task. results showed the rehearsal training had an overall facilitatory effect on recall, which was more pronounced for signs than words. A three week follow up showed that the differential facilitatory effect for signs was maintained. The findings are discussed in the context of using signs in educational settings.

The test of ideational fluency is the only test included under this head in FAB. This test appears to be appropriate and relevant for the sample under study. Further, males as well as females with mental handicap show similar or comparable strengths or weaknesses in this function.

Even though the general trends in the performance of mentally handicapped adults with their sub samples on FAB have been highlighted it is important to restrain from generalising these findings to larger population of persons with mental handicap. There are many reasons for this refrain:

1. It is not the primary intention, spirit nor the purpose of idiometric approaches to functional assessment to provide normative or nomothetic comparisons;

2. Normative comparisons from data derived primarily from idiometric sources can prove erroneous or fallacious in the context of larger population and the various uncontrolled variables therein;

3. Idiometric assessments are executed for specific individuals or target groups of individuals per se. Any comparison should be made within that individual or group under consideration.

However, the main study utilising idiometric strategies has demonstrated that there is a possibility of:

1. arriving at inductive hypothesis on profile patterns of neuropsychological functions in specific individuals or groups of individuals with mental handicap;

2. identifying specific areas of neuropsychological functional deficits in a give individual or groups of individuals with mental handicap;

3. comparing two or more individuals on the neuropsychological profiles of assets and/or deficits in adults with mental handicap;

4. comparing same individual or groups of individuals on the profile of neuropsychological assets/deficits over time;

5. evolving tailor made curriculum or teaching programme suitable for each individual or groups of individuals with mental handicap based on the idiosyncratic structure or content of their profile of neuropsychological assets and/or deficits;

6. evolving tailor made teaching or training modes suitable for each individual or groups of individuals with mental handicap, based on their unique structure, content or modes of their profiles of neuropsychological assets and/or deficits respectively (Venkatesan and Reddy, 1990).

EXTERNAL VALUATION OF FAB

The exercise towards external validation of FAB against a tentatively developed WBRS for use by vocational instructors has been fruitful. The results have shown statistically significant degree of positive correlation between scores on FAB and the perceived ratings of vocational instructors on WBRS for the subsample (N: 34) of adults with mental handicap.

Besides, there is intra domain validity too specifically for memory scores on FAB and the perceived ratings for memory items alone on WBRS by the instructors. Therefore, the results of validation exercises confirm FAB as a useful and valid instrument for functional assessment of adults with mental handicap. Incidentally, the data also highlights the need to conduct more detailed research on work behaviours in adults with mental handicap. Admittedly, the primary objective of this study was to validate FAB and not WBRS (Venkatesan and Reddy, 1991).

SENSITIVITY OF FAB

It is important not only to show that the FAB is a valid tool for regular use during the pre training assessment of mentally handicapped adults; but also, to demonstrate its sensitivity to changes in the assessed neuropsychological functions over time, particularly, after training. This is also an indirect way of validating FAB.

A group pre test post test intervention design was used to demonstrate the sensitivity of FAB on a sub sample of five adults with mental handicap. The subjects in experimental group as well as control group were matched and similar in their mean pre test scores for all the assessed domains on FAB.

Thereafter, experimental group alone was exposed to a six month general vocational training course at a day care centre for rehabilitation of adults with mental handicap. The post test assessment of subjects in experimental as well as control group on the FAB shows significant gains in almost all the assessed functions for the exposed group while there are no changes (sometimes even losses) in the non exposed group respectively. These results imply that.

1. the training course at Vocational Rehabilitation Centre has been beneficial to subjects in experimental group;

2. the lack of any systematic training exposure to subjects in control group has adversely decreased or reduced their profile of neuropsychological assets during intervention phase;

3. the functional assessment battery has been indeed, sensitive to detect neuropsychological functional gains over time in a group of persons with mental handicap exposed to a systematic training programme (Venkatesan and Reddy, 1992).

Reiser et al (1987) attempted to study the sensitivity of mentally retarded and non-retarded adults to changes in visual perspective, especially when these changes are occluded from the view of the subject. This sensitivity was tested by adopting a procedure of staring subjects at a target object located in one room of an unfamiliar office building. The subjects were then walked via a circular path into a new room from where the target was occluded. The subjects were now asked to arm a pointer straight at it.

Direction judgment and spatial arrangements as perceived by the subjects was assessed. The results indicate that, both, mentally retarded as well as non-retarded show similar levels of sensitivity to changes in visual perspective, when they walk with or without environmental clues (i.e., with or without eyes closed). However, in the presence of visual environmental cues, the non-retarded subjects showed a dramatic improvement, whereas the mentally retarded subjects did not improve at all. Thus, the study concludes that the use of proprioceptive cues to mediate perceptual learning and the use of visual environmental cues to mediate influential thought processes may be deficient in mentally retarded individuals.

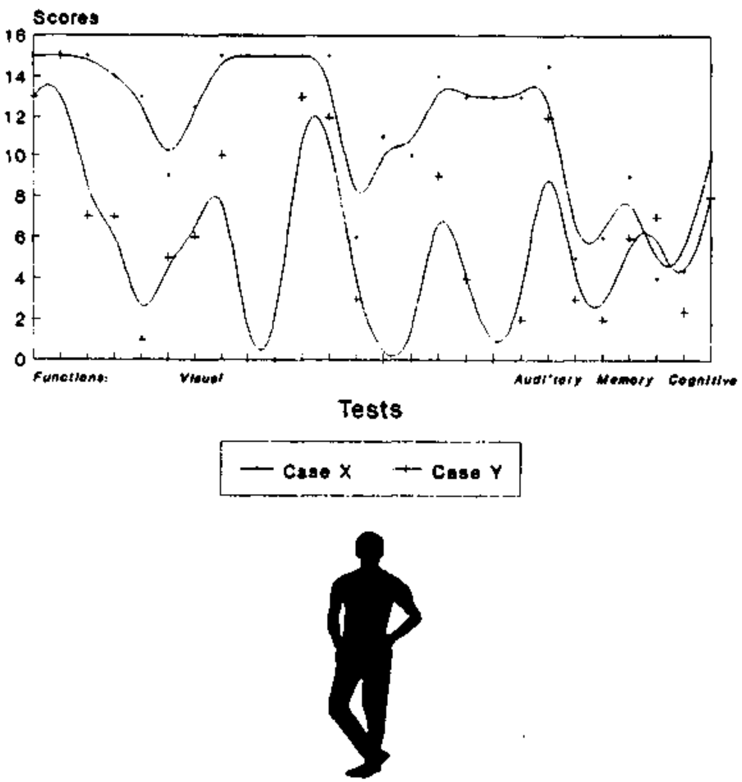
Young et al (1990) used a multiple baseline across subjects design to assess the relative benefits of two instructional methods (DISTAR Arithmetic versus Discrimination Learning Theory) in the acquisition of number skills in a group of moderately retarded students. The DLT intervention covered the same content as the DISTAR Arithmetic/Programme. The results shower greater acquisition and mastery of number skills in children during the DLT intervention.

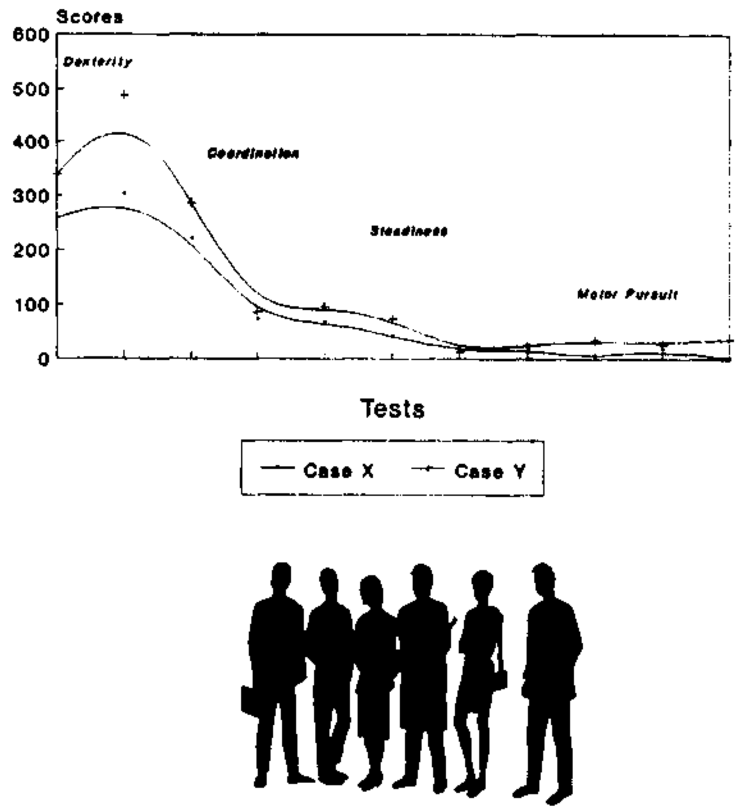
Ellis et al (1989) used a modified stroop color-word interference test (Stroop, 1935) on persons with mental retardation to assess automatic effortful processing in comparison with a group of college students. The results showed that owing to familiarity of stimuli effortful processing (needed to suppress the automatic reading response), mentally handicapped subjects experienced greater stroop interference than college students. In the second phase of the experiment, all the subjects practised the stroop calor naming tasks over three or form daily sessions. The changes in stroop interference over practice was viewed as reflecting automatisation of the suppression of reading response. Results showed that both the groups automatised the suppression response at about the same rate. However, the automatised responses had far greater and more durable suppression effects for retarded subjects, which was described as cognitive inertia; a phenomena similar to "cognitive rigidity" as defined by Kounin (1948).

These studies highlight the efforts of investigators towards designing or developing specific indices for evaluating changes in particular neuropsychological functions of individuals with mental handicap. However, comprehensive reports on sensitivity of neuropsychological tools to functional changes in mentally retarded individuals is still a virgin area for research.

Graph Nine.

Sample Inter Case and Intra Case Comparison





COMPARISON OF INDIVIDUAL PERFORMANCES

A Sample comparison of inter individual performances on various assessed functions of FAB is attempted below by taking two cases included in the main study (See Graph Nine). The results of such a sample comparison show wide inter individual differences in subjects on FAB for all the assessed domains.

IMPLICATIONS FOR FURTHER RESEARCH

Summarily, this study shows that idiometric approaches to functional assessment can be successfully employed to form a baseline evaluation of adults with mental handicap. Besides, they can be used for planning and implementing intervention programmes in order to see if there are any changes over time in the profile of functional assets/deficits recorded currently. Moreover, the present study confirmed FAB as a valid as well as sensitive tool for regular use in this direction (Venkatesan and Reddy, 1992).

The broad framework in which the present study has been carried out poses tremendous implication for further studies in this direction with mentally handicapped individuals.

1. Curricular Development:

The development of an appropriate and relevant curriculum for teaching or training mentally handicapped persons must be in consonance with the brain preferences of a given individual. Just as there are specific laterality preferences, there are specific neuropsychological functional preferences, modes of mental operations, left or right hemispheric preferences, etc., in each human being. As we have seen , there are mentally handicapped adults who show auditory preferences to visual inputs and there are individuals with reverse preferences. It is vital for every special teacher to be aware of such modality specific preferences and functioning of the handicapped individuals. However, more research along the lines what Bogen calls it as neuropsychoeducation is required for throwing further light on these issues.

2. Programme Evaluation:

The idiometric approaches to functional assessment provides a model for making baseline evaluations of mentally handicapped individuals before evolving specific/general training programmes for the identified deficit areas. Besides, the sensitivity of FAB facilitates periodic programme evaluation to determine the efficacy of training inputs in enhancing the functional profiles of individuals with mental handicap.

3. Individual Preferences in Cerebral Functioning:

The results of the present study clearly highlights the crucial inter individual and intra individual differences in the psychological functioning and functional preferences of individuals with mental handicap. There are clear cut preferences with regard to use of specific sensory modalities, processing pathways, strategies, etc., which warrant further research.

4. Supplementary Approach to Psychological Assessment:

The model for idiometric approaches to functional assessment as explored in this study do not purport to replace earlier approaches to psychological assessment, such as, normative, behavioural and/or criterion approaches. Each approach has its own place in the holistic assessment of individuals with mental handicap. Rather, one may conclude as follows:

i) No single approach to psychological assessment of individuals with mental handicap can suffice for enabling all types of decisions;

ii) Each approach measures psychological phenomena at different levels and attempts to answer different questions to varying lengths and/or depths of the phenomena under study;

iii) Ideally, a combination of all the approaches to psychological assessment at varying levels or depths is required to provide a complete or integrated view of the assessed individuals with mental handicap;

iv) Specifically, there is need to develop and standardise an array of tools/tests suited for persons with mental handicap depending on the specific type of question that is sought to be answered.

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APPENDICES

NEUROPSYSHOLOGICAL TEST BATTERY
(for mentally handicapped adults)

Part of Ph.D. research project

VISUAL PICTURE COLOUR MATCHING TEST

Booklet consists of 15 leaves.

Subject is required to match the model colour to the various alternatives Given below the line on each page.

Score in terms of number of correct matchings identified. Incorrect matchings to be noted down, but not included in scoring

Kote : Item on page one to he used for demonstration. It is not meant for scoring.

Maximum score possible : 30

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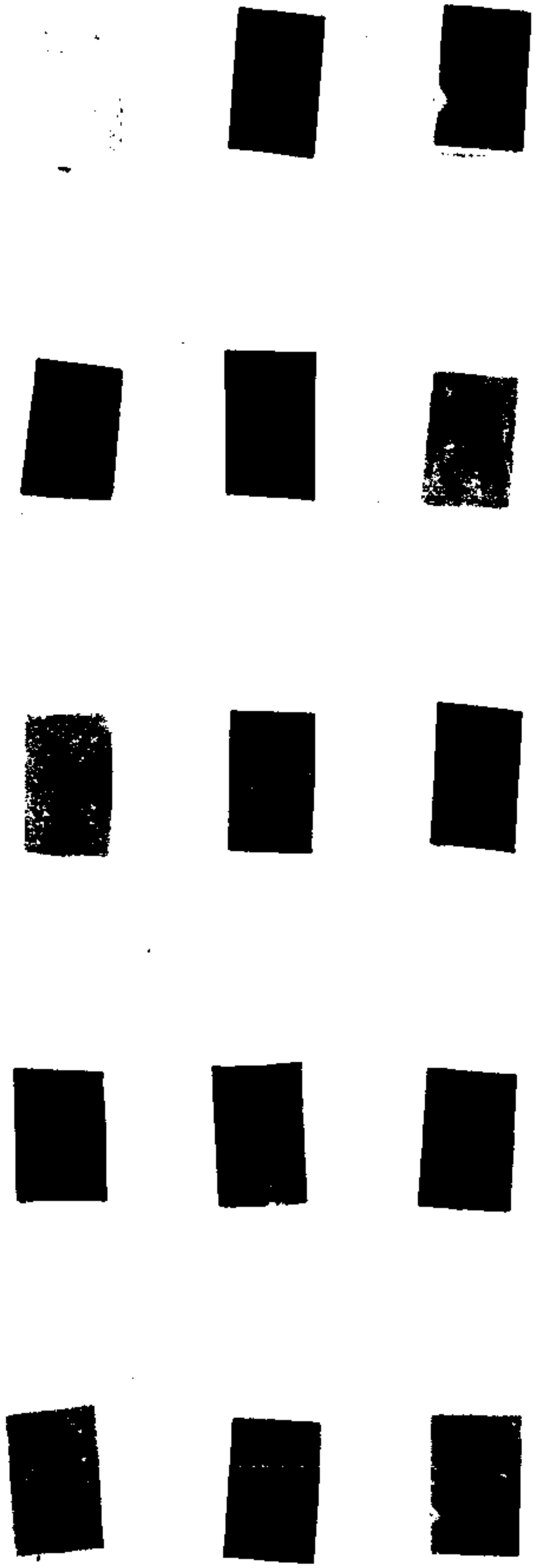

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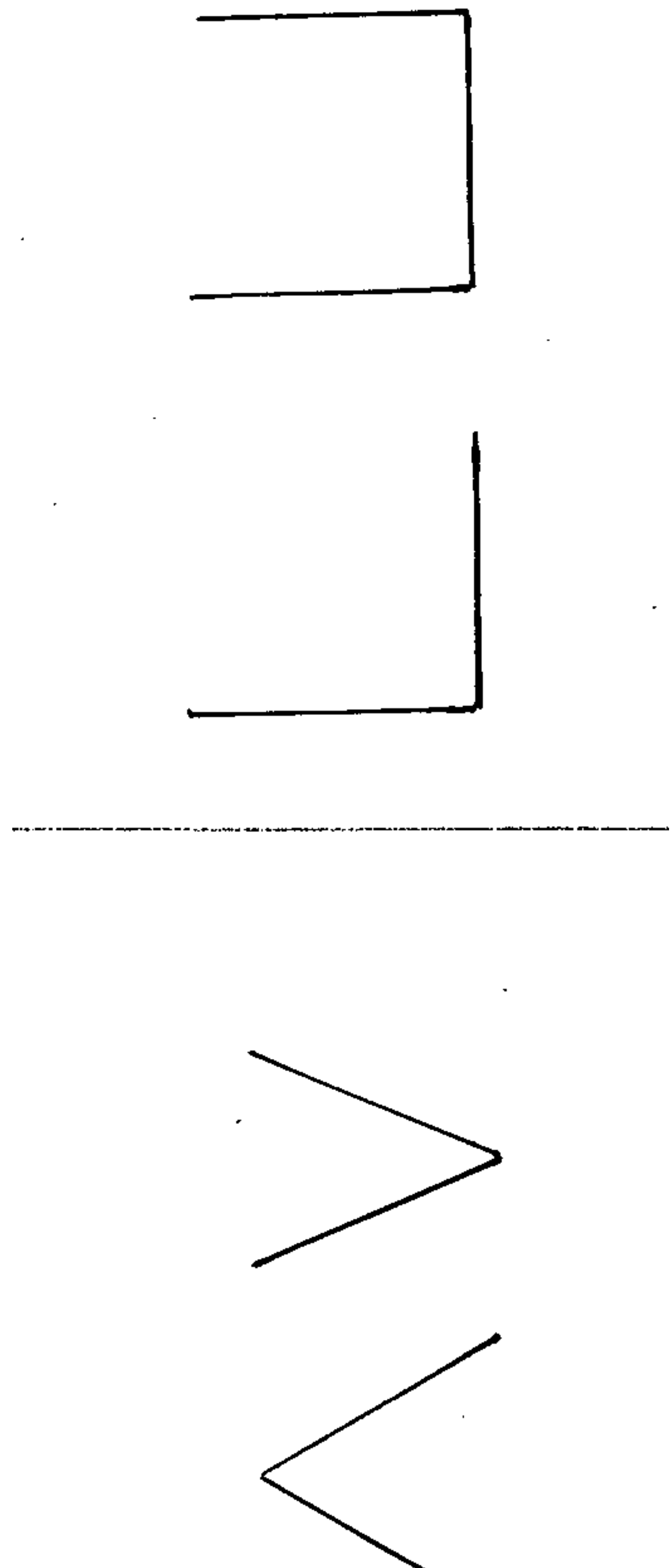
STICKS TEST

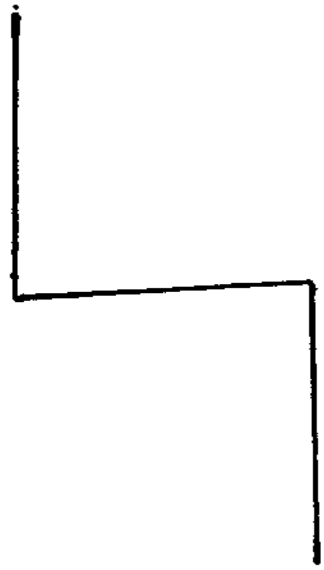
Booklet consists of 15 model figures.

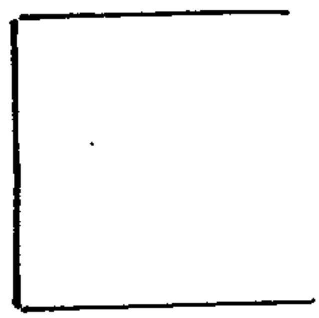
Subject is required to match the model figures and construct, with the use of match sticks, similar ones. There is a first demonstration item.

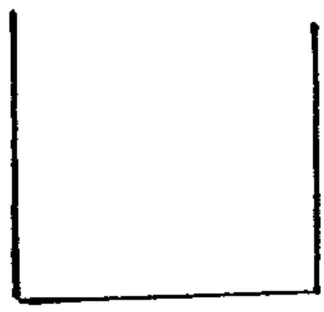
Score one for every correct reproduction.

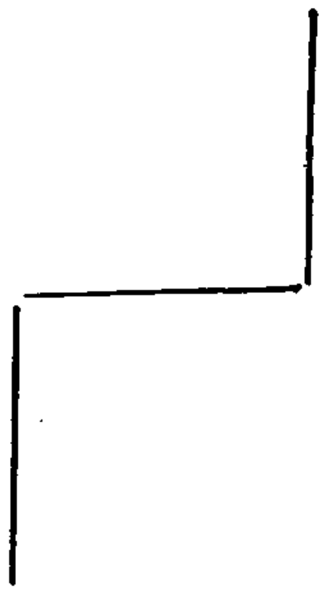
Maximum score : 15

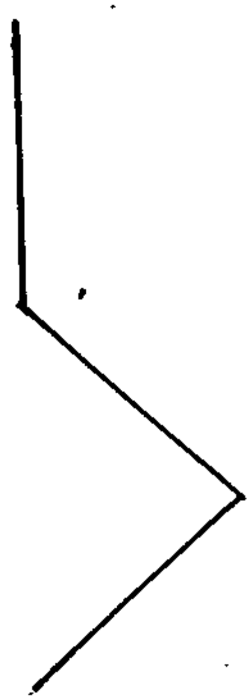


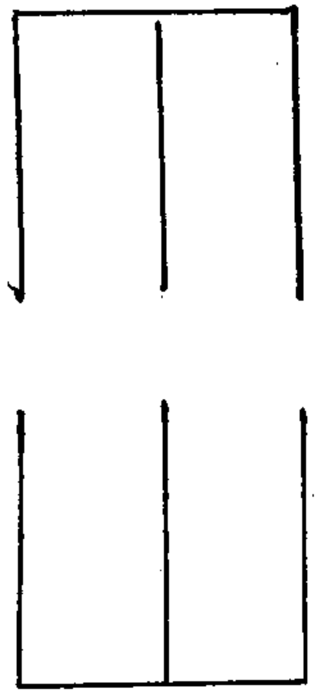


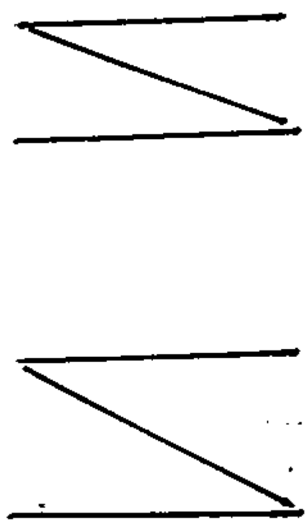


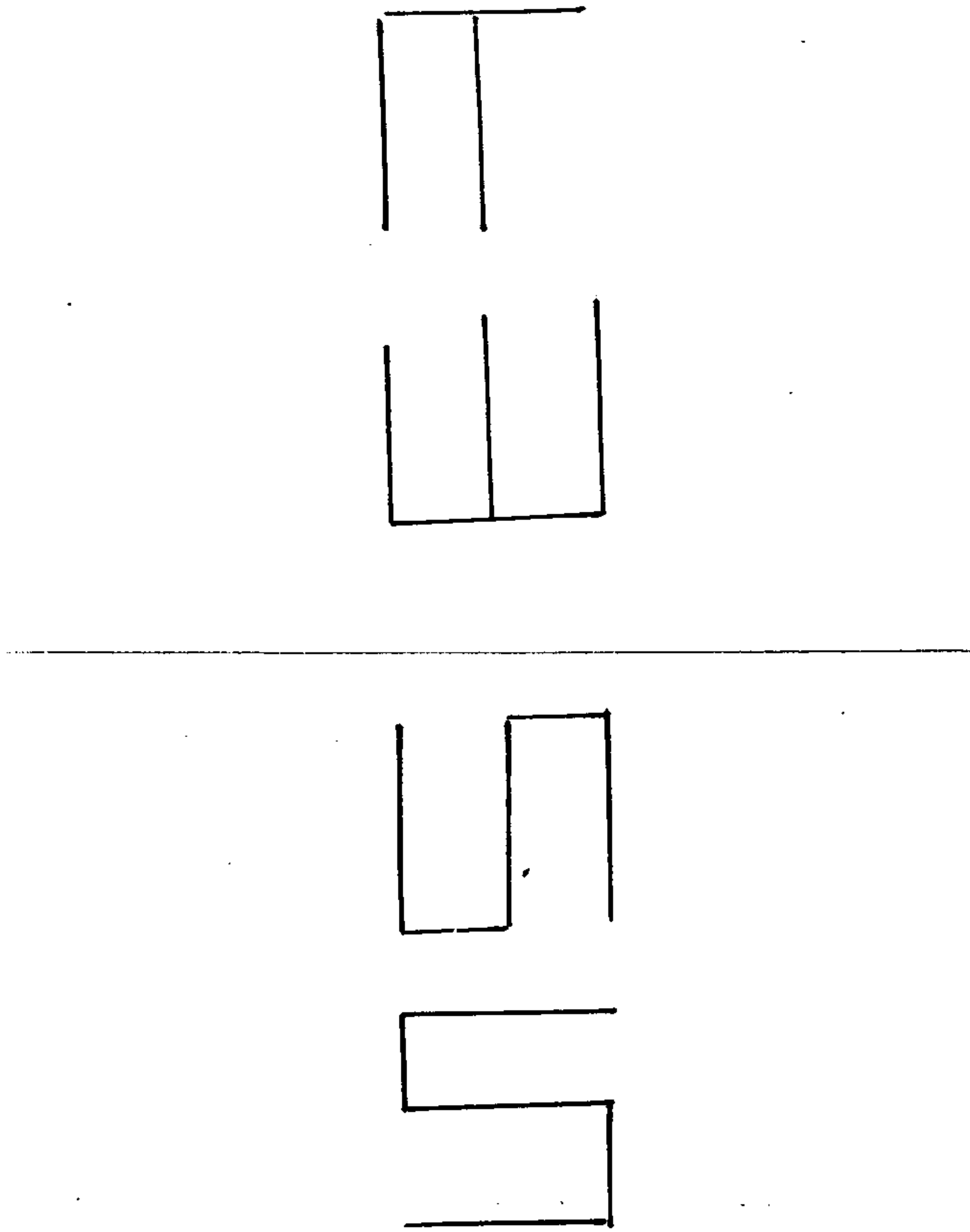


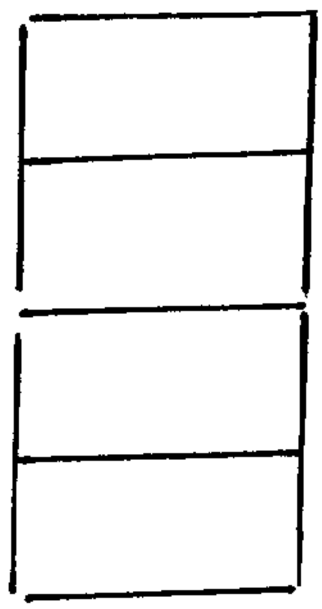


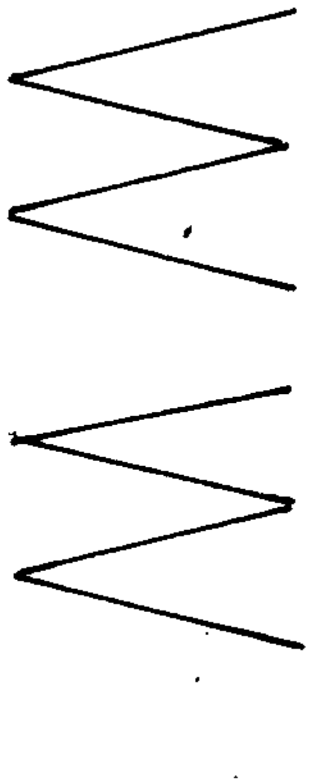


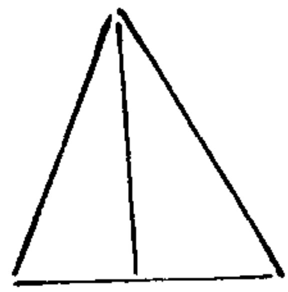


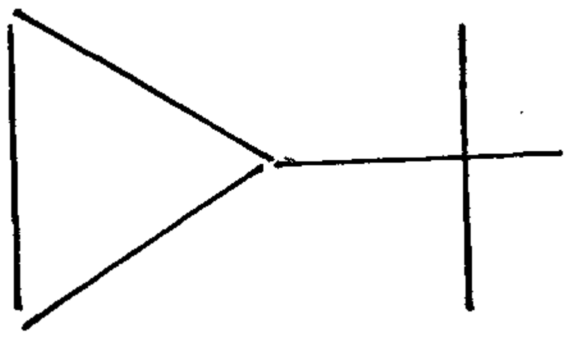


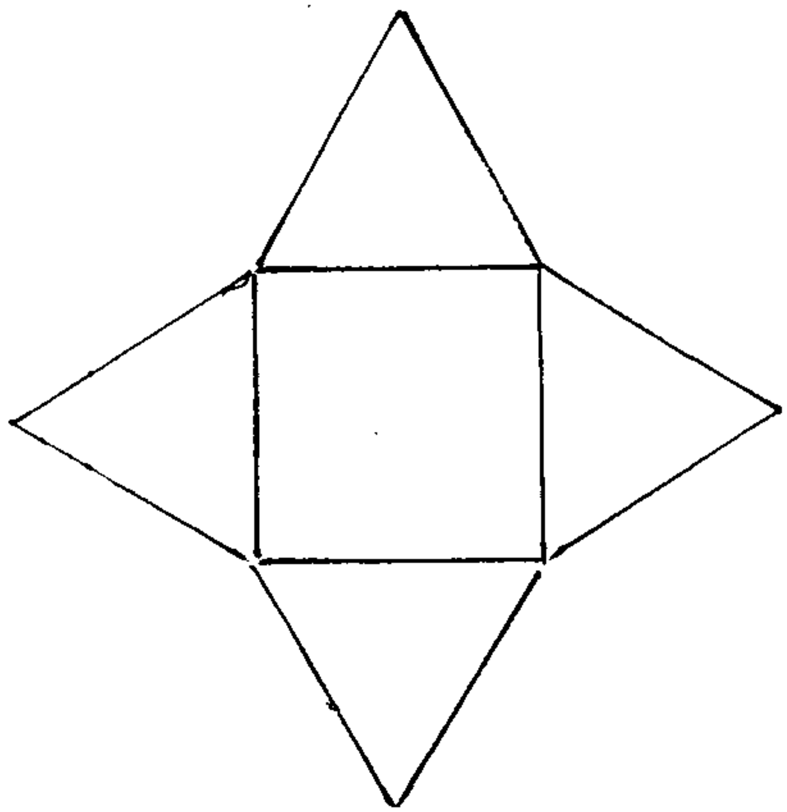












SCORED DISCRIMINATION TEST

Essentially a verbal test, it requires the subjects to imitate and produce basic speech sounds (consisting of vowel sounds dipthones and consonants) after the examiner.

Maximum score : 15

ITEMS

1.	आ	Aā	2.	औ	Ou
3.	इ	Ee	4.	ए	A
5.	ऊ	Oō	6.	ऐ	Eye
7.	ओ	Ov	8.	प	Pa
9.	भ	Ba	10.	म	Ma
11.	त	Tha	12.	द	Dhā
13.	ण	Na	14.	ठ	Tā
15.	ड	Dā	16.	ण	Nnā
17.	क	Ka	18.	ग	Ga
19.	ह	Ha	20.	ङ	Inġ
21.	फ	Fā	22.	व	Va
23.	स	Sā	24.	च	Chā
25.	न	Nā	26.	ल	Lā
27.	ळ	Lá	28.	र	Rā
29.	श	Shā	30.	य	Yā

MEMORY TESTS

Consists of six subtests :

a) Test of Immediate Auditory Memory
b) Test of Recent Auditory Memory
c) Test of Immediate Visual Memory
d) Test of Recent Visual Memory
e) Test of Immediate Kineasthetic Memory
f) Test of Recent Kineasthetic Memory

The maximum scores for each of the above subtests are ten.

A. Test of Immediate Auditory Memory :

This is essentially the sound snan test,

1.	ब र	1.	स ट
2.	स ब क	2.	ट प च
3.	ब र ल च	3.	ट ल प च
4.	र स क ल ट	4.	ब ल ट र च
5.	ब र ट ल क प	5.	प च ल र ब स
6.	र ब प क ब ल ट	6.	ब र क प ट च
7.	र च क ट ल ब प स	7.	ट क ल प स र ब
8.	स क ल ट र म च ब	8.	प क ल ट र ब च
9.	स ट च ल ब क प ब र	9.	ट ल क स र ब म प
10.	स ब र ल च ट प क प म	10.	म ब क प ट च ल र ब

B. Test of Recent Auditory Memory :

The following list of names of objects are to be read slowly and clearly, at the rate of one word for every five seconds during presentation. The subject is required to recall as many of them after a minimum gap of ten minutes.

1.	Table	2.	Door	3.	Towel	4.	Doctor
5.	Cycle	6.	Tree	7.	Cat	8.	Black
9.	Banana	10.	Rose				

C. Test of Immediate Visual Memory :

Subject is shown a picture consistino of ten objects for a period of thirty seconds, following which he is immediately asked to recall as ManY of them. The display card consists of the following pictures:

1. Lock & Key	2. Pen	3. Fan	4. Chair
5. Doll	6. Comb	7. Cot	9. Almirah
9. Knife	10. Book		

In case of subjects, where there is impairent difficulty in visual picture naming, concrete objects can be used in its place. Then, the list would be as follows:

1. Lock	2. Pen	3. lid	4. Needle
5. Money	6. Comb	7. Bangle	9. Button
9. Knife	10. Cloth		

D. Test of Recent Visual Memory :

Administration and test items are the same as above. The subject is required to recall as many of the test items after a 'Minimum gap of ten minute.

OTHER COGNITIVE TESTS

Consists of two subtests :

a) Attention Checklist
b) Test of Concentration

The attention checklist consists of seven items. Each item is followed by four alternative responses. Based on the examine 's overall impression of the subject, the items are checked. The score for each item is the individual number given against each statement urder the items. The total of the scores gives the attention Checklist score.

Maximum score : 21

The Kit for test of concentration consists of selected list of 25 objects, each of which is given a numerical/alphabetical code. There is a standard series of ten presentations. On each series of the ten series, presented to the subject, he has to correctly identify the last three objects. Score one for every correct identification.

Maximum score : 10

ATTENTION CHECKLIST

AROUSAL

0 Attention cannot he aroused at all

1 Attention can be aroused only by using both, physical and verbal prornts

2 Attention can be aroused by using verbal prompts alone

3 Attention car he amused spontaneously

ORIENTING RESPONSE:

0 Orienting response is absent

1 Orienting response is present, Both, on physical and verbal prompts

2 Orienting response is presENt, on verbal prompts alone

3 OrientinG response is Present sponetaneously

(Orienting response or reflexive arousal or phasic arousal or involuntary arousal is characterised by physiological changes like increased heart rate, blood pressure, changes in skin conductance, etc.? and behavioural changes like head turning, ears cocking up, postural changes, etc.)

ACTIVATION

0 Activation of attention is absent

1 Attivates attention throuch less than half minute

2 Activates attention through more than half minute, but less than a minute

3 Activates attention through more than a minute

(Activation or tonic response or voluntary arousal refers to the ability to maintain a mental set to continue an ongoing activity.)

HABITUATION OR FATIGUABILITY

0 Habituates or fatigues to same stimuli immediately

1 Habituates or fatigues to same stimuli within less than half a minute

2 Habituates or fatigues to sare stimuli within a minute, but after half a minute

3 Habituates or fatigues to same stimuli only after a minute

(Habituation or fatiguabiity occurs with the recurrence of the same stimulus task or evert over a period of time. The more slowly an organism habituates to, stimuli, the greater his attentional control.)

VIGILANCE OR SHIFTING ATTENTION

0 Vigilane or shifting of attention to chances in stimuli is absent

1 Manages to shift attention to chances in stimuli but only after nersistance on the orginal stimuli for more than five seconds

2 Manages to shift attention to changes in stimuli but only after persistance on the original stimuli for less than five seconds

3 Spontaneous vigilance or shifting of attention is present

DISTRACTION

0 Attention is easily distracted by unrecognisable stimuli

1 Attention is distracted by recognisable irrelevant external stimuli

2 Attention is distracted by recognisable relevant external stimuli

3 Attention is not distracted at all

If distracted, (deduct 1/2 scores for eac

a. brings back attention to original task only by physical and verbal prompts

b. brings back attention to original task by verbal prompts alone

c. brings back attention to original task by intermittent cueing

d. brings back attention to orininal task on own

INSIGHT

0 Not aware of disturbances in attention

1 Becomes aware of disturbances in attention, if made aware of

2 Becomes aware of disturbances in attention on own in due course of time

3 Is aware of disturbances in attention on own spontaneously

TEST OF CONCENTRATION

1.	Bangle	2.	Ball
3.	Money	4.	Key
5.	Chocolate	6.	Needle
7.	Lid	8.	Button
9.	Cup	A.	Eraser
B.	Watch	C.	Diarv
D.	Cloth	F.	Thread
F.	Pencil	G.	Marble
H.	Spoon	I.	Toothbrush
J.	Small bottle	K.	Penknife
L.	Comb	M.	Matchbox
N.	Safetypin	0.	Blade
P.	Keychain		

ORDER OF PRESENTATION :

7 KING	3 BEAN
1 FLOP JAM	268 JOG
59 HAD FLIP	34 LIMB COP
479 ACE PLAN	7281 IS HOLD
248 LAD IN GO	57913 FAN

LANGUAGE, TESTS

Consists of two subtests :

a) Controlled Word association Test

b) Walton-Black Modified New word Learning

Controlled word Association Test is a test of ideational fluency. In a given maximum time period of two minutes the subject has to associate and produce as many words related to specific categories of concepts. The total number of correctly associated words to specific categories is the score.

Maximum score : Depends on subjects responses

Walton Black Modified New word Learning Test is essentially a test of linguistic learning of new vocabulary. Test consists of an ascending order of list of words-raning from simple names of concrete objects to abstract words. The subject is required to give meanings to each of these words one after another. The list of words are to be administered till the subject is unable to give meanings to five consecuetive words in the list. Then, the meanings of these words are told to the subject, before the explained meanings of these words are asked again. The number of new words for which the subject is now able to give meanings in just one trial is vocabulary learning score.

Maximum score : 5

. . . . .

A. <u>CONTROLLED WORD ASSOCIATION TEST OR TEST OF IDEATIONAL FLUENCY</u>

a) Things which are round :

b) Things which are green :

c) Things rrade of wood :

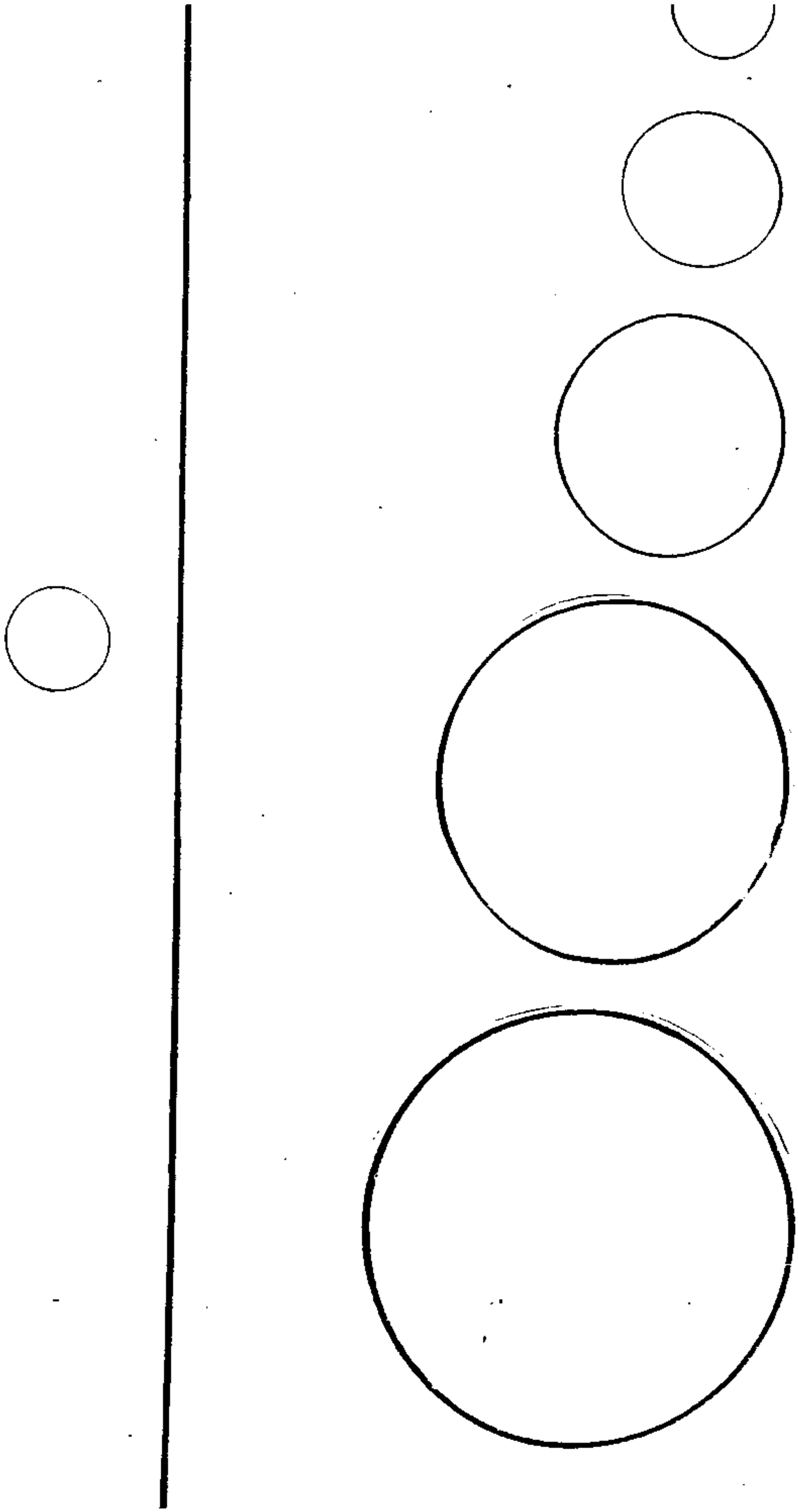
d) List of animals :

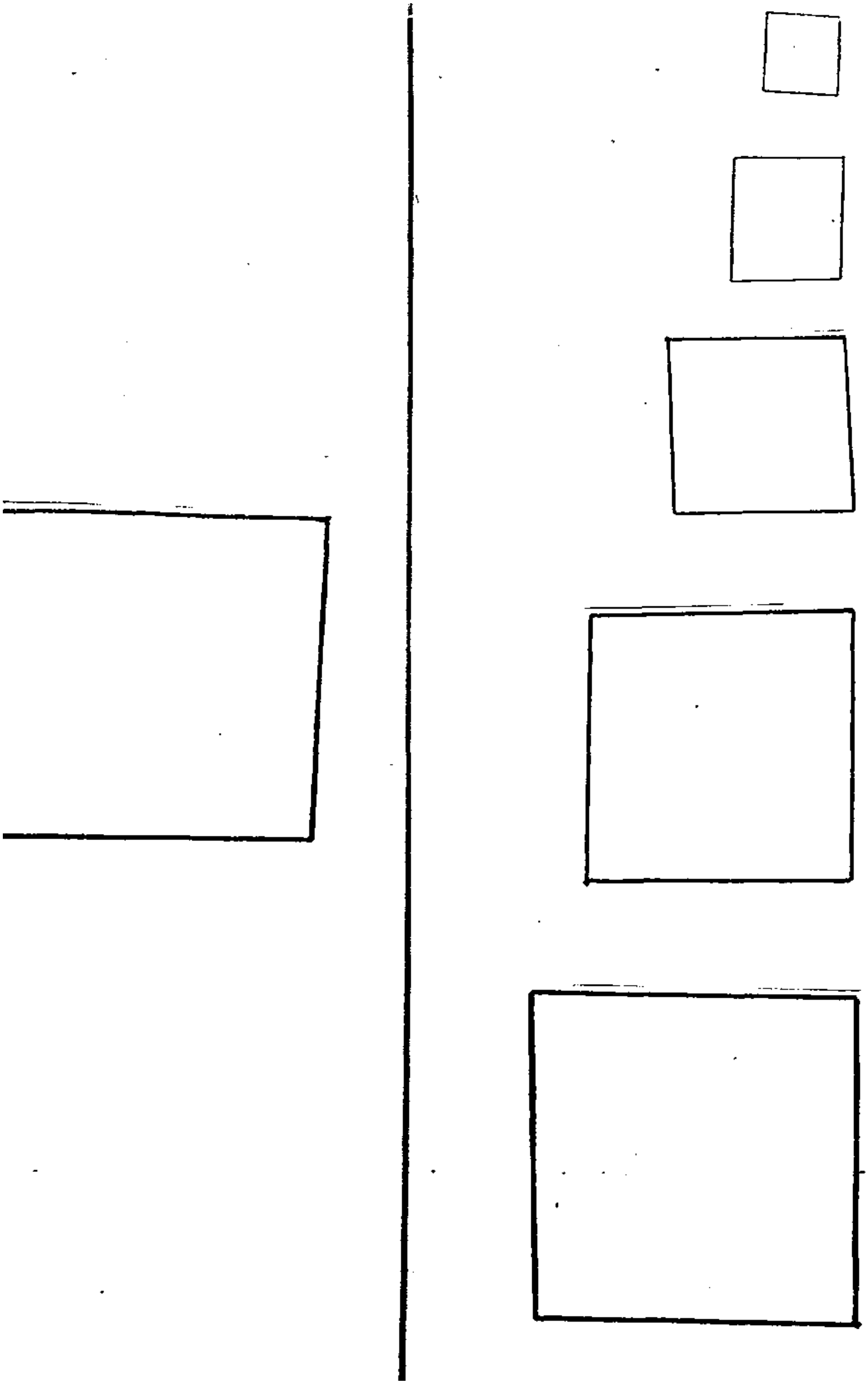
e) List of fruits :

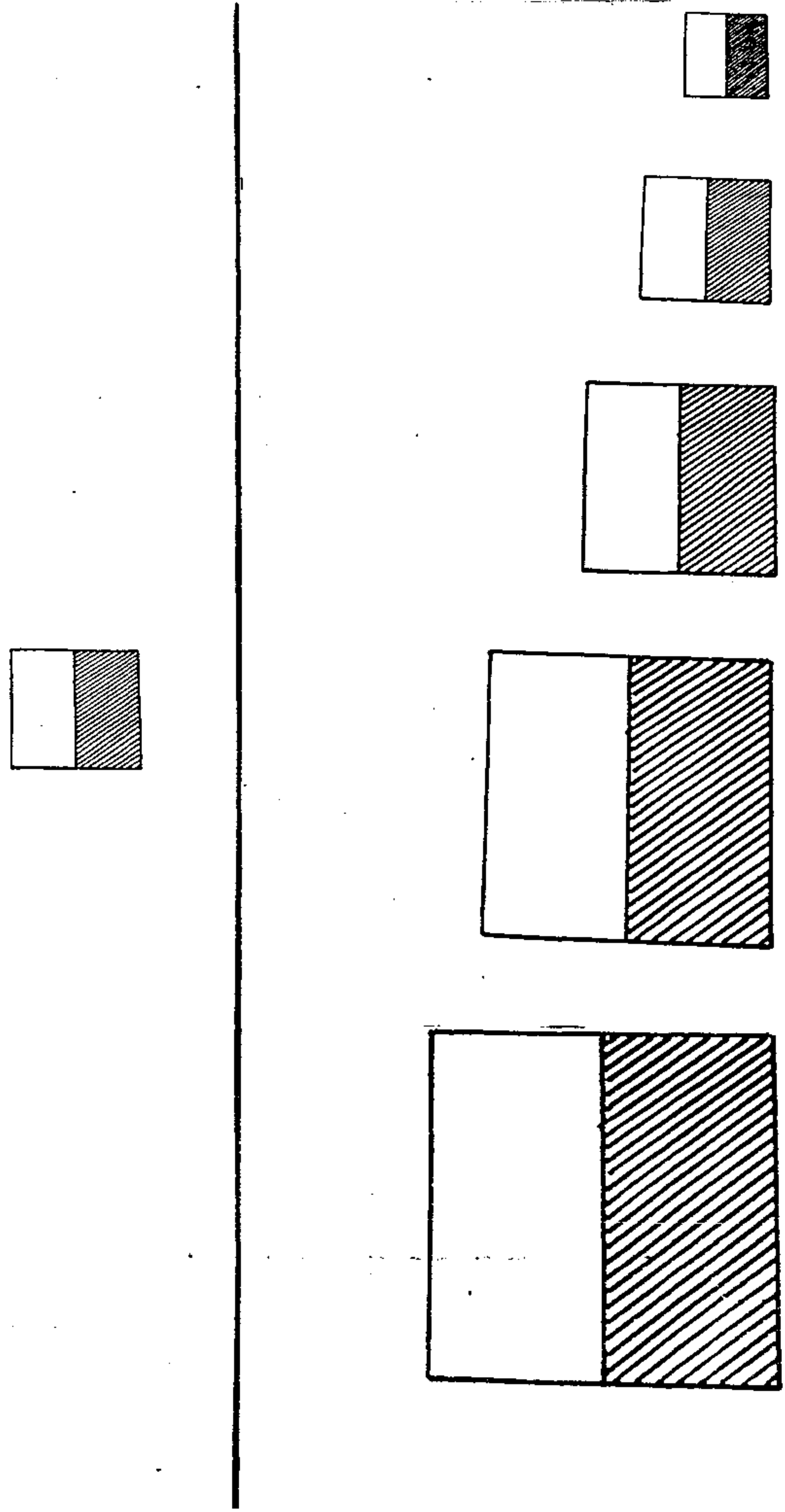
B. <u>WALTON BLACK MODIFIED NEW WORD LEARNING TEST</u>

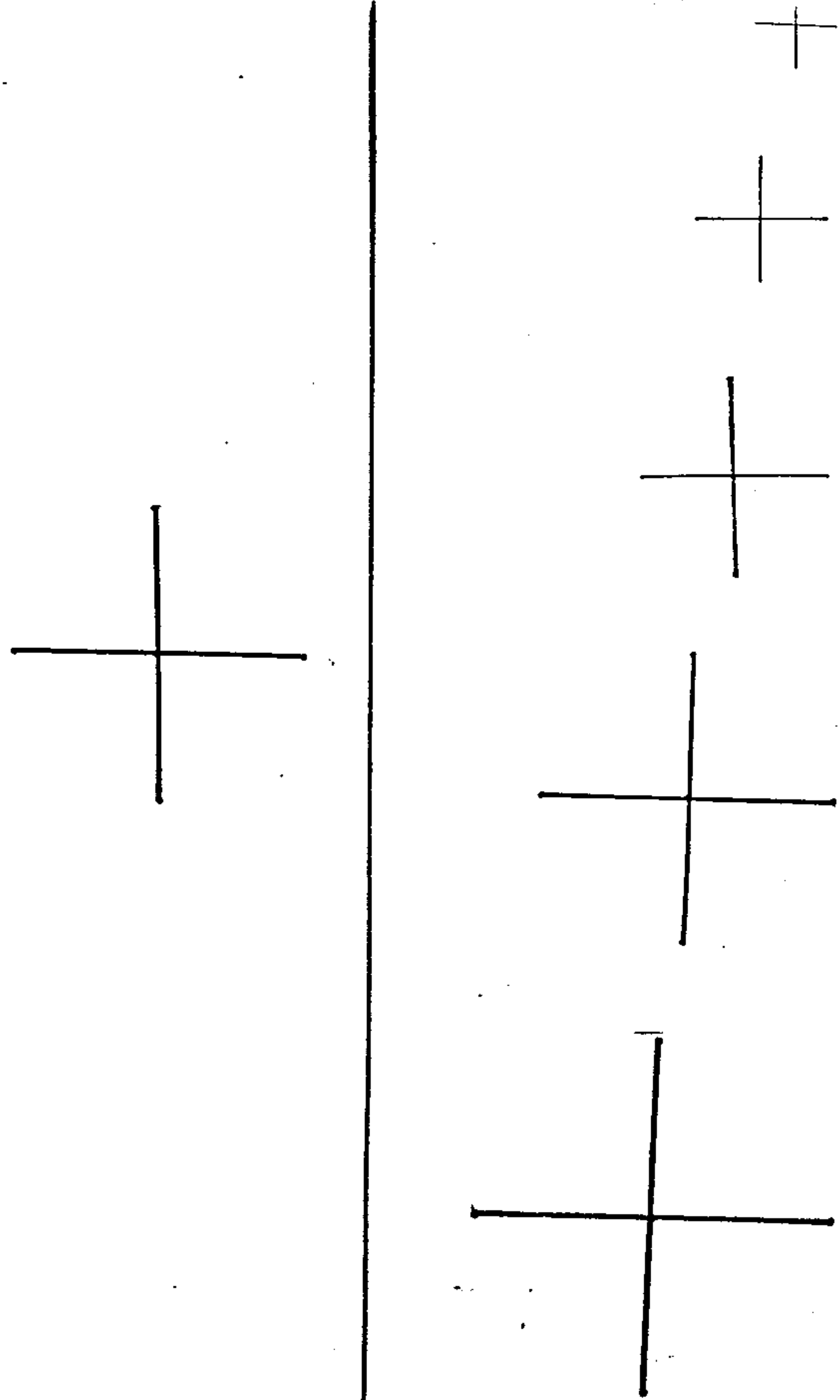
- - - - - - - 4 -

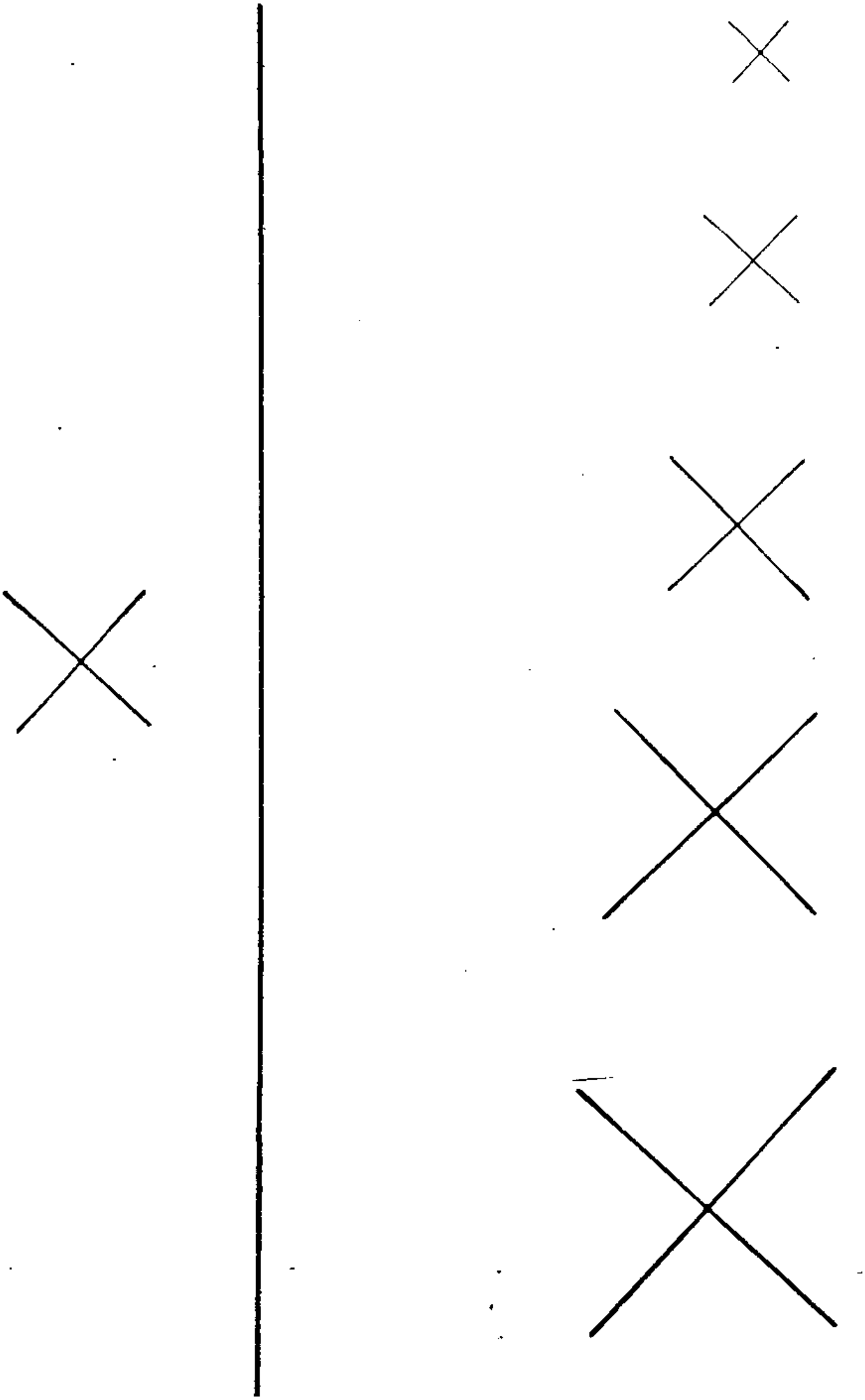
1. Key	2. Watch	3. Pencil
4. Chair	5. Horse	6. Spoon
7. Doll	8. Blanket	9. Pall
10. Cycle	11. Shoe	12. Knife
13. Umbrella	14. Pillow	15. Letter
16. Nail	17. Tiger	16. Hammer
19. Soldier	20. Gold	21. Clever
22. Brave	23. Editor	24. Injustice
25. Poor	26. Revenge	27. Charity
28. Envy	29. pride	30. Lazy
31. Respect	32. Admiration	33. Sadness

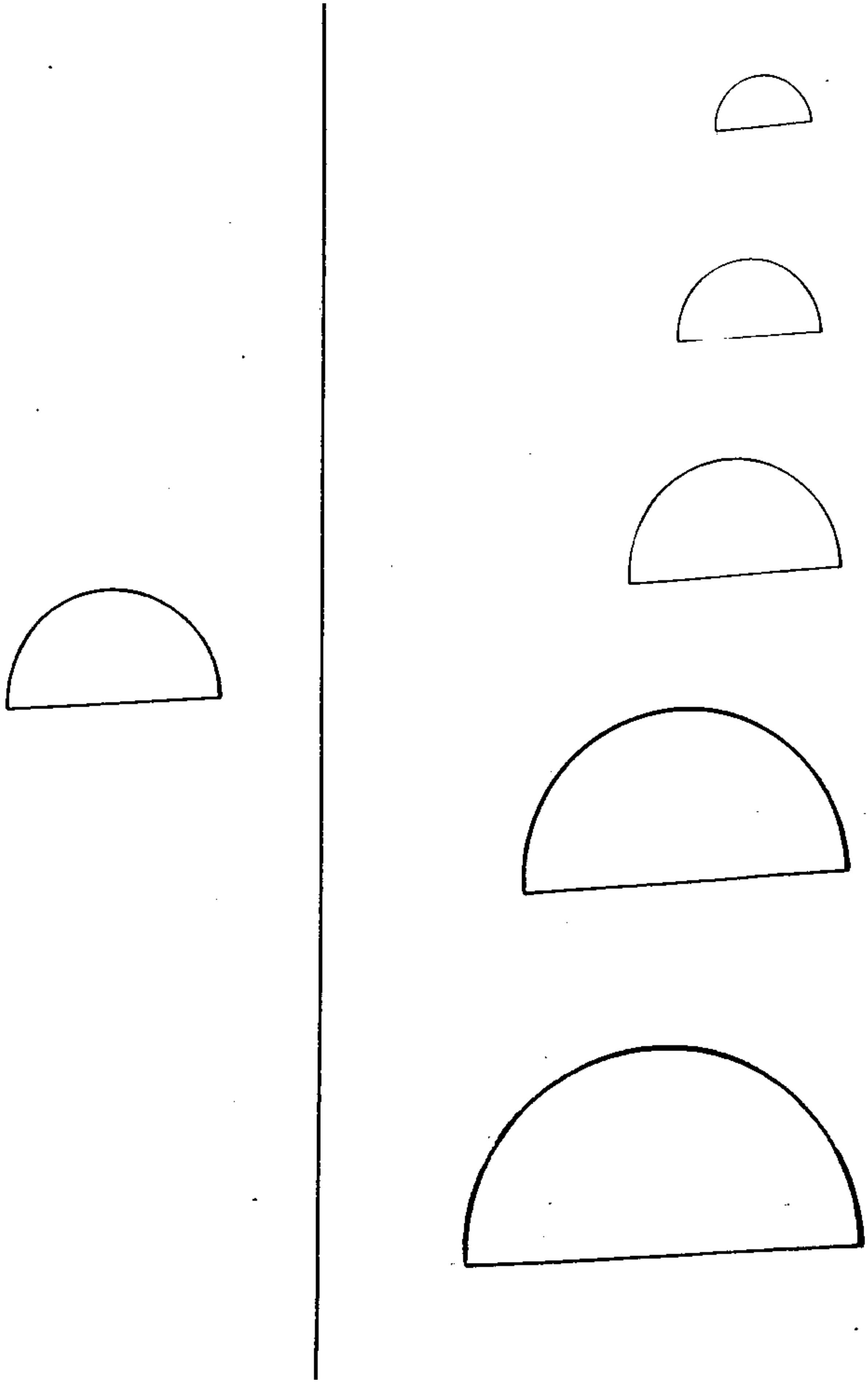


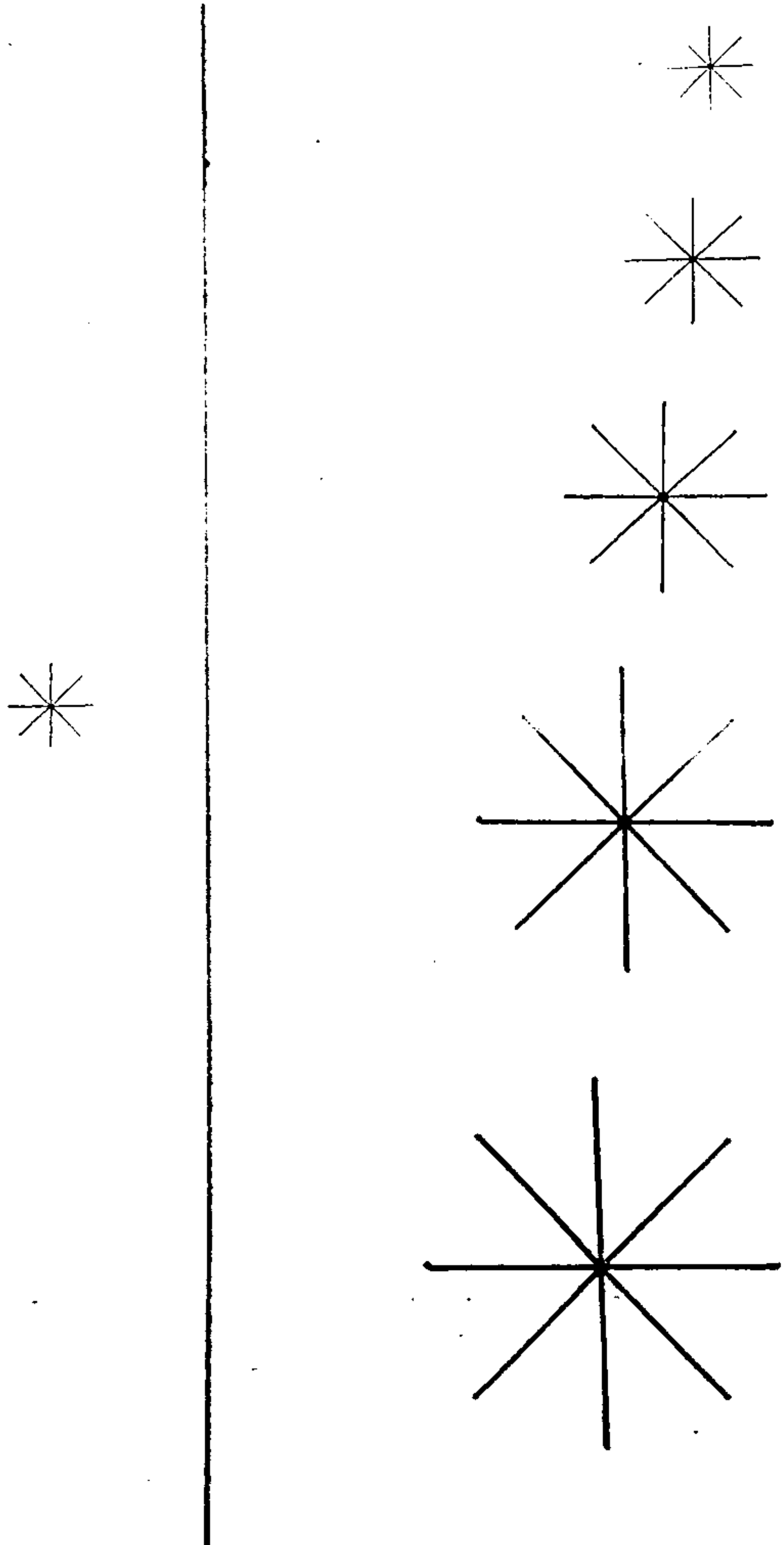


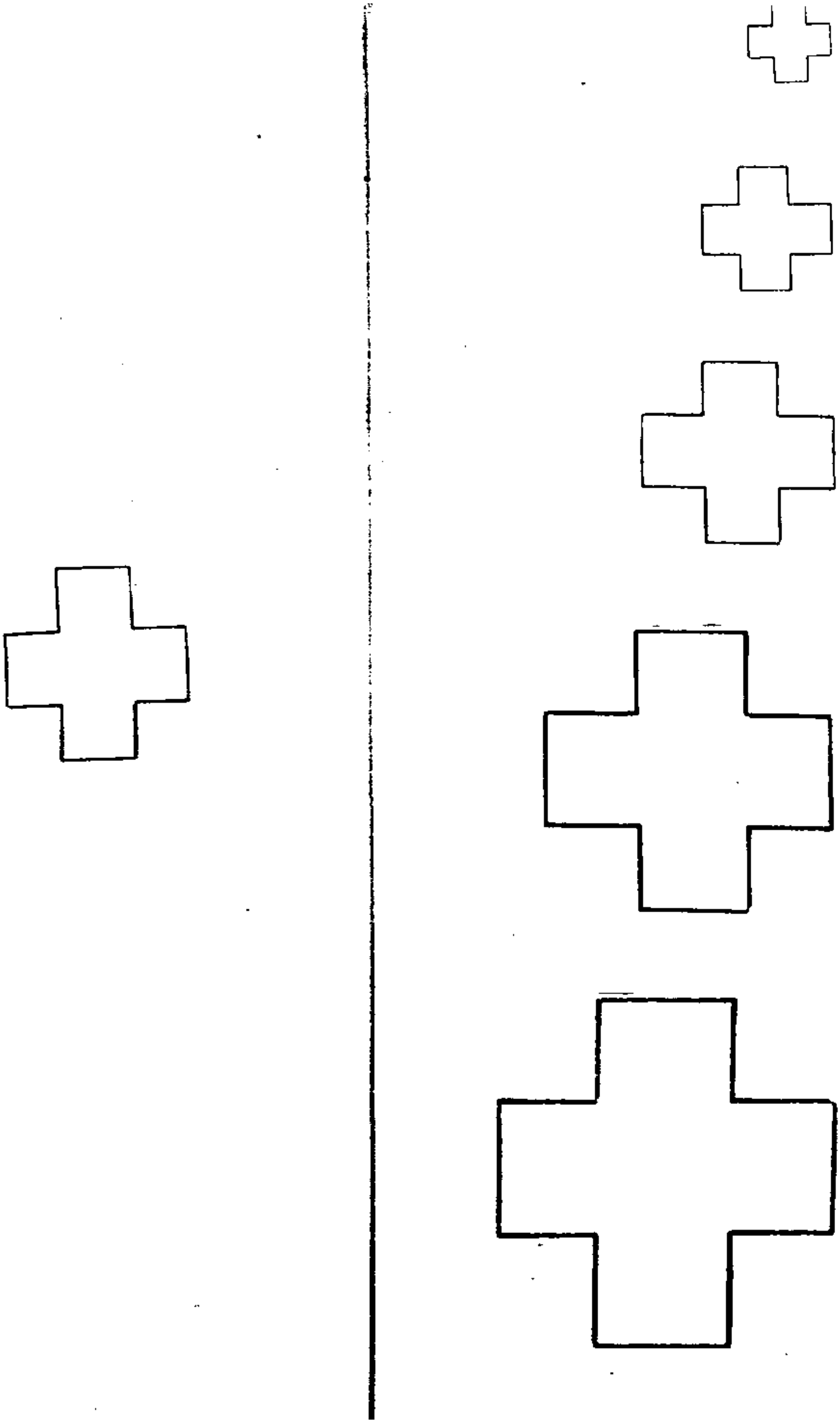


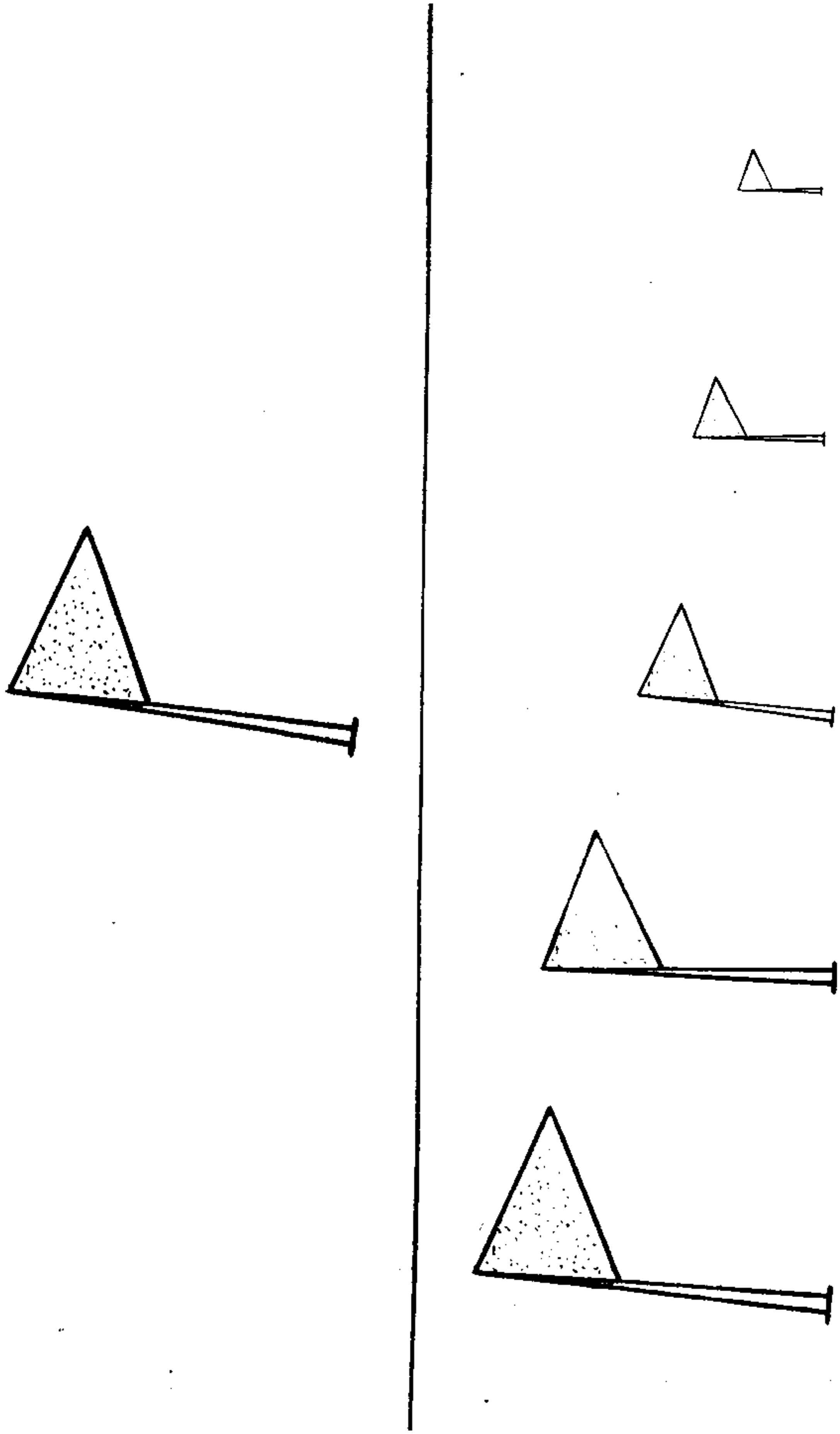


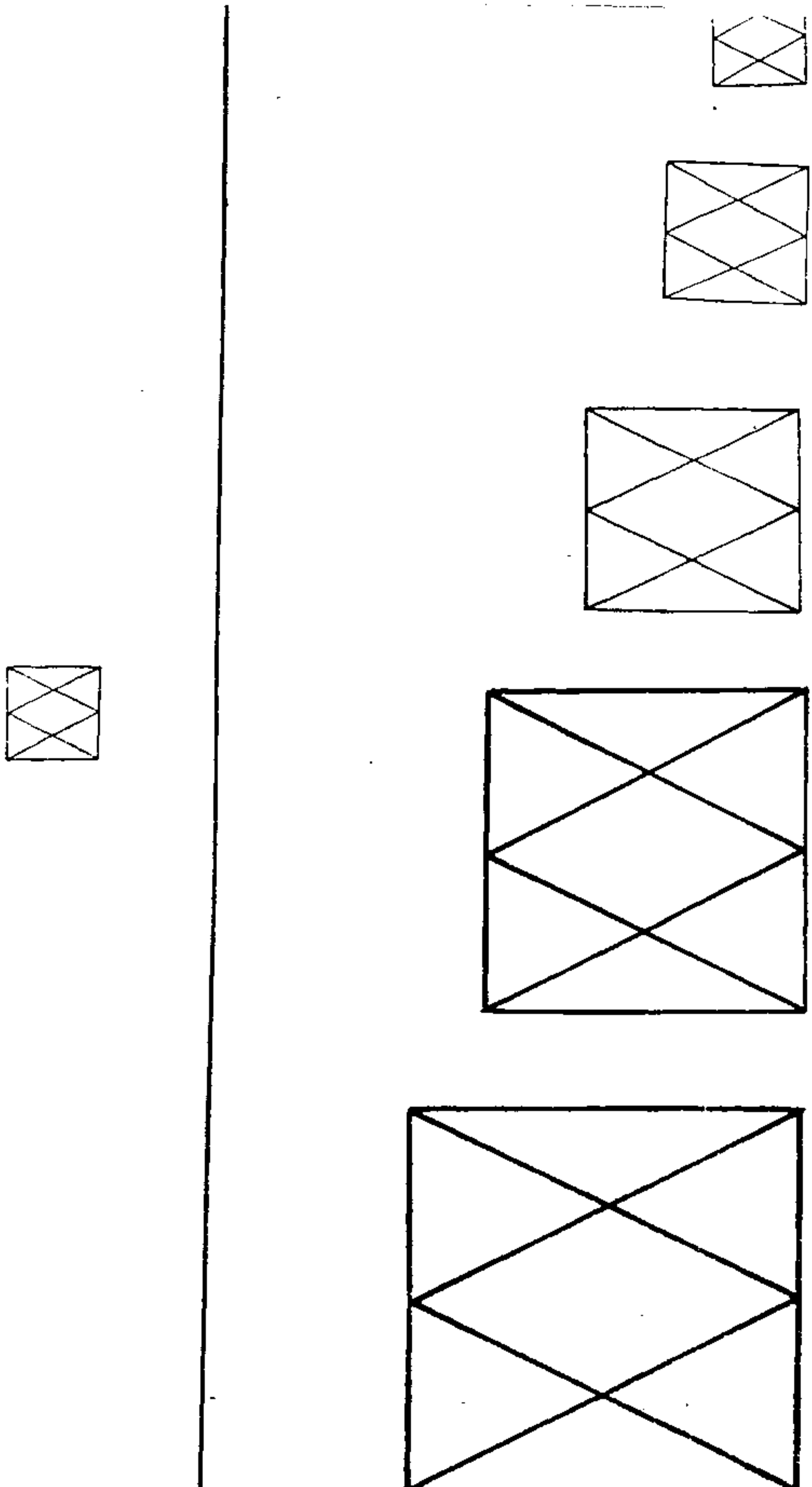


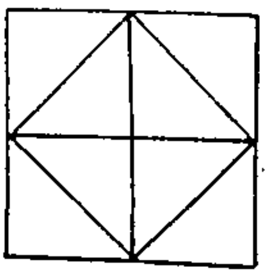


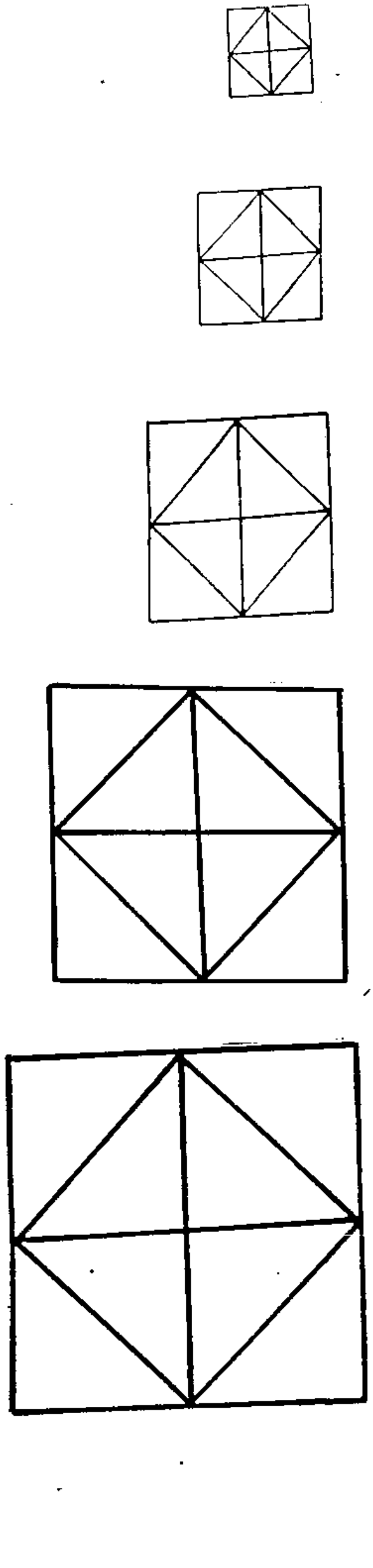


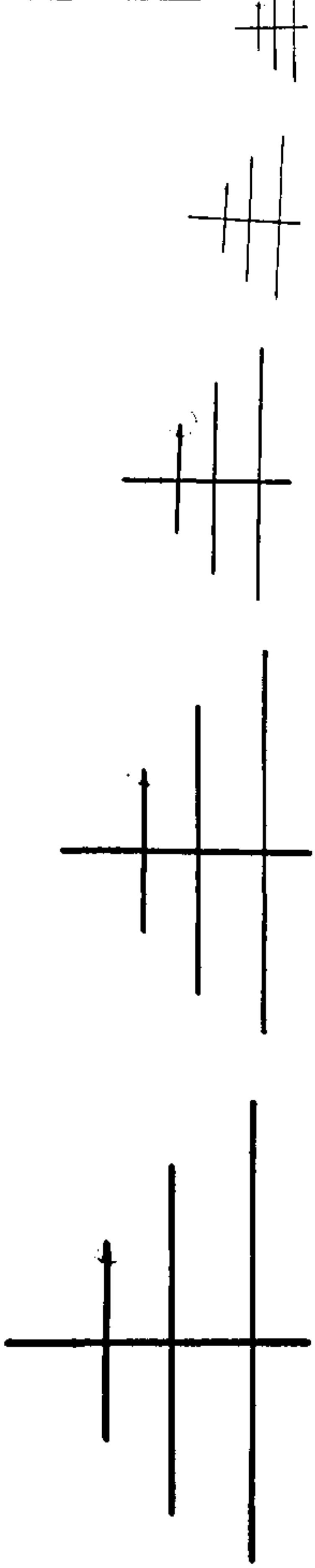


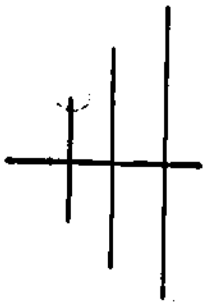


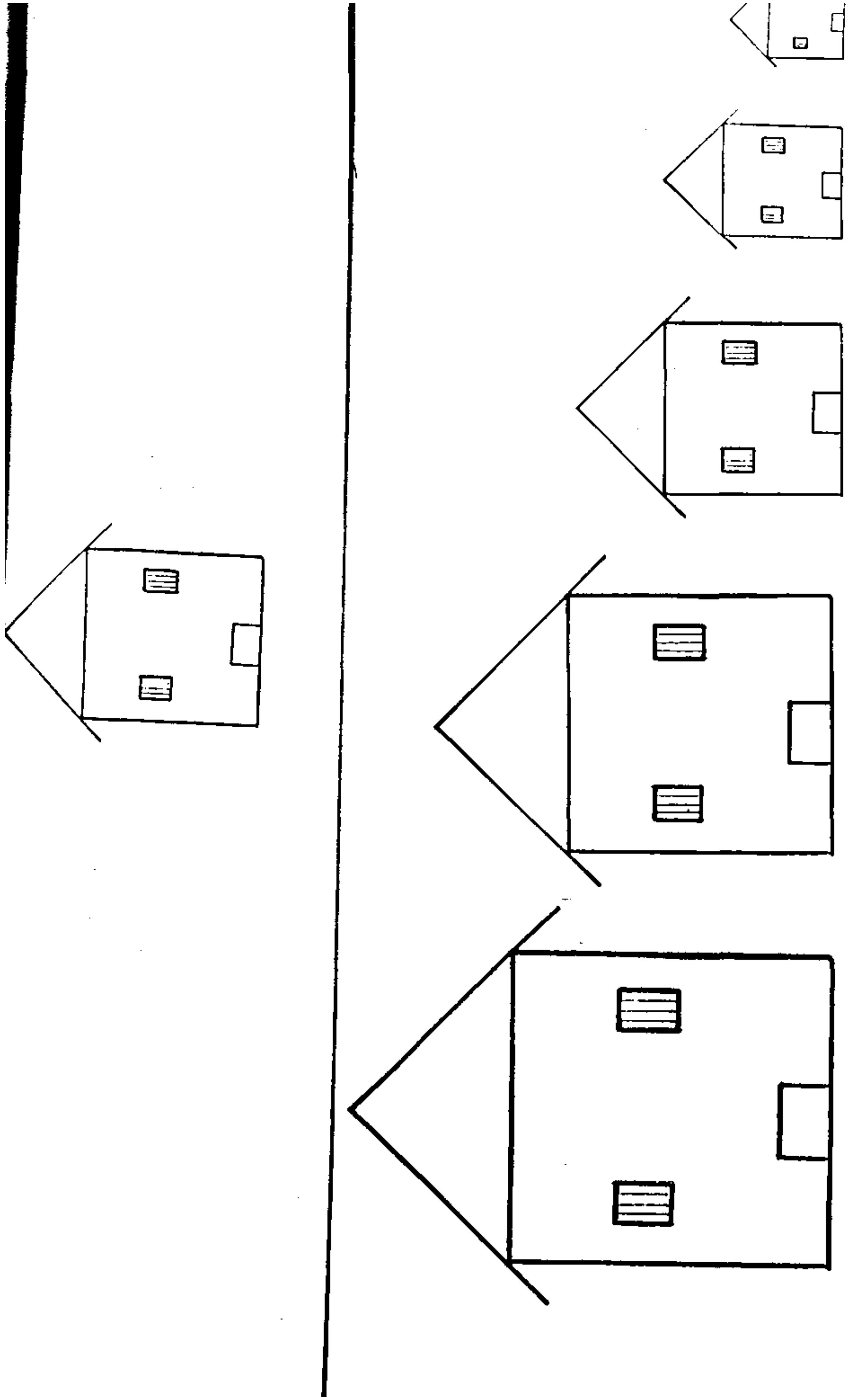












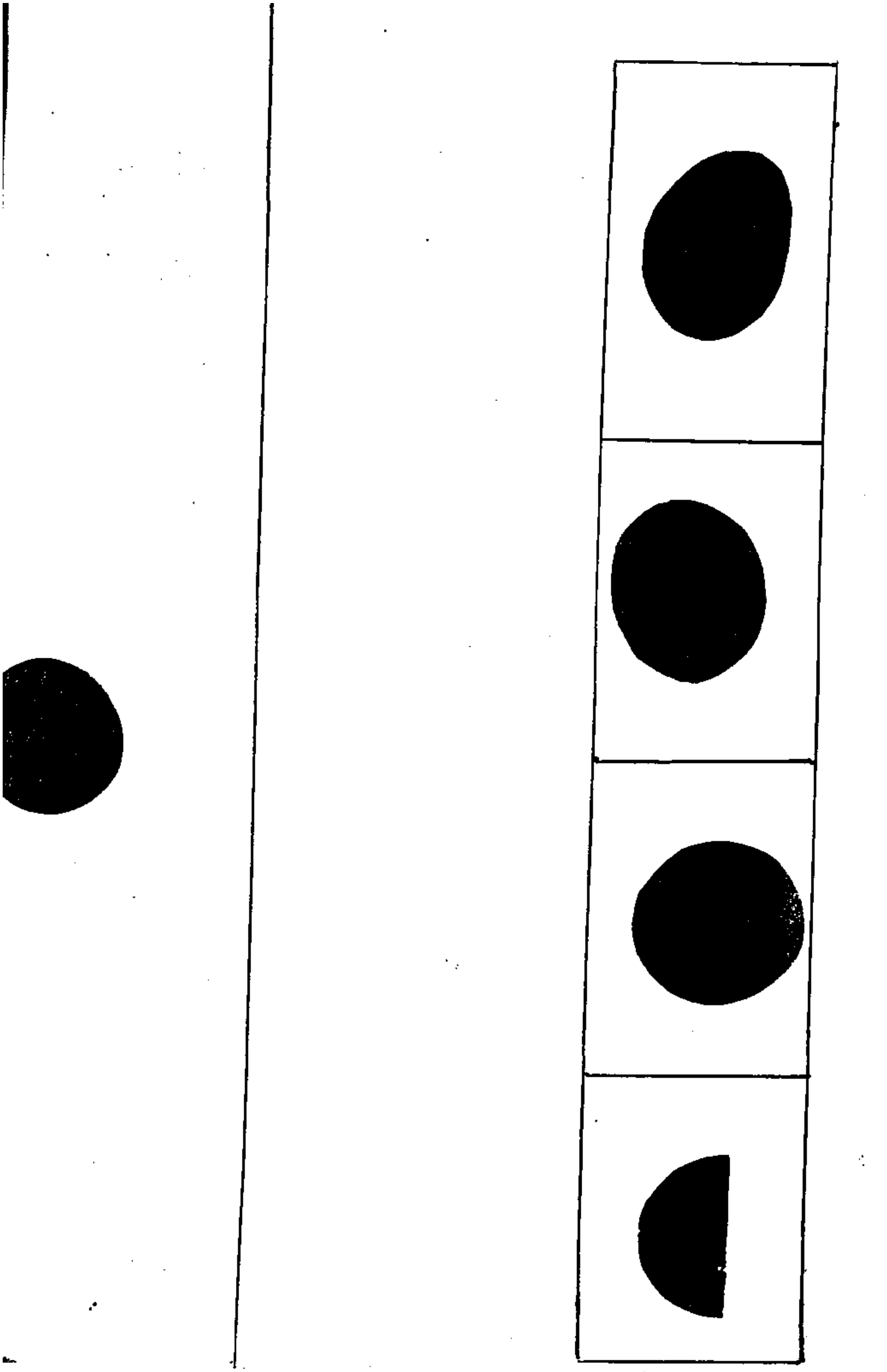
VISUAL PICTURE SHAPE MATCHING TEST

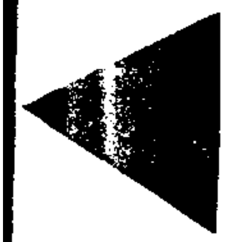
booklet consists of 15 leaves.

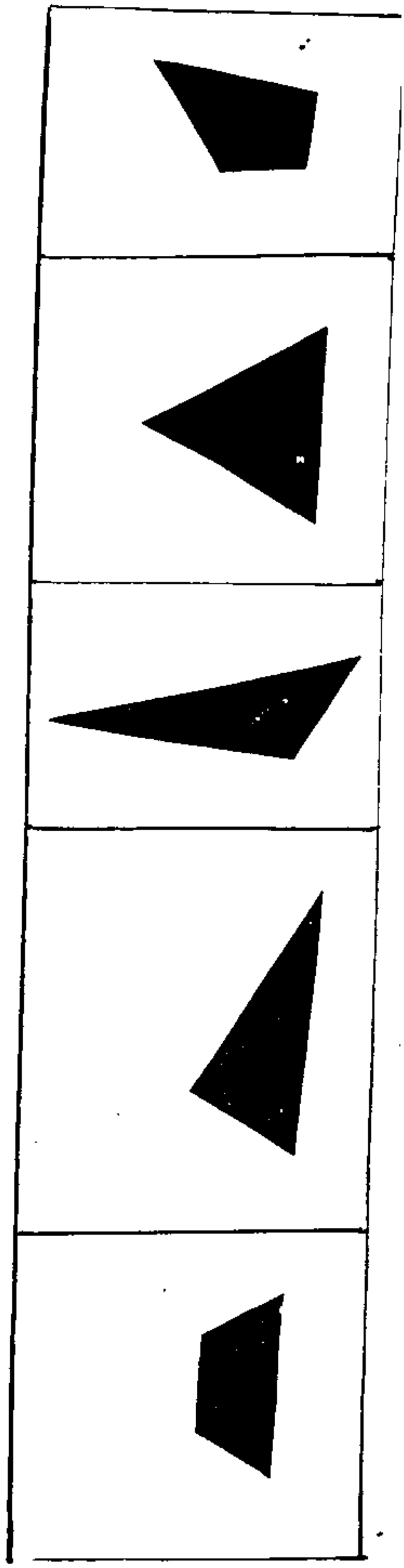
Subject is requried to match the model shape- to the various alternatives given below the line on each page.

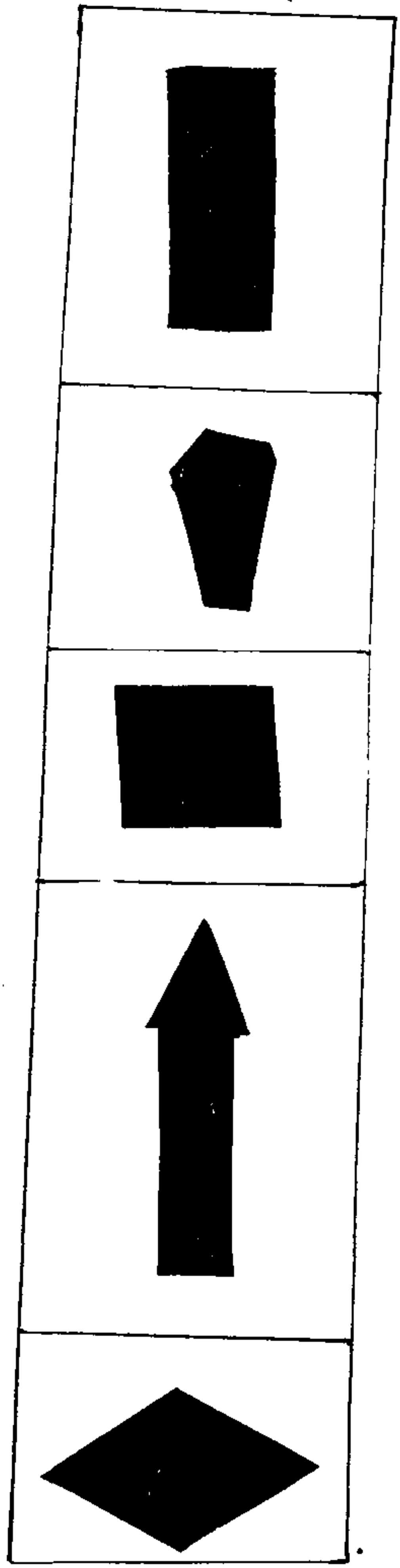
Score one for every correct matching on each page, incorrect matctings are to be noted down, but not included for scoring.

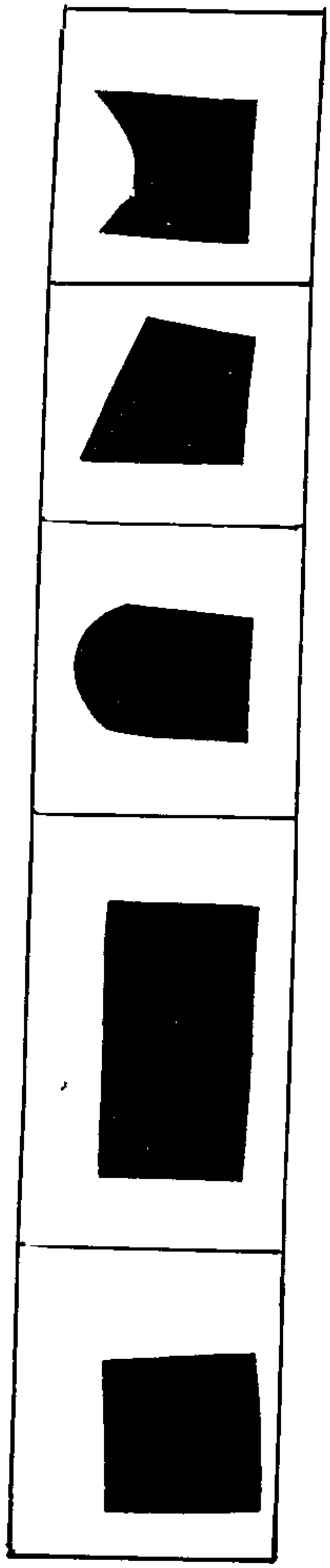
Maximum score : 15

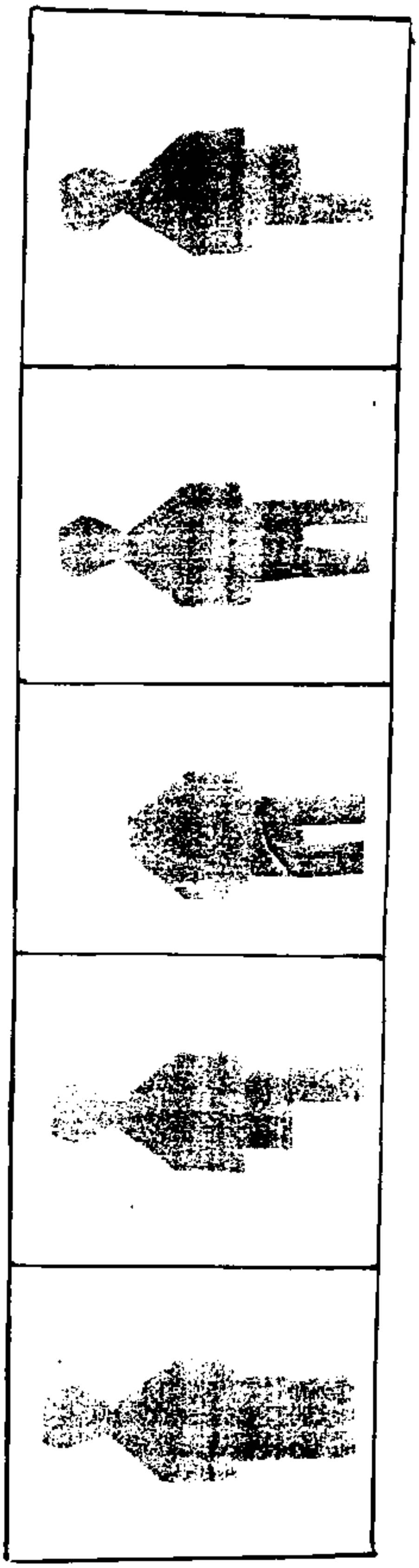


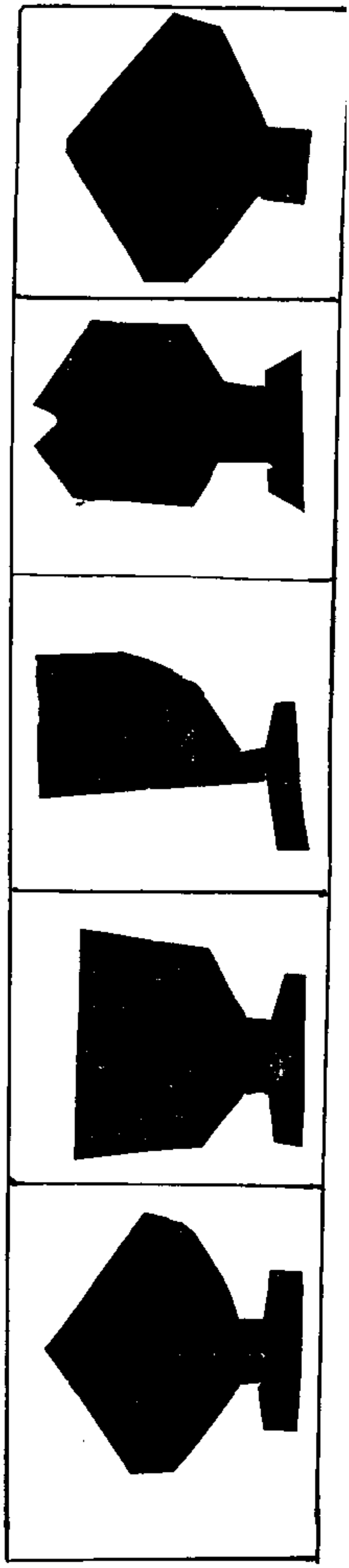


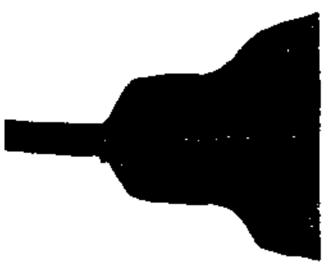


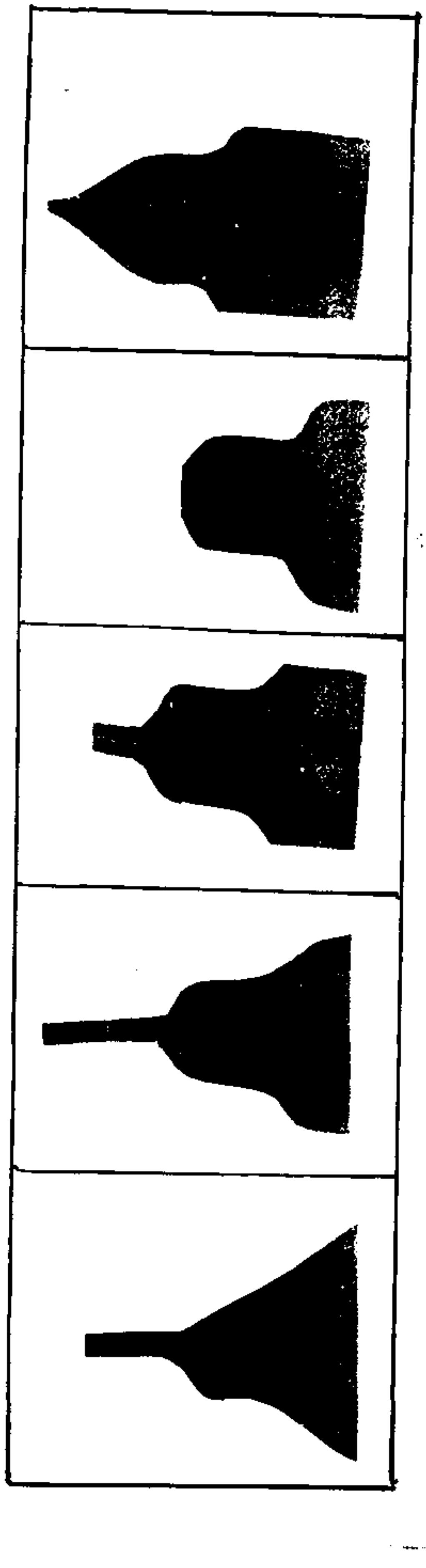


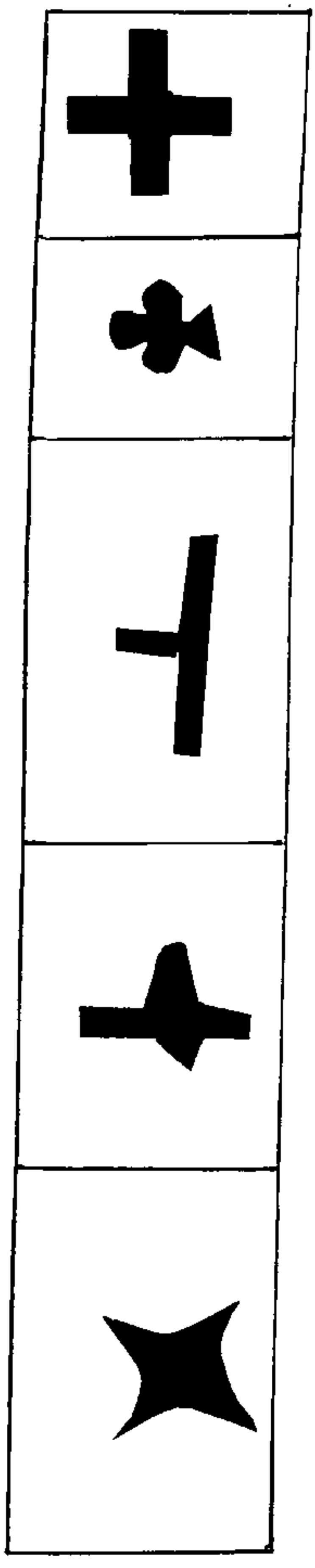


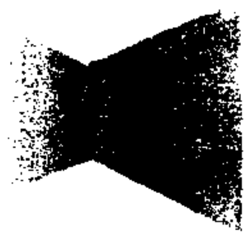


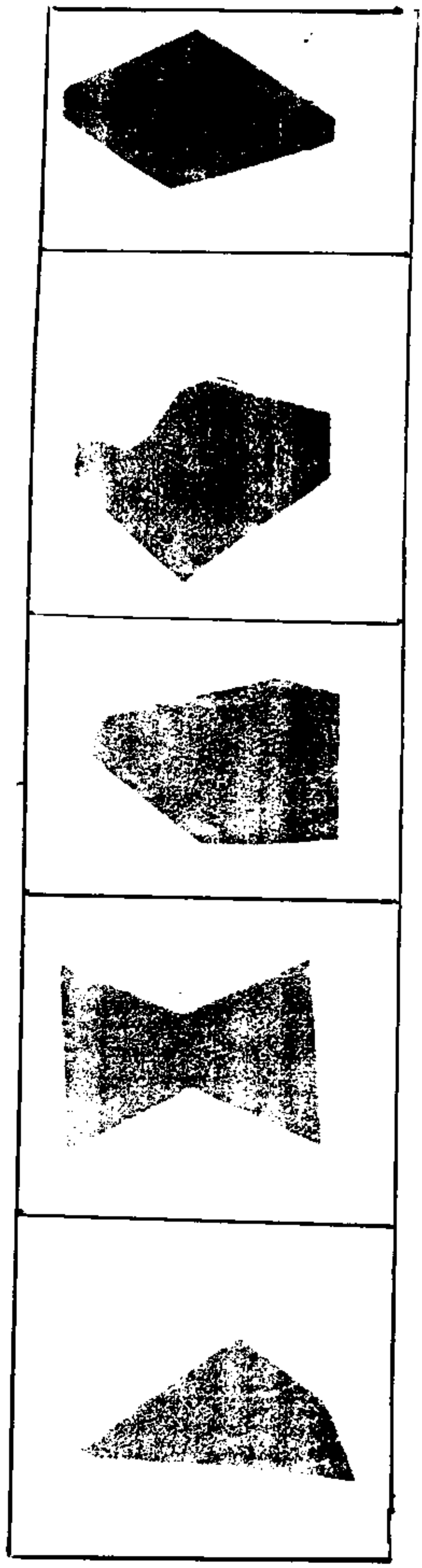


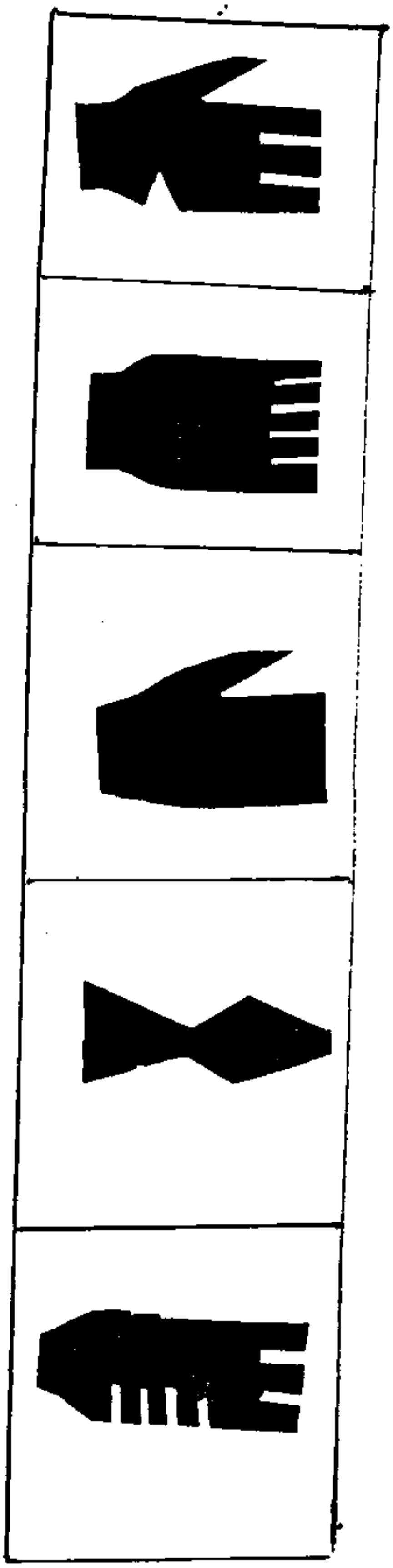


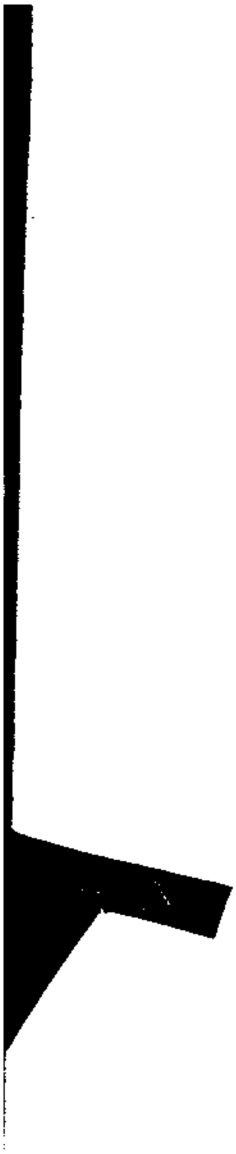


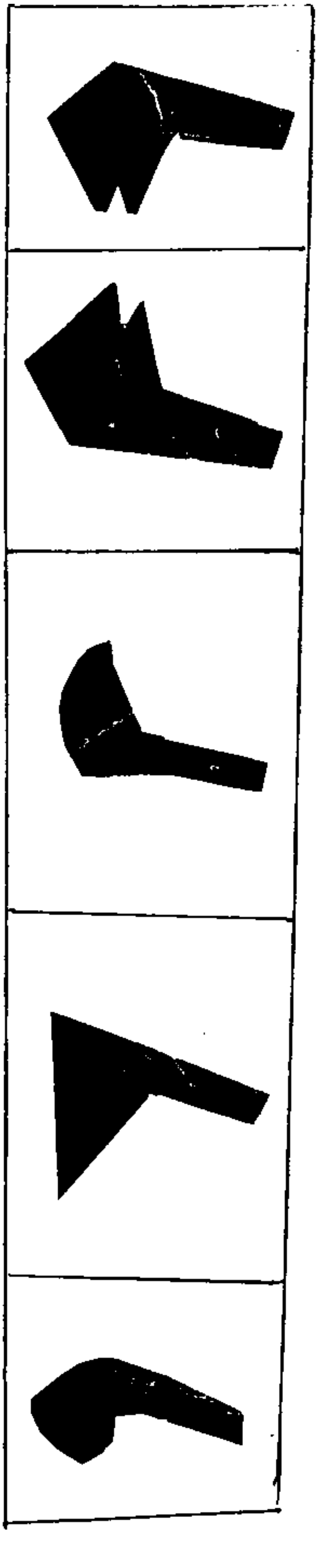


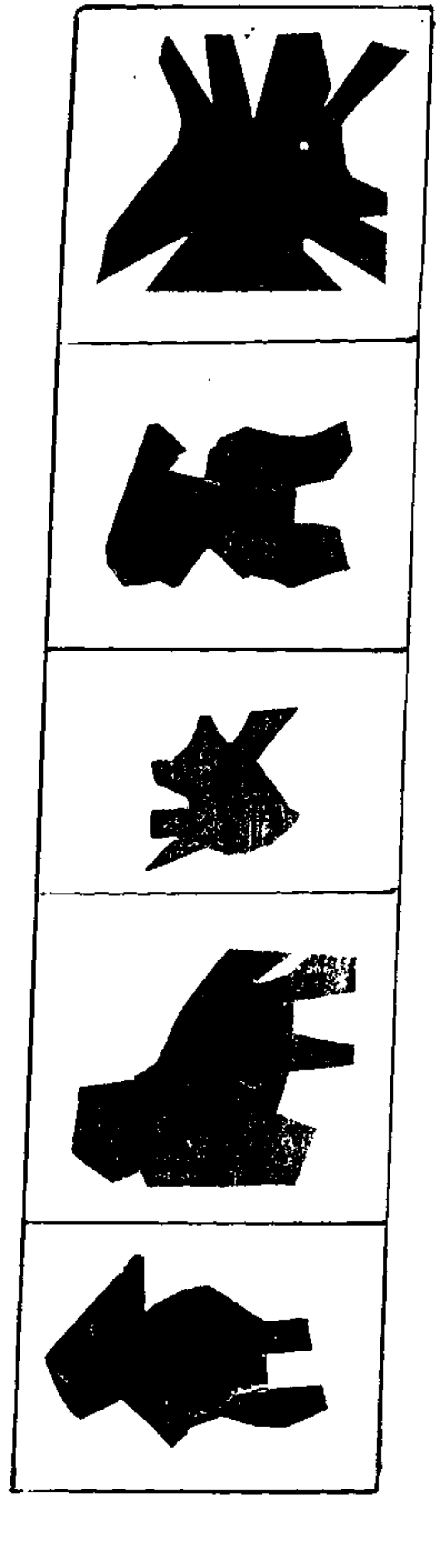


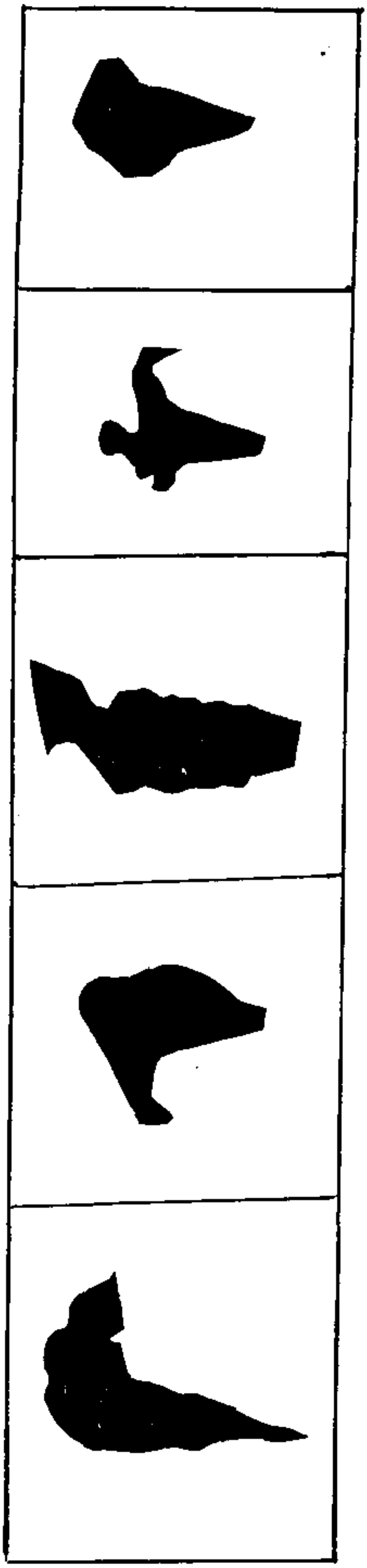


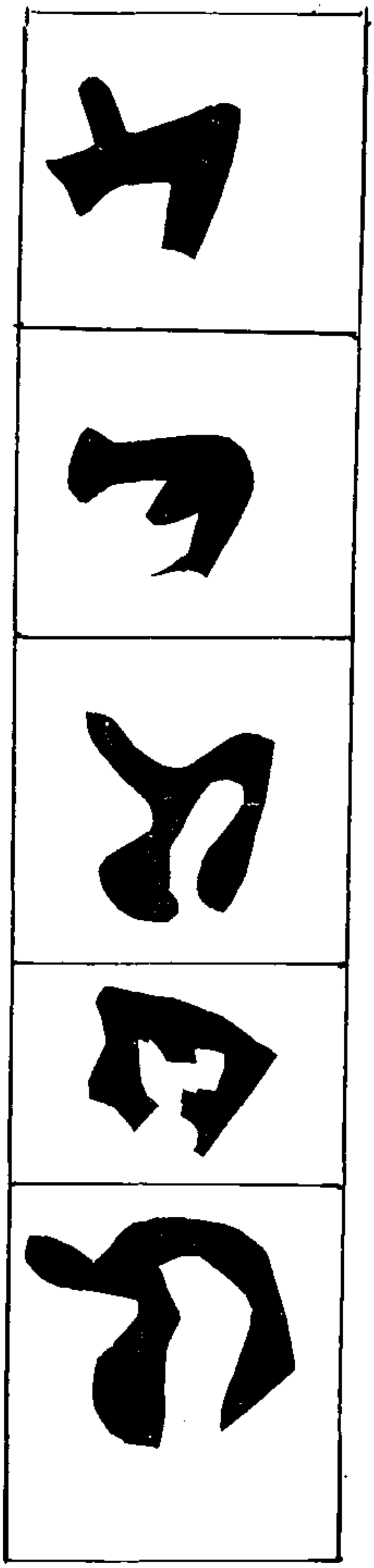












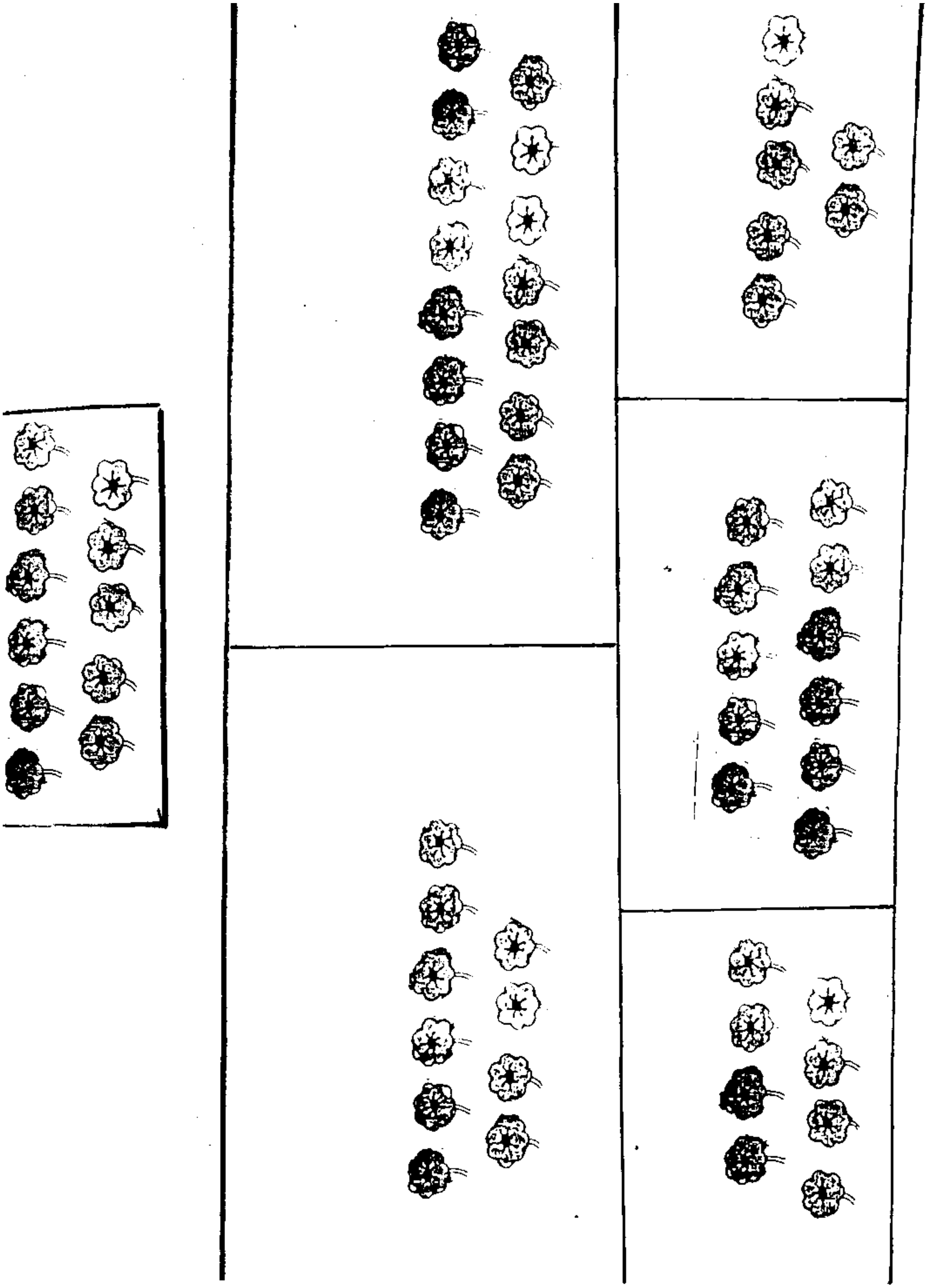
VISUAL PICTURE MATCHING TEST

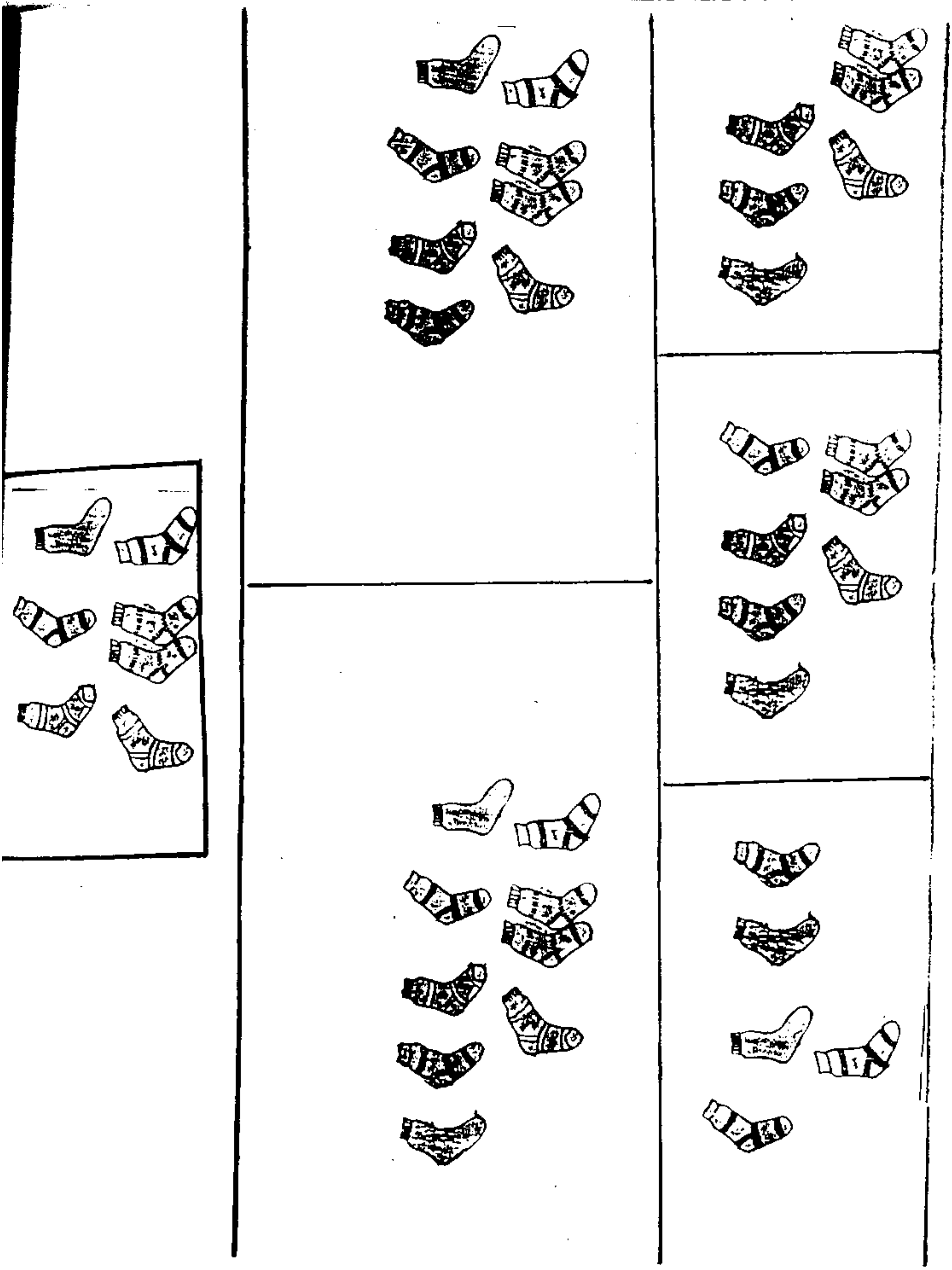
booklet consist of 15 leaves.

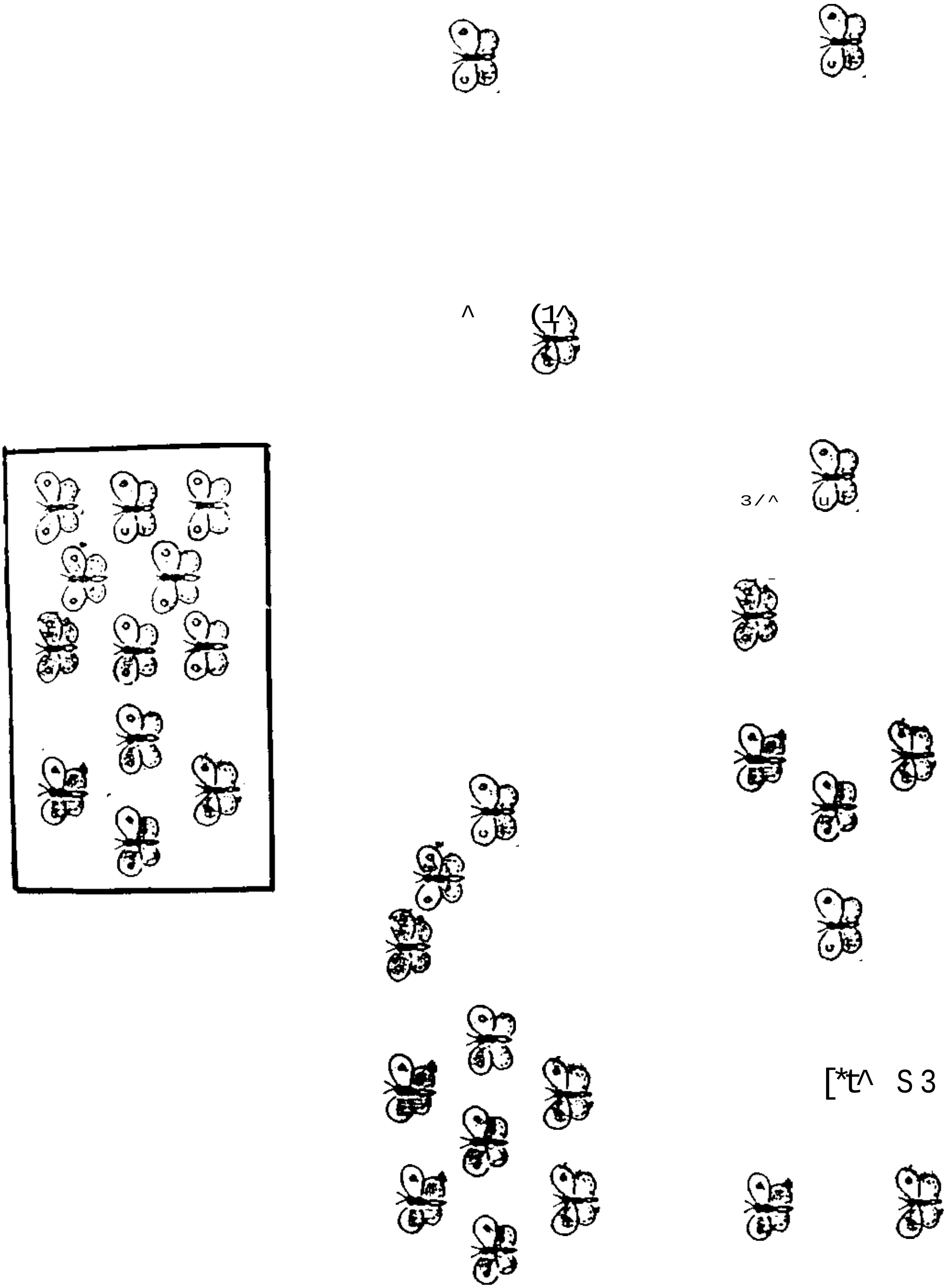
Subject is requried to match the model numbers, either is numerical, pictures or figures to the various alternatives given below the line on eacr page.

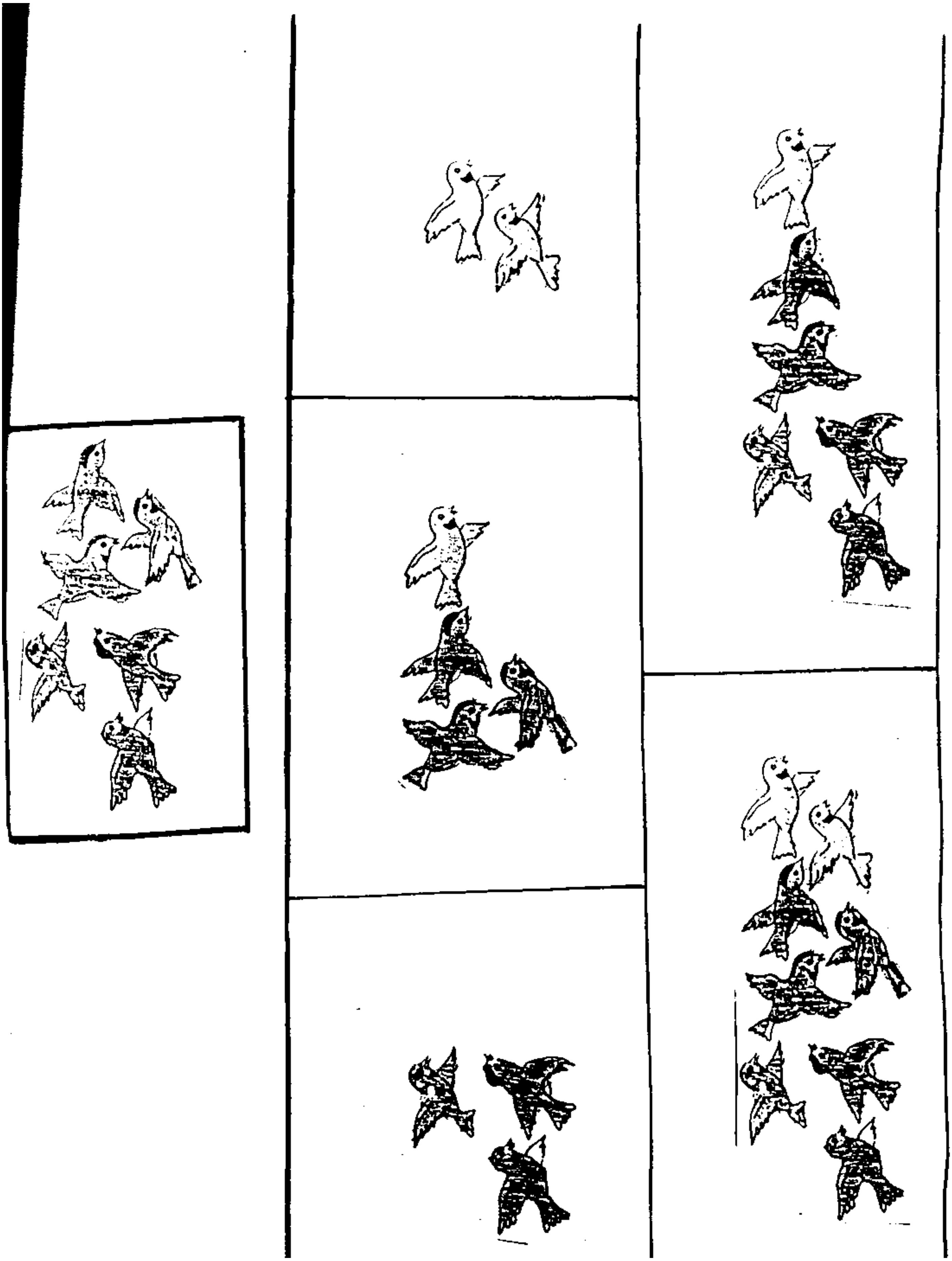
Score one for every correct matching on each page. Incorrect matchings are to be noted down, but not ircluded for scoring.

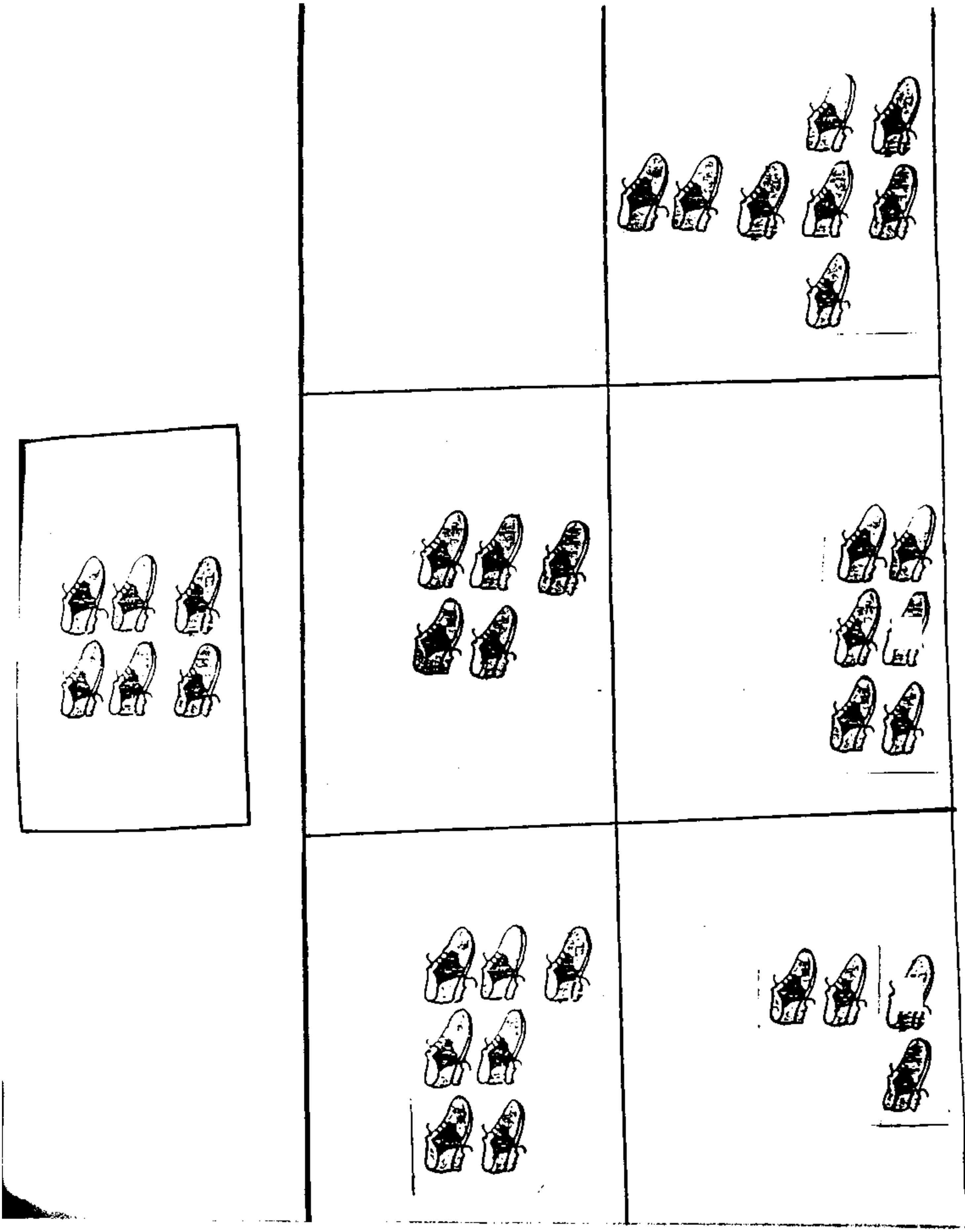
Maximum score : 15











1

7	4	1	3	5

9

6	9	1	4	2

7

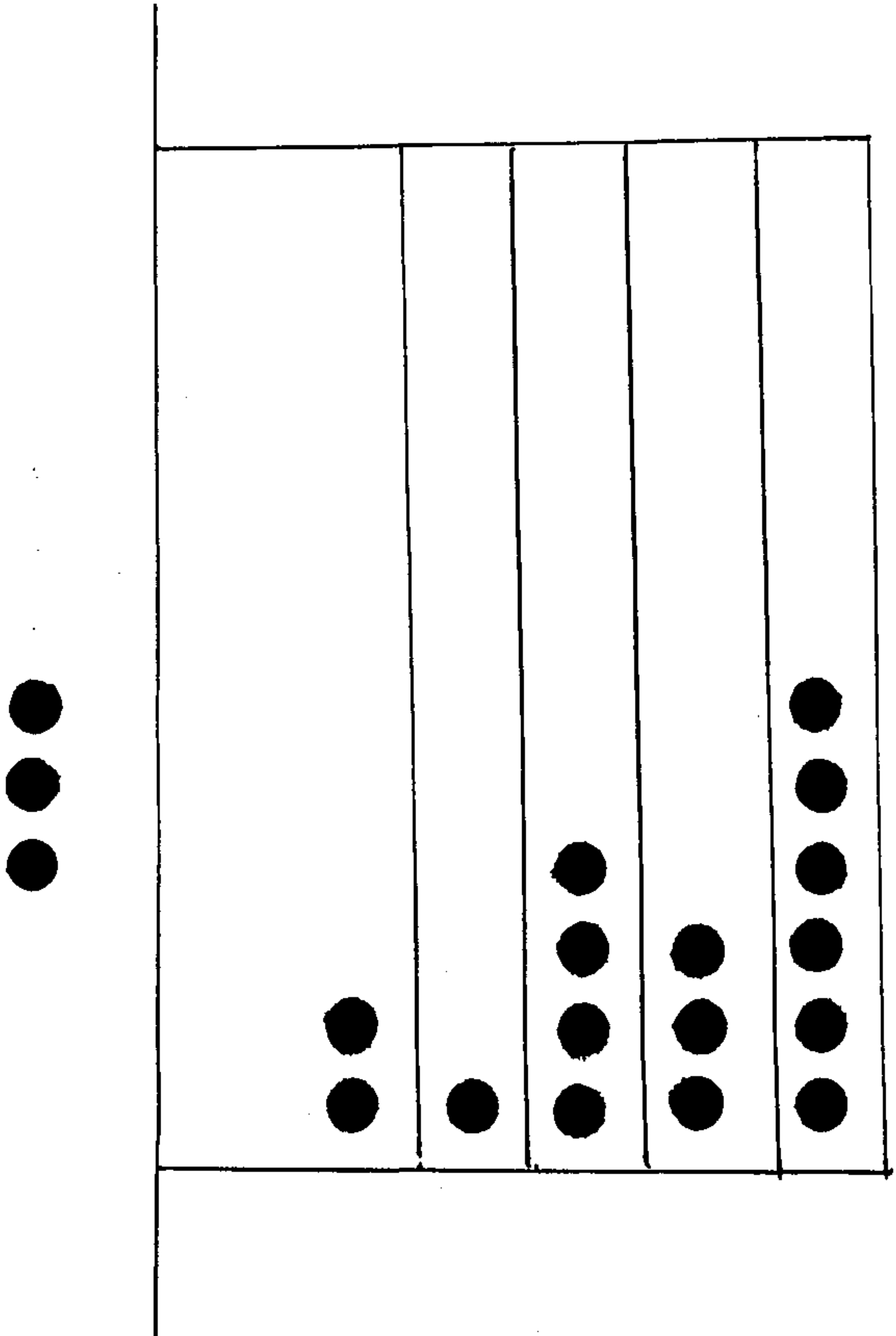
6	1	7	8	2

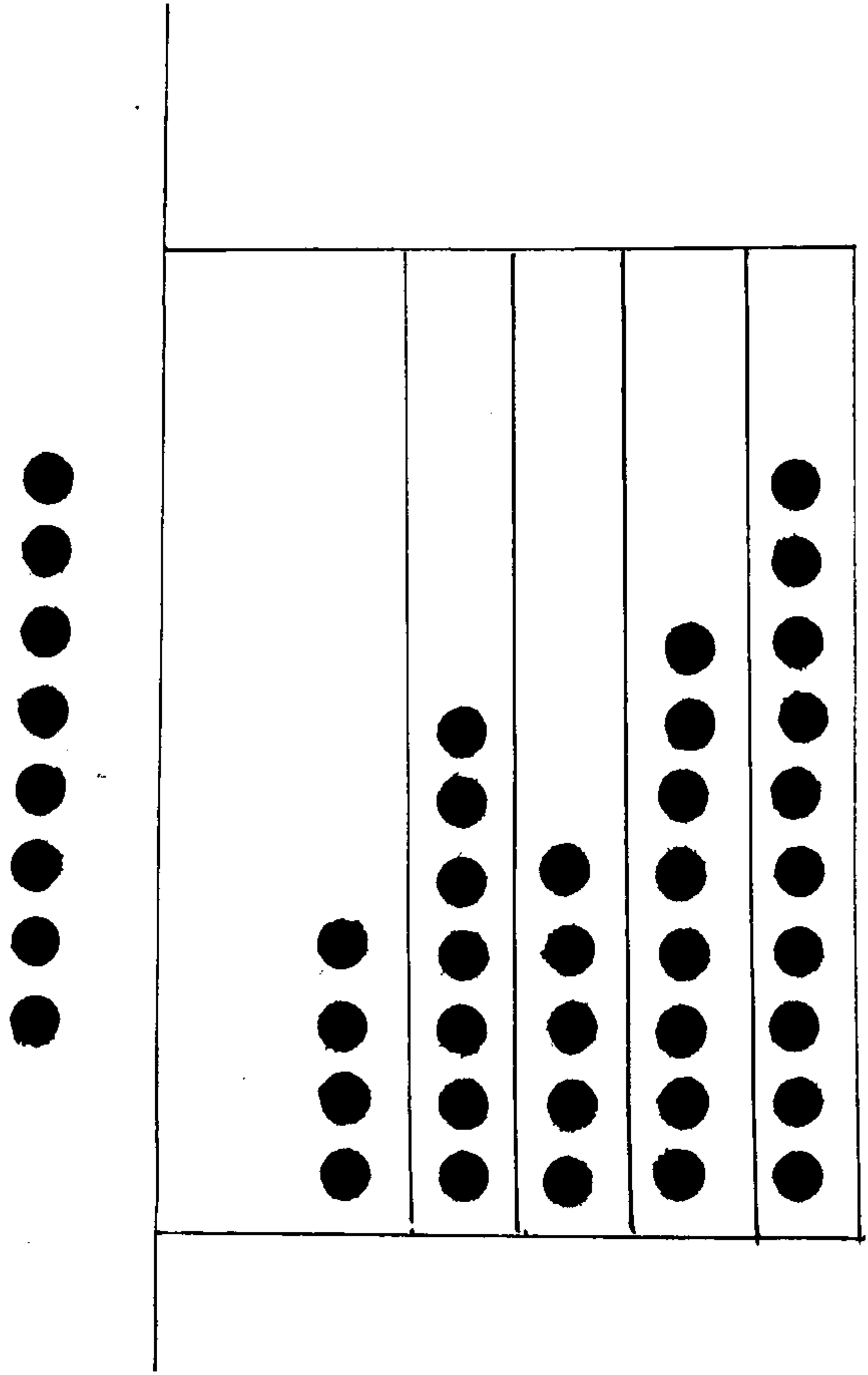
3

2	1	8	7	3

15

14	18	21	15	1





[redacted]

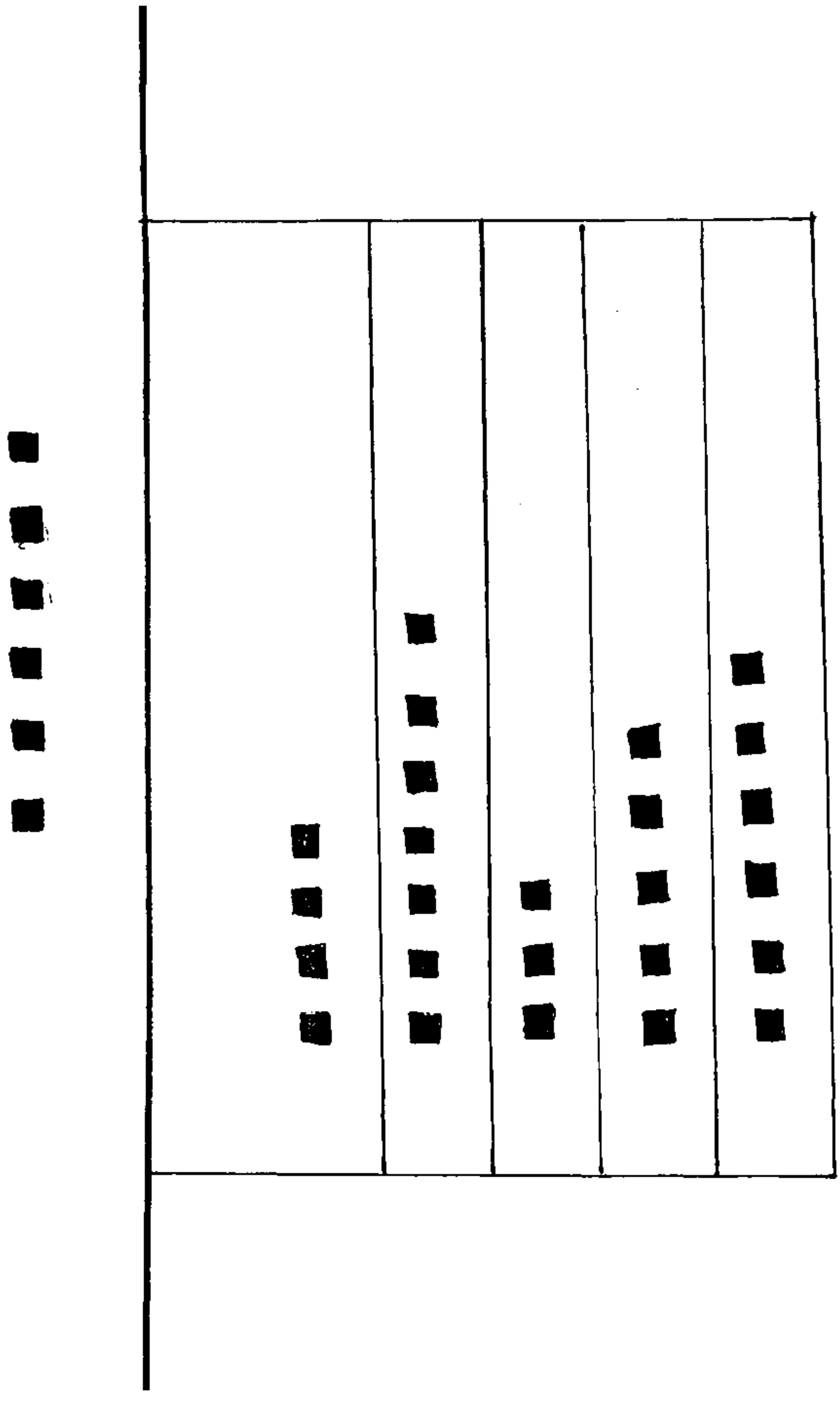
[redacted]

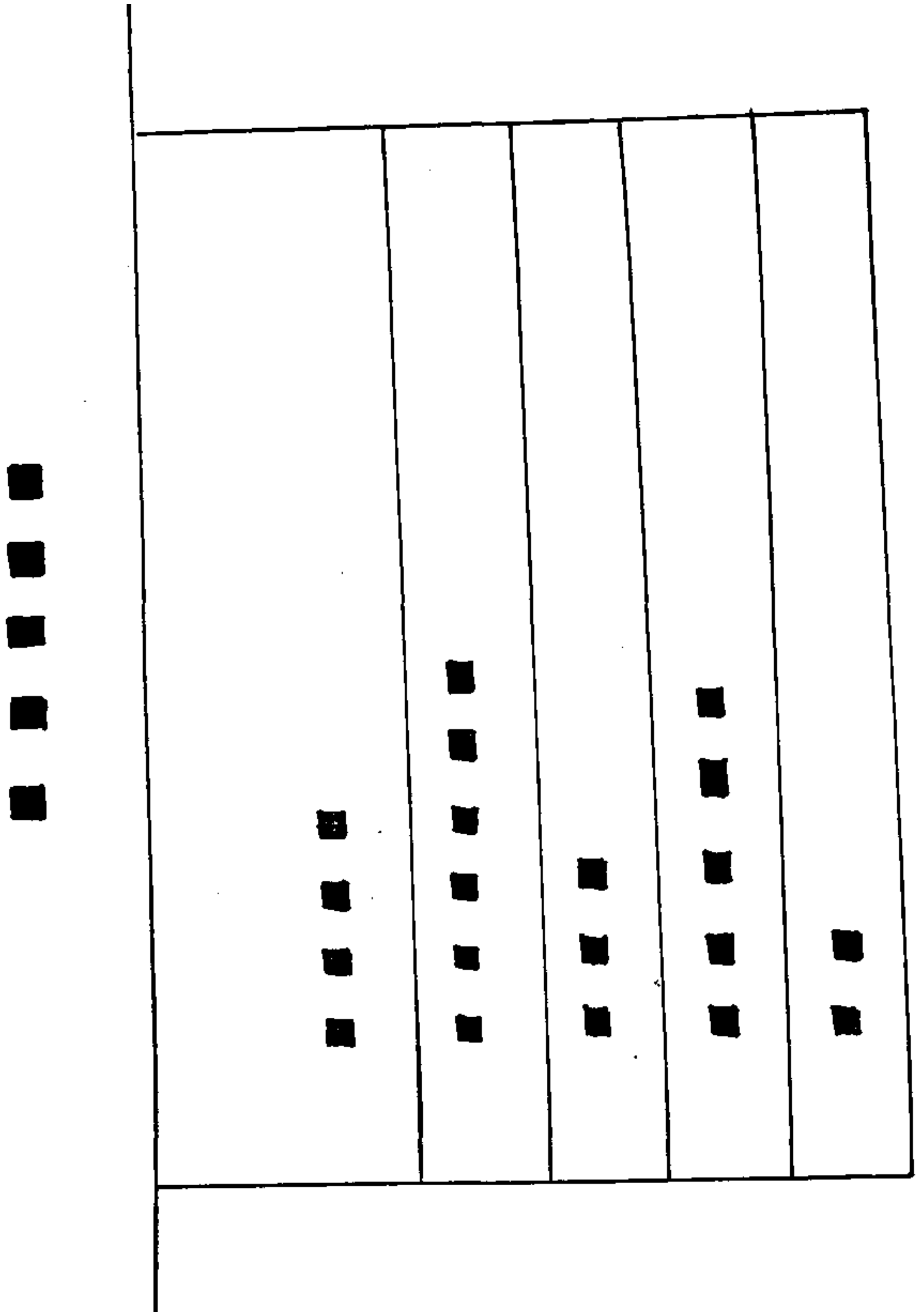
[redacted]

[redacted]

[redacted]

[redacted]





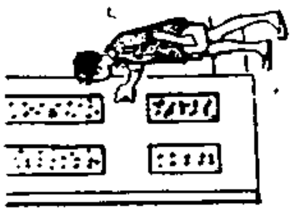
VISUAL PICTURE DISCRIMINATION TEST

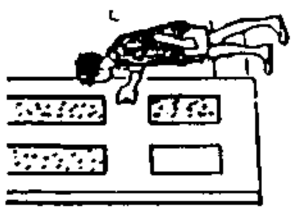
Booklet consists of 15 leases.

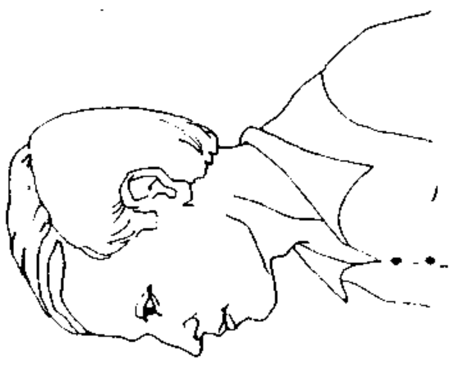
Subject is required to discriminate and point out to differences between pairs of similar pictures presented before him.

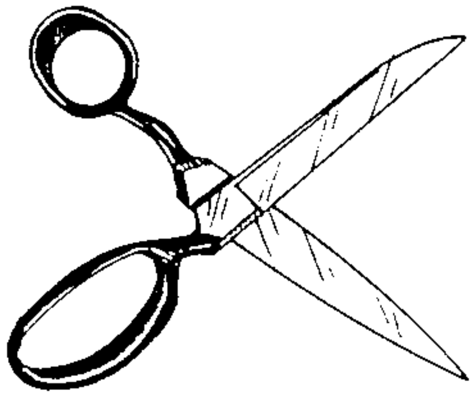
Score one for every correct discrimination pointed out in each page.

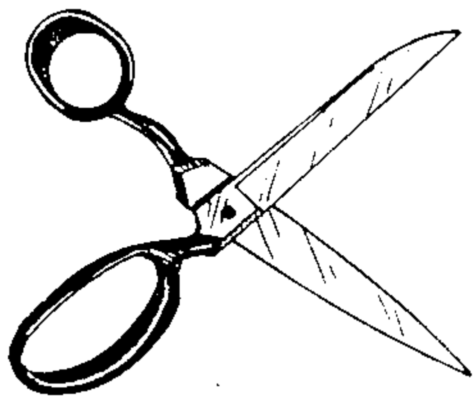
Maximum score : 15

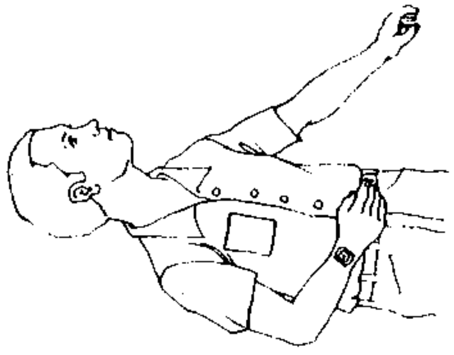


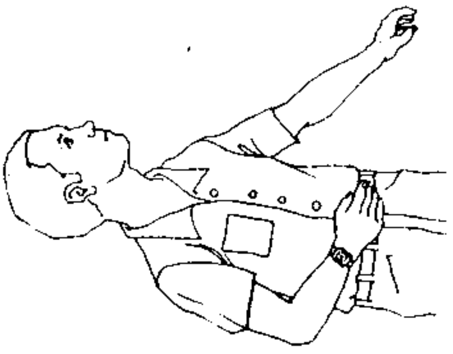


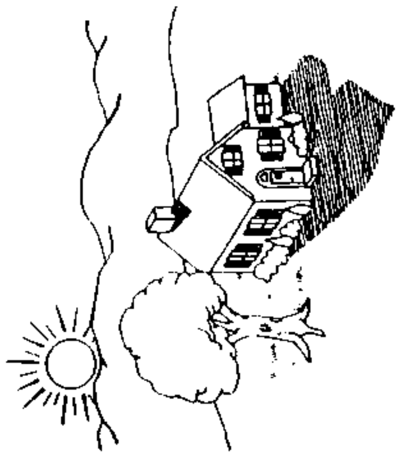


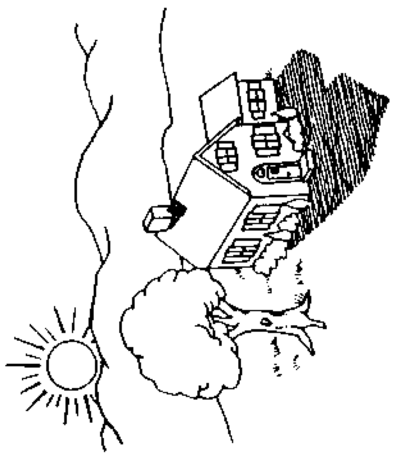


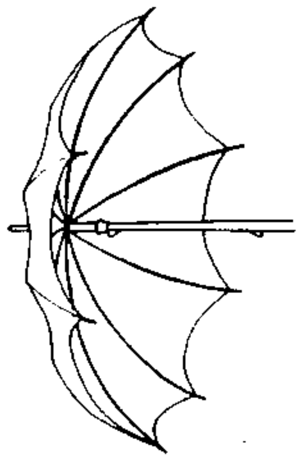


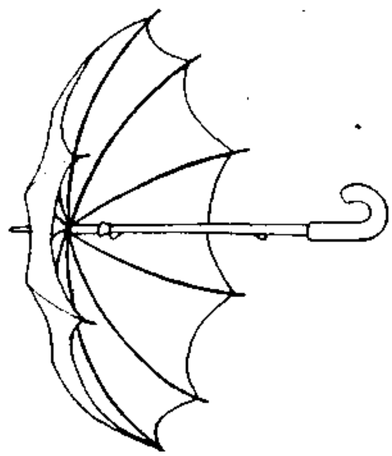


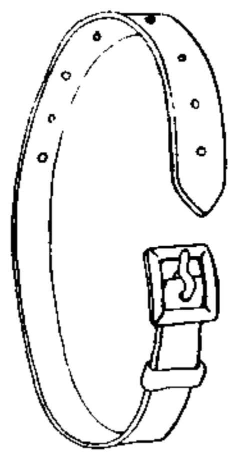


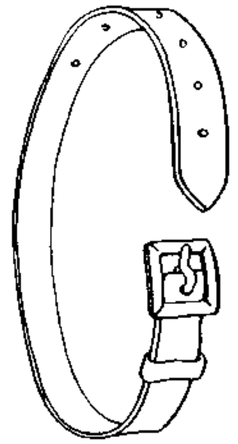


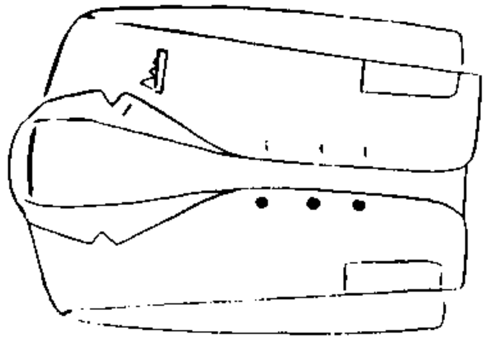


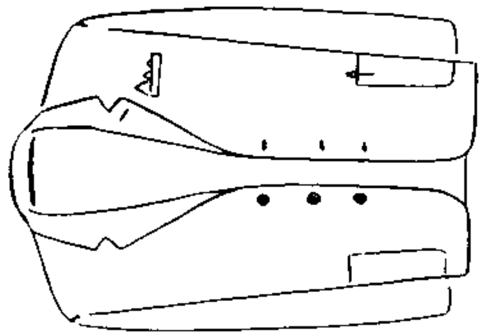


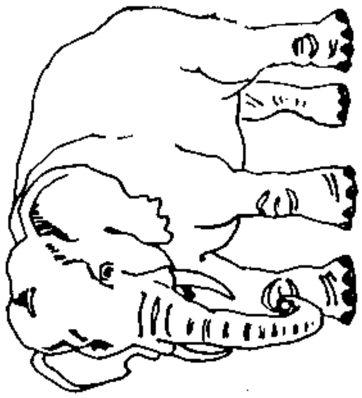


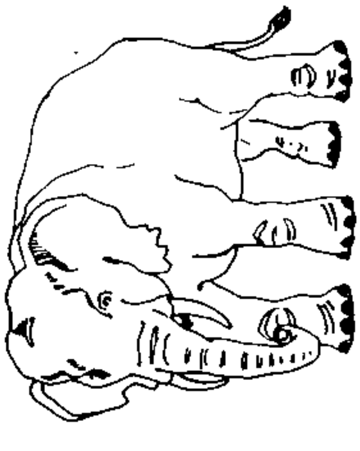


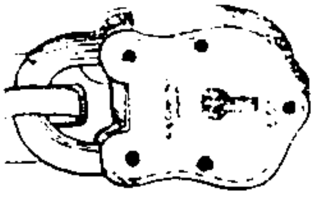


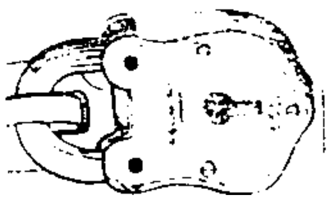


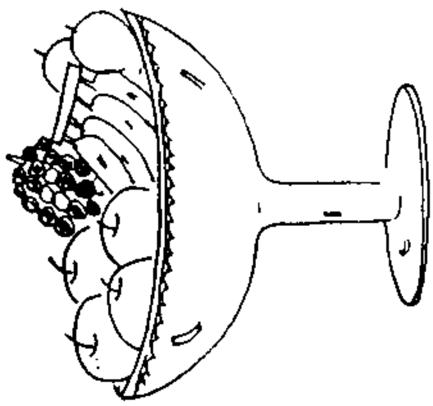


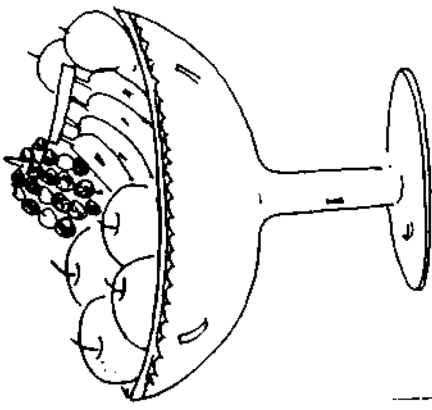












EMBEDED FIGURES TEST

Booklet consists of five leaves.

Subject is required to correctly identify the names of objects drawn superimposed on each other.

Score in terms of number of correctly idnetified objects.

Figure 1 Maximum score is	2
2	3
3	3
4	3
5	4

Maximum score : 15

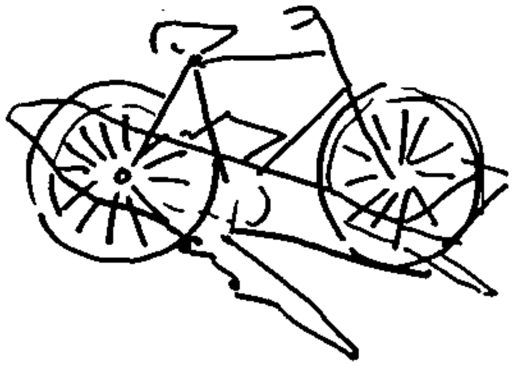


Figure 1

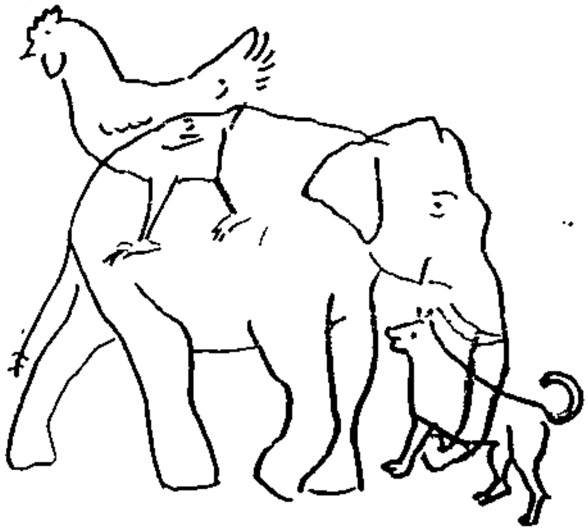


Figure 2

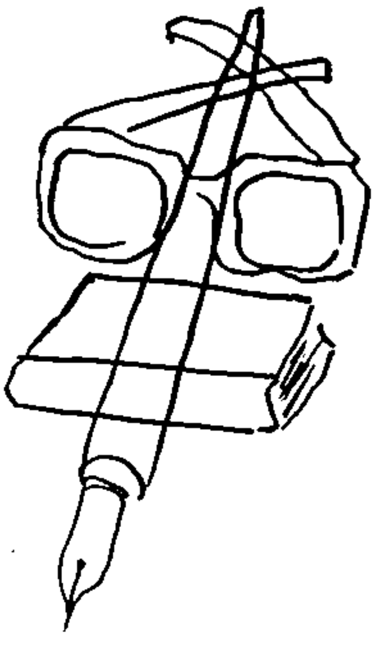


Figure 3

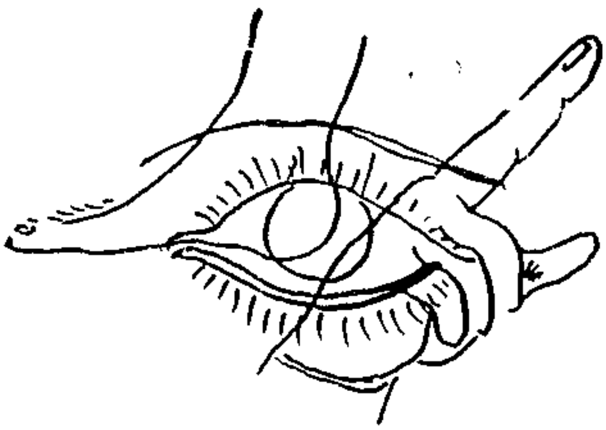


Figure 4

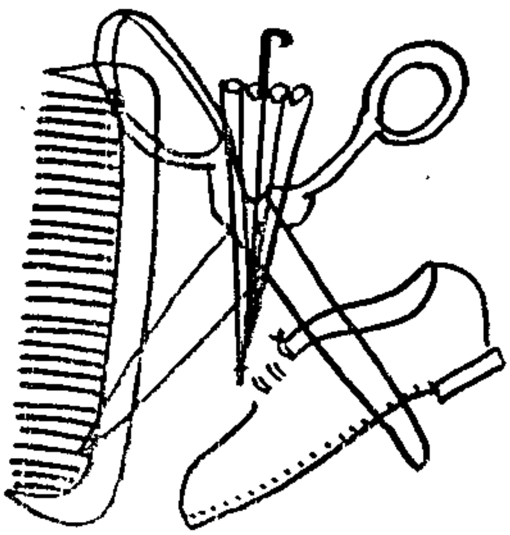


Figure 5

VERTICAL BLOCKS ASSEMBLY TEST

Consists of ten models of cube constructions (including the first demo strat'or item) which is to be presenter before the subject one after the other, to be assembled by the subject.

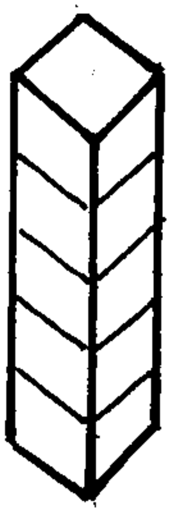
Scoring : For correct assembly of

Items 1 - 3 Score one each
4 - 9 Score two each

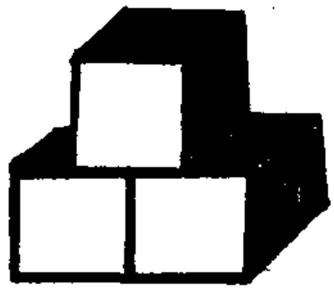
(Item one is for demonstration)

Maximum score : 15

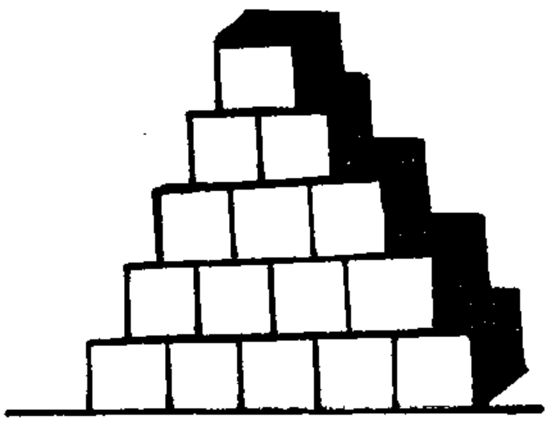
(Item for demonstration)



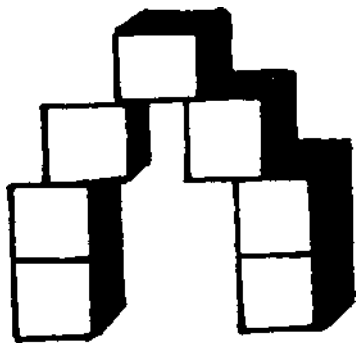
(Item : 1)



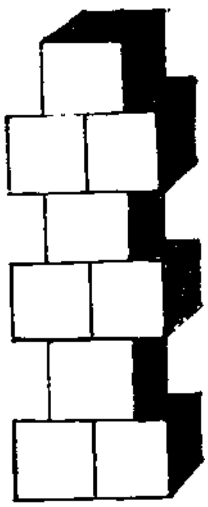
(Item : 2)



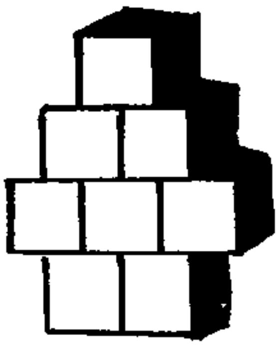
(Item : 3)



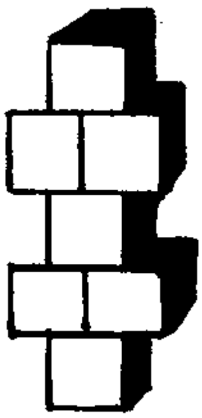
(Item : 4)



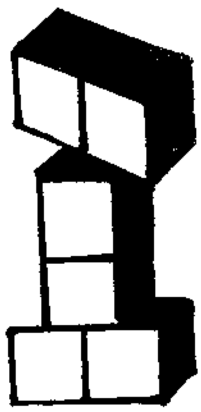
(Iten : 5)



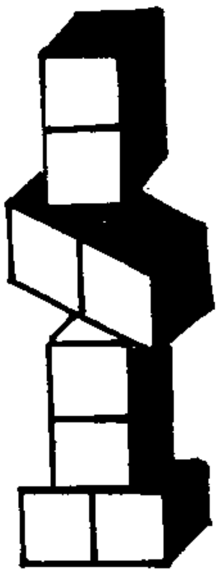
(Item : 6)



(Item : 7)



(Item : 8)



(item : 9)

Appendix 1

Laterality Preference Schedule, Modified

With which hand would he/does he:

1. Wipe a table with cloth
2. Hold a glass when drinking
3. Put a coin into a box
4. Raise when called out
5. Write
6. Brush teeth
7. Eat
8. Comb or brush hair
9. Open a drawer or dresser
10. Point to objects
11. Pick an object kept on a table
12. Switch on light
13. Have the greatest strength
14. Hold a pair of scissors for cutting
15. Use first while putting on shirt
16. Erase a pencil mark with eraser
17. Hurl a ball
18. Hold an umbrella while walking

With which foot would he or does he:

19. Kick a ball
20. Hop
21. Put on his footwear first
22. Stand the longest
23. Extend first when asked to stand and walk
24. Have the greatest strength

With which eye would he or does he:

25. Look through a small hole
26. Aim while hitting a marble/ ball
27. See thorough a tube or kaleidoscope
28. Spontaneously see when asked to close one eye

With which ear would he or does he:

29. Listen to telephone
30. Listen to faint sound from a distance

Appendix 2
Work Behaviour Rating Scale

Given below are a few statements describing the various components of work behaviour. Read them carefully and attempt to rate each student in your class/section along a six point scale, not applicable (0), unaaceptable (1), poor (2), satisfactory (3), good (4), or excellent (5). Only the last item on this Scale has to be rated as not applicable (0), fully dependent (1), needs physical guidance (2), needs visual instruction (3), needs hints (4) or independent.

Name of student: Section:
Name of instructor:
Age: EQ: Experience:

1. Readiness or willingness to work
2. Acceptance of works or responsibilities
3. Punctuality at work
4. Regularity at work
5. Speed of work
6. Persistence or perseverance at work
7. Independence at work or working by self
8. Comprehension of work instructions
9. Memory in work
10. Quality of work
11. Use of safety measures at work
12. Achievement or accomplishment of work goals
13. Reporting of finished work
14. Spontaneous seeking for more work
15. Learning from past experience in work
16. Team work
17. Interpersonal relationships at work
18. Interpersonal relationships with members of opposite sex
19. Acceptance of authority figures, rules and regulations at work
20. Amount of supervision or assistance required at work

Appendix 3
Sample of Recording Sheet

VISUAL OBJECT MATCHING TEST

Items	M	M
Pencil		
Cloth		
Bottle		
Knife		
Pin		
Key		
Money		
Needle		
Tie		
Lock		
Bangle		
Eraser		
Button		
Comb		
Thread		

VISUAL PICTURE MATCHING TEST

Items	M	M
Table		
Bird		
Sun		
Cycle		
Cow		
Boy brushing		
Eye		
Moon		
Bus		
Chair		
Elephant		
Girl writing		
Jug		
Cock		
Dog		

VISUAL OBJECT SHAPE MATCHING TEST

Items	R/W	Items	R/W
Circle		Rectangle	
Triangle		Plus	
Semi circle		Square	
Quadrant of circle		Diamond	
Flag		Rectangle with circular ends	
Hexagon		Star	
Rectangle with curved ends		C shape	
Cone			

Score________

VISUAL PICTURE SHAPE MATCHING TEST

Items	R/W	Items	R/W
1.		2.	
3.		4.	
5.		6.	
7.		8.	
9.		10.	
11.		12.	
13.		14.	
15.			

Score________

VISUAL OBJECT SIZE MATCHING TEST

Objects	Ratio	R/W
Buttons	1 : 4	
Cross	1 : 3	
Circle	1 : 5	
Bangles	1 : 6	
Nails	1 : 7	
Washers	M : 3	
St. Lines	2 : 10	
Triangles	3 : 10	
Squares	4 : 10	

Score________

VISUAL PICTURE SIZE MATCHING TEST

Items	R/W	Items	R/W
1.		2.	
3.		4.	
5.		6.	
7.		8.	
9.		10.	
11.		12.	
13.		14.	
15.			

Score________

VISUAL OBJECT COLOR MATCHING TEST

Color	Materials	No.	Name
Blue	Bangle, pencap, button (3)		
Red	Pencil, spoon, cup, bangle, ball, star (6)		
Green	Bangle, button, Chocolate, pencil (4)		
Yellow	Bangle, ring, pen, stick, crayon (5)		
White	Thread, lid, pen, Crayon, cloth, chalk (6)		
Black	Box, pencil, lid, bangle, button, diary (6)		

Pink Brown Purple Orange

VISUAL OBJECT NUMBER MATCHING TEST

Heap	R/W	Heap	R/W
2 - 2		2 - 7	
3 - 3		2 - 3	
7 - 9		6 - 6	
8 - 8		9 - 8	
13 - 15		12 - 13	
11 - 11		21 - 21	
19 - 19		5 - 9	
14 - 14			

Score________

Serial counting : Present/absent

Rote :

Object :

Max.No. :

No.recognition :

VISUAL OBJECT DISCRIMINATION TEST

Button	Color, size, no.holes
Pencils	Color & size
Spoons	Color, shape, size & material
Bangles	Color & size
Coins	Size & value
Beads	Color
Lids	Color

Score________

VISUAL PICTURE COLOR MATCHING TEST

Items	Max. Score	Score
1	1	
2	2	
3	1	
4	1	
5	2	
6	4	
7	3	
8	2	
9	1	
10	4	
11	2	
12	4	
13	1	
14	2	
15	1	

Score________

VISUAL PICTURE NUMBER MATCHING TEST

Page	R/W	Page	R/W
1		2	
3		4	
5		6	
7		8	
9		10	
11		12	
13		14	
15			

Score________

VISUAL PICTURE DISCRIMINATION TEST

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Score________

MEMORY FUNCTIONS

IMMEDIATE AUDITORY MEMORY — RECENT AUDITORY MEMORY

IMMEDIATE VISUAL MEMORY — RECENT VISUAL MEMORY

EMBEDDED FIGURES TEST

Figure	Max.Score	Score
1	2	
2	3	
3	3	
4	3	
5	4	

Score________

FIGURE DRAWING TEST

1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.

Score__________

AUDITORY FUNCTIONS
SOUND PRODUCTION TEST

1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.
16.	17.	18.
19.	20.	21.
22.	23.	24.
25.	26.	27.
28.	29.	30.

Score________

ATTENTION CHECKLIST

(Score 0 - 3)

Arousal

Activation

Orienting response

Vigilance

Habituation

Distraction

VERTICAL BLOCK ASSEMBLY TEST

Items	Max.Score	Score
1.	1	
2.	1	
3.	1	
4.	2	
5.	2	
6.	2	
7.	2	
8.	2	
9.	2	

Score________

STICKS TEST

1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.

Score_______

TEST OF IDEATIONAL FLUENCY

1. Round
2. Green
3. Animals
4. Fruits
5. Wood

Total:

Average:

V I T A

S VENKATESAN

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Professional Background:

Underwent pre Doctoral training and specialisation in Clinical Psychology at NIMHANS, Bangalore in 1985-87.

Developed and co-authored "Behavioural Assessment Scales for Indian Children with Mental Retardation" (BASIC-MR) and "Behavioural Approach in Teaching Mentally Retarded Children: A Manual for Teachers" under a UNICEF funded "BM Project" between the years 1989-92.

Published over fifteen Research Articles/reviews on various topics in the field of Mental Retardation in various Indian and foreign Journals.

Consultant Clinical Psychologist to various Special Schools.

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