CHAPTER II

REVIEW OF RELATED LITERATURE

Reviewing the related literature helps the researcher to know the studies already conducted in the field and to ensure that what one is going to do is not just a repetition of the previous work.

2.1 Structure of Intellect Model – Studies in Abroad

The studies conducted in this area are reviewed in this section. Since the number of pertinent studies conducted in Abroad is small in number the reviews are presented as a part of the second chapter.

Williams, M. (1969) studied the Structure of Intellect factors as determined by the Stanford-Binet in kindergarten boys.

This study investigated factors of Guilford's Structure of Intellect in Kindergarten boy using Meeker's Structure of Intellect Analysis of Binet responses. It was also concerned with the relationship of these Structure of Intellect Binet patterns and behavioural characteristics.

The study was limited to 50 male kindergarteners from lower-middle class homes who were enrolled in five elementary schools in the El Monte School District of Los-Angeles County. These boys were selected by their kindergarten teachers because their behaviour was "Somewhat different" from "average" kindergarten age behaviour. Binet test was administered to each of the 50 boys. Structure of
Intellect templates were used on each of the Binet tests to arrive at a Structure of Intellect profile for each child. Evaluation by first grade teachers of children's present behaviour was done according to the following categories: reading problems, behaviour problems, educationally handicapped, doing well, creative and shows leadership ability. Data was tabulated and analyzed. Structure of Intellect profile responses were identified as a strength if there were two or more pluses in the same content, level or process. A weakness was the presence of two or more minuses.

Findings

i. Thirty Five of the 50 boys in the study showed deficits in "Memory" Operations on the Structure of Intellect profiles.

ii. 38 Boys showed strengths in the Figural dimension of "Cognition".

iii. 12 of the boys showed strengths in Semantic dimension throughout all five operations.

iv. Six boys showed strength in Evaluation.

v. Boys with IQ's over 120 showed a greater number of strengths in "Memory" and the Semantic dimensions throughout the Structure of Intellect profile than those with IQ's below 120.

vi. The six boys considered educationally handicapped by their Structure of Intellect profiles showed higher total weighted scores on both 'parents' and 'teachers' ratings on the Burk's Scale indicating
that their behaviour problems were noticed to a more severe degree.

vii. 12-20% who were rated as having a problem to a 'considerable' degree regarding a poor self-concept also had low Divergent production scores.

**Feldman, B.** (1970) studied the relationship between Structure of Intellect (selected) factors and academic achievement at the primary level.

The concern of this study was the discovery of specific intellectual correlates of first-grade reading success. The study was designed to test the predictability of first-grade reading achievement from selected intellectual abilities that were defined in Guilford's Structure of Intellect model. The study sought to confirm the existence of CFU-V, MFU-V, MFU-A, EFU-V and CMU at the 6 year level, to establish the existence of CFU-A and EFU-A at the 6 year level, and to identify those Structure of Intellect abilities that significantly correlate with first grade reading achievement out of CFU-V, CFU-A, MFU-V, MFU-A, EFU-V and CMU. The Content of information selected for this study was Figural.

The experimental subjects consisted of first-grade pupils within a particular age range drawn from 15 elementary schools. The group on which the factor analysis was made contained 196 pupils of whom 93 were boys and 103 were girls. The sample that underwent the multiple regression analysis was reduced in size to 174 pupils most of
which was due to sampling alternation over time. A Battery of 21-predictor tests was administered. The order of test administration was random for group and individual tests. All predictor tests were scored by hand and separately checked by a different scores. Research design was a multivariate correlational field design, incorporating the methods of factor analysis for testing the construct validity hypotheses and multiple regression analysis to test the predictive validity hypotheses.

**Findings**

i. The factors MFU-V, MFU-A, EFU-V and CMU were confirmed at the 6-year level, while CFU-V was extended for first time from 5 year level to the 6 year level.

ii. CFU-A emerged as a new factor at the six-year level. It did significantly increase multiple-R by 3 per cent.

iii. EFU-A was identified as a unique factor for the first time at any age. EFU-A played a minor role in word reading and was virtual absent in paragraph meaning.

iv. CFU-V was the only factor not significant related reading achievement in first-grade.

v. EFU-V was another strong predictor of reading success, accounting for 12% of the total variance.
vi. CMU, the ability to comprehend the meaning of words was also significant predictor of reading skill, both for word reading and paragraph meaning.

vii. CMU accounted for 7% of success in total reading.

Brown Darrell (1971) conducted a study which sought to find whether some mental abilities measured by items on the Stanford-Binet Scale are more closely related to the sex and social class status of preschool children than others and the relative magnitude of the relationships be predicted from Guilford’s Structure of intellect (SOI) theory of intelligence.

Subjects for the study were drawn from a pool of 616 children between the ages of 3 years and 2 months and 4 years and 7 months, who were routinely tested over a 2½ year period for possible early entrance into kindergarten in the sampling community. The two-dimensional design was used. Equal numbers of males and females, high status and low status children constituted the groups, 100 in each cell of the design. Correlation coefficients (indices showing the degree to which ratings on any 2 factor agree with each other) were computed between the social class rations of subjects and their item scores on each and every item of the Stanford-Binet Scale to which atleast 5 subjects responded. Data on mental abilities, social class and tests behaviours of the children were collected when their parents brought them for voluntary preschool testing. The instruments used for measuring the data were.
1. The Stanford-Binet Intelligence Scale, Form L-M, (Terman & Merrill, 1960)

2. Templates for Structure of Intellect Analysis, designed by Meeker

3. The Two Factor Index of Social Position (Holling Shead, 1957)

4. A Check-Sheet for Social and Emotional Status of the Child: Test Behaviour (Brich, Tisdall, Barney and Marks, 1965)

Findings

i. Cognitive abilities showed more frequent and larger statistical relationships to social class than did other thinking processes measured by Binet.

ii. Those items categorized as Semantic in Content were more often significantly related to social class and tended to yield correlations of greater magnitude than items measuring Figural Content. All significant correlations favoured the HS group, even the few for Figural Content. Several items correlating negatively (LS group) were all Figural items.

iii. There was no systematic increase in magnitude of relationships along the Structure of Intellect Products dimension for 3 and 4 years old.

iv. The only phi co-efficient significantly relating sex and scores on Semantic items did favor girls.
Meeker, M. N. (1971) studied memory factors and school success of average and special groups of ninth-grade boys. Study focused on short-term memory in its relation both to the Structure of Intellect and to differential school success.

The purpose of the study was to investigate the assumption that immediate Memory is molar and to ascertain whether certain tasks which are assumed to test Memory not only demand but are predicated upon different kinds of Memory abilities. It sought to differentiate span-type Memory abilities in ninth-grade boys of average intellectual ability and to determine whether specific Memory abilities can be related to specific curricular tasks. It also sought to determine whether specificity in Memory is due in part to mode of input.

The study was conducted in three parts.

Part I Studied different short term Memory ability factors of Structure of intellect model existing independently of other abilities and of each other and also discriminated according to sensory modes of presentation, and according to forward vs. backward re-product by the subject. Part II tested some relationships of the resulting Memory factors with school subject matter by exploring the achievement status of students of Part I. Part III was an extended study of the significance of high and low Memory ability by determining the factor scores of other ninth grade students with unusual learning characteristics. The boys identified were of: (i) Behaviour Problem-13 boys with behaviour problem but not failing any academic subject. (ii) Educationally
Handicapped-11 boys labeled as an educationally handicapped in a special program for those of average or superior IQ but 3-5 years retarded in school achievement; considered potential dropouts with learning difficulties. (iii) A-English-11 boys making 3 consecutive A's in English but no A's in other academic subjects. (iv) F-English-6 boys making 3 successive F's in English but not failing in other academic subjects. (v) A-Math-13 boys making 3 consecutive A's in mathematics but no A's in other academic subjects. (vi) F-Math-6 boys with 3 consecutive F's in maths but not failing in other academic subjects. The 4 separate memory ability factors were Auditory-forward, Auditory-backward Visual-forward and Visual-backward.

Subjects for Parts I and II were 90 boys of ninth grade, selected to have IQs on group tests between 90 and 110 and to be otherwise undistinguish in personal or physical traits. In Part II, 10 boys out of original 90 receiving the highest and the lowest factor scores for each factor provided the basis for relating Memory abilities to academic success or failure. Part III reversed the logic of part two; Factor scores on Memory were determined for other boys who were distinguished in one way or another in the high school and who were not in the original 90. Three contrasting pairs of small groups were formed, each the total available in the high school. One was Behaviour problems vs. Educational handicap. The Second were groups receiving A's only in English not in other subjects vs. F's in English only. The Third
were groups receiving A’s in mathematics only vs. those receiving F’s in maths only.

**Findings**

i. Factor analysis of the resulting inter-correlation matrix yielded 6 interpretable factors, of which three saturated the 8 span tests. These were thus identified as three of the anticipated 4 factors. A very clear Auditory-forward factor (VI) completely fulfilled expectation. The Auditory-backward (II) also saturated one Visual-forward test; the Visual-backward factor (V) saturated one of the Visual-forward test. Thus, while three Memory factors emerged unmistakably independent of the other tests, they cross-loaded each other some what. The Memory tests did not load to any extent on the other factors nor did other variables load importantly on the memory factors.

ii. High and low scores of Auditory-backward (II) were distinguished in arithmetic and in language sentences. Visual backward (V) related to spelling, but also distinguished language sentences as well. High and low scorers on Auditory-forward (VI) did not distinguish subject matter achievement but did relate to spelling, which was affected by Auditory-backward as well. Spelling was thus predicted by all three Memory factors. Reading was not significantly related to any, because reading is complexly determined.

iii. The most dramatic difference occurred for Behaviour problem vs. Educational Handicap where
all three Memory factors clearly distinguished the groups. The maths groups were distinguished primarily by Auditory-backward, as predicted but also somewhat by the other two Memory scores. The two English groups were distinguished significantly only by Visual-backward (V).

Keith Allen Holly (1971) has conducted a study regarding the "structure of intellect factor abilities and a self-concept measure in mathematics relative to performance in high school modern algebra".

Within the theoretical framework of Guilford’s Structure of Intellect (SI) model, the major purposes of this investigation were to determine the comparative validities of the following composites of predictor variables:

1. SI factor tests alone,
2. Commercially available achievement and aptitude tests alone (COMM tests).
3. Grade point average earned in eighth-grade mathematics courses (MATH) and SI factor tests and
4. MATH and COMM tests.

Stepwise multiple-regression analyses and accompanying double cross-validation procedures involving use of even and add numbered students were employed in the prediction of each of two criterion variables GPA in modern algebra and performance on the Cooperative Mathematics Tests, Algebra (CMT) – from optimally weighted predictor variables consisting of 15 SI factor tests, nine
measures from the California Achievement Tests, three from the California Test of Mental Maturity, and MATH.

Findings

Whereas the validities of the SI factor-test composites were 56 and 60 relative to the GPA and CMT criteria, respectively, the corresponding validities of the 10 COMM composites ranged between 25 and 44 and between 38 and 58. With respect to the same two criteria, the validities of the S.I. factor-test and MATH composites were 60 and 59 and the ranges of validities for the COMM-MATH composites were, respectively, between 44 and 51 (16 composites) and between 46 and 54 (four composites). Typically the administration time of COMM composites was at least twice and often trice that of SI factor tests. Upon cross-validation, the average drop in correlation was about 15.

Lenann Nye (1972) conducted a study on dietary treatment and cognitive development of galactosemic children as analyzed with the Structure of Intellect.

The study sought to find any significant difference in intellectual functioning between galactosemic children who never ingested galactose and those children who ingested galactose prior to initiation of their dietary treatment and which Cognitive factors are affected. Secondly, to find the relationship between intellectual development
and the age of the galactosemic child when the dietary treatment was initiated and which Cognitive factors were affected.

Total sample consisted of 29 children and are divided into dietary treatment groups (TG) according to their age. An assessment test battery of 6 instruments was individually administered to the 29 children. Binet profiles were abstracted from the case files at Children's Hospital.

Findings

i. Children placed on a galactose free diet at birth had higher levels of intelligence.

ii. Children whose dietary treatment was initiated between 3 days of life and 1 month of age had lowest levels of intellectual functioning, the weakest ability as defined by the Structure of Intellect factors in Transformations for all galactosemic children regardless of the age when the dietary treatment is initiated.

iii. Children placed on a galactose-free diet at birth function significantly better on factors of Implications and Divergent Production.

iv. Children placed on g-free diet between 1 and 2 months of age had the most flat profile of Structure of Intellect. Abilities indicating no outstanding strengths or weakness.
Ball, R.S. (1972) conducted a study on comparison of thinking abilities of five-year-old white and black children in relation to certain environmental factors.

The purpose of this study was to discover the developmental changes which have taken place with 5 year old children in their ability to do the test of thinking. Both black and white five year olds were studied and there responses were related to environmental information. Another purpose was to present a series of test items for preschool children which would utilize modern techniques for analysing data and the major purpose was to investigate the "Structural" nature of preschool mentality. The final objective was to develop standardized test for the measurement of the specific mental functions and abilities which characterize the different preschool age levels.

The sample includes the 1947 retested five years old and 255 other white 5 years olds. In addition 211 black 5 year olds were tested. A questionnaire covering the environmental influences in the life of 5 year olds was asked of each mother. Scoring of the protocols was done, scores were tabulated for computer treatment. The two groups of children were studied separately. Correlations and factor analyses were made for each.

Findings

i. 15% of the variance in Convergent Figural thinking systems was attributed to race, much less with
Divergent thinking Semantic and reversed with Convergent Figural thinking units, so that in the Figural Cognitive aptitudes, black children outperform white children.

ii. The Figural factor Divergent Thinking Semantic and Convergent Figural thinking units were positively related to age.

iii. Boys had higher means than girls in factor Convergent Figural thinking Systems while sex seems unrelated to Divergent thinking Semantic and Convergent Figural thinking Units.

iv. Education of the mother was a contributor to all 3 factor except for factor Convergent Figural thinking Units in black children.

v. Whether the parents play with the child was clearly a source contributing to performance on factor Convergent Figural thinking systems.

vi. The father's occupation had a more differentiating effect in black than in whites in Semantic Content.

Hays, B. M. & Pereira, E. R. (1972) studied the effect of visual memory training on reading ability of kindergarten and first grade children.

The purpose of this study was to determine whether a specific cell (MFU-V) of Structure of Intellect can be significantly affected by training KG and first grade children, and whether improvement in
MFU-V has a significant effect on reading achievement of first grade children.

Subjects in the project were the entire KG population (4 class rooms) who were randomly assigned to one of two rooms, A or B. Pretest measurements consisted of – The Steinbach Test of Reading Readiness; SRA Primary Mental Abilities (PMA) Test; Winter-haven Visual perception Test; The post testing included a long term Visual Memory Test of Figural, Symbolic and words; and the Gilmore Oral Reading Test. Fifty lessons were constructed and compiled into a manual for the Visual Memory training sessions. Data was compiled on 3 groups of first grade children. Group one was the control group who received no special training. Group two received 1 year of Visual Memory training in first grade only. Group three received training during first grade.

Findings

i. No relation was found between Visual Memory and CA, Visual Memory and home environment, Visual Memory and MA or Visual Memory and sex, favoring girls.

ii. A low correlation of Visual Memory with the auditory score of the ITPA pointed out the differentiation of receptor modalities.

iii. Median scores on the MFU-V subtest of both control and experimental groups improved significantly.
iv. There was not a significant difference between pretest and posttest scores for either group.

v. The median scores of both control and experimental groups on the MSU-V subtest improved significantly.

vi. Both control group and experimental group exhibited improvement in MFU-V and MMU-V due to maturational factors.

**Tucker, J. A.** (1974) developed Prescriptive Approaches to Remediation (PAR) for Austin state school.

The objectives of the PAR project was to provide an individualized educational plan complete with suggestions for materials, methods and techniques to be utilized, for every school-aged pupil in the formal school program of Austin State School for the mentally retarded and to maintain at least status quo with respect to academic skill acquisition and intellectual level of achievement. The plan followed in each individual case was first to test the child, then to formulate a coded educational plan based on information obtained from testing. Standardized testing procedures were maintained and all children were assessed. After scoring the test protocols, the scored data are transferred to a short protocol from which both the Meeker grid profile and the Tucker major dimension profile were filled out. The information presented on the profiles were translated into coded educational plans for each pupils. The educational plan was developed for each child according to strengths and weakness found on the 14
major dimensions, i.e., Cognition, Memory, Figural, Transformations for obtaining the second objective, subjects in the evaluation phase of this study were 121 mentally retarded children. Pupils were tested on the Stanford-Binet (S-B) along with selected personality and motor development tests. From the S-B, mental ages and IQ scores were obtained and subscales scores for the 14 major dimensions were derived. The sample of 88 subjects with mean IQ 39.23 were taken as Quasi-control group and sample of 54 subjects of mean IQ 39.68 were the treatment group. Pearson product moment correlations were performed among all depended variables collected on children during study.

**Findings**

i. The plan developed by PAR Project was in Structure of Intellect program cycle the coded form appeared as MFU-I at MA =6. MFU was followed by MFC, followed by MFR, MFS, MFT and MFI in that order all at a difficulty level appropriate for a child of six. The level at which programming would begin was determined by the age level equivalent at which the child is operating on his weakest dimension. The length of such a programming period depended on the success of the child's performance on the tasks assigned. Quick completion of an MFU-1 program cycle allowed for a recycle through MMU-1 at MA=5 thus using established Memory and Figural strengths to move into Semantic dimension. A typical series of program cycle is MFU-1 at MA=5, MMU-1 at MA=5, CFU-1 at MA=6 CMU-1 at MA=6,
MFU-1 at MA=6 MMU=1 at MA=6, EFU-1 at MA=6 EMU-1 at MA=6. Thus the PAR project prescriptions were given directly for teachers in such coded form for each child in the formal school program.

ii. There were few significant correlations between measures, between intelligence and personality and significant and high correlations between the Structure of Intellect dimension scores and both MA and IQ.

Dailey, Joanne V. (1975) studied the effect of selected Structure of Intellect memory ability materials on second grade reading achievement.

The purpose of this study was to determine if there was a significant difference in visual and auditory memory abilities and reading achievement between disadvantaged second grade pupils whose curriculum consisted of systematic experiences in selected Structure-of-intellect memory ability materials (experimental group) and disadvantaged second grade pupils who have not had access to these systematic experiences using the S.O.I. memory ability materials (control group).

It was found that the desired level of significance was reached from three criterion variables: reading vocabulary, reading comprehension and auditory memory. Sex differences and the
interaction between treatment and sex were not found to be significant.

In view of these results, it was concluded that reading vocabulary, reading comprehension and auditory memory skills for these pupils were improved significantly through the use of daily S.O.I. memory ability experiences.

Boecklen, Warren A. (1975) studied the effect of using a Prescriptive Modulation Retrieval System (PMRS) on attention, concentration and memory as measured by the Wechsler scale of intelligence of children.

In an attempt to aid in the selection of test instruments for differential diagnosis of children with specific learning disabilities, this study investigated the effect of using a Prescriptive Modulation Retrieval System (PMRS) on the psychological processes of attention, concentration and long-term memory as measured by appropriate subtests of the Wechsler Intelligence Scale for Children (WISC).

The research hypothesized that learning disabled students who demonstrated significant gains on the Arithmetic portion of the Iowa Test of Basic Skills would show corresponding gains on the WISC Digit-Span-Arithmetic-Information subtest cluster after completing the treatment program prescribed by the PMRS.
A population of ninety intermediate grade males with full-scale WISC scores ranging from 90 to 110 was selected from six elementary schools in a seventeen school district. All subjects had repeated one grade prior to inclusion in the study and had scored at least one grade level below age expectancy on the Arithmetic portion of the ITBS.

In addition, the WISC Digit Span – Arithmetic-Information cluster of each subject was depressed by six or more scaled score points.

Students thus selected were randomly assigned to three groups. Group A received the PMRS prescriptions and used special materials and teaching strategies. Group B had access to similar special materials but no PMRS prescriptions. Group C served as a control and received instruction in the regular classroom with the teacher making whatever provisions she normally employed for dealing with individual differences.

At item analysis was made of ITBS scores and a behaviourally oriented test, the Basic Educational Skills Inventory (BESI) was used to formulate PMRS prescriptions for use in a six-month treatment program administered by teacher assistants in daily arithmetic sessions with a teacher/pupil ratio never exceeding 1:6.

An analysis of variance was used to test for any significant differences between groups in responding to the hypotheses concerning change in intellectual functioning, change in psychological
processing of information and change in arithmetic skills as a result of treatment.

Findings

1. Use of the PMRS to improve arithmetic skills in learning disabled students was afforded guarded acceptance.

2. Use of the PMRS to improve attention concentration and long-term memory as measured by the Digit Span-Arithmetic-Information cluster WISC subtests was demonstrated untenable.

3. While the negative results of this study need not form a basis for final conclusion, use of this WISC subtest cluster should not be used in the differential diagnosis of students with specific learning disabilities in arithmetic without additional investigation.

D'Errico, Albert Pasquale (1976) studied the relationship between conservation, academic achievement and non-verbal intelligence in children during the concrete operational period.

Psychologists have investigated a multitude of intellectual variables which are thought to represent the extent to which cognitive development has occurred throughout the course of childhood. The picture becomes almost unfathomable complex when it is realized that these investigators do not agree on which variables most truly image cognitive development.
The dominant force in the psychology of development has been the work of Jean Piaget whose impact upon psychology is conceded by many to be second to Freud. One reason for this is his stipulation of the invariant sequence of sensorimotor, preoperational, concrete and formal operations which are known collectively as the operator. Under normal circumstances, these stages begin at birth, about two years, eight years and twelve years respectively, and the child progresses from one stage of the operator to the next quite naturally.

As far as the body of variables considered in the present investigation, three hypotheses were explored:

(H₁) scores on Piaget's conservation tasks are predictable by a series of regressions through the subtests of the Comprehensive Test of Basic Skills (CTBS) and the Thorndike, Hagen and Lorge Noverabal Cognitive Abilities Test (CAT);

(H₂) Economically deprived children score significantly lower on all conservative tasks than do those who are economically privileged;

(H₃) Performance on the conservation tasks, academic achievement and nonverbal IQ are all members of the same system of relationships.

Two hundred ninety-one children in Grades – II through VII were drawn from two elementary schools in Elbert County, Georgia. Grades II-V were administered the conservation of substance, Grades
III-VI the conservation of weight and Grades IV-VII the conservation of displacement volume. All were given the Comprehensive Test of Basic Skills (CTBS) and the Thorndike and Hagen Non Verbal Cognitive Abilities Test (CAT). Of the 291 children examined, 161 were advantaged and 130 were disadvantaged, according to guidelines established by the Office of Economic Opportunity. Children were selected from the following Age-Grade populations:

a. 45 Ss Grade II: 7-6 to 8-6;
b. 59 Ss Grade III: 8-6 to 9-6;
c. 46 Ss Grade IV: 9-6 to 10-6;
d. 51 Ss Grade V: 9-6 to 11-6;
e. 46 Ss Grade VI: 11-6 to 12-6;
f. 44 Ss Grade VII: 12-6 to 13-6.

The specific conservation tasks were administered to age grade levels on the basis of findings by Piaget and many others cited in the test. These authors all report that conservation tasks are mastered according to the following sequence:

a. Substance: 7-8 years;
b. Weight: 9-10 years; and

c. Displacement volume: 11-12 years.

The general results of the study can be most briefly summarized by the oversimplification that the findings warrant by the oversimplification that the findings warrant acceptance of all three hypothesis. Multiple regression correlations show that performance
on the conservation tasks was found to be predictable from performances both on the academic achievement subtests and on the nonverbal intelligence test, analyses of variance found socioeconomic status to exert substantial effects upon the rate of development of concrete operations and canonical correlation analyses yielded the unilateral findings that development of concrete operational thinking, level of academic achievement and nonverbal intelligence were indeed all members of the same system of statistical relationships.

Conway, Phyllis Denise Carlson (1976) has conducted a longitudinal analysis of intellectual ability and educational achievement of children from different social class and cultural groups.

This study investigated the patterns of intellectual growth and academic achievement of children who experienced similar elementary school education and differed in cultural group membership and socio-economic status.

The subjects of this study were 271 junior high students in the Lincoln, Nebraska public schools who had been in continuous attendance in that school system during their elementary school years. These students were from white, black, Mexican-American and American Indian cultural groups. Whites were grouped according to middle and low socioeconomic status, while the other cultural groups were of low socioeconomic status. Measures of school readiness,
school achievement and intelligence which had been administered to these students throughout elementary school were analyzed for (1) the two groups of whites of low and middle SES, and (2) the four groups of low SES who differed in cultural group membership.

Means and standard deviations were computed for all groups to determine the level of readiness status as measured by the metropolitan Readiness Test. Analysis of Variance was employed to determine significant difference for groups on readiness status at the beginning of first grade. Since groups differed in total number, the number and percentage of total students in each readiness category were shown.

Means and standard deviations were computed for the groups on the different subtest areas of the Iowa Test of Basic skills at Grades 4, 5 and 6 and expressed in grade level equivalents. Analysis of covariance was employed for those subtests to determine if rates of achievement in each subtest area differed significantly for the different groups at each grade level.

Means and standard deviations were computed for each group for each of the three intelligence tests administered at the kindergarten, fifth and seventh grade levels. A test of trend using orthogonal polynomials was employed to determine the trend and direction of that trend for the groups of the three intelligence
measures and also to determine if significant differences existed between the IQ's of the groups.

Middle SES whites indicated a significantly higher level of readiness for school instruction after a year of kindergarten than did their counterparts of low SES, while differences in school readiness status did not reach significance for the four low SES groups of different cultural group membership.

Achievement test data indicated that at the fourth-grade level the middle SES white group was achieving at a significantly higher level than the low SES groups on all subtests of the achievement measure. Significant differences in favour of the middle SES group were evident at later grades in the areas of vocabulary, language skills and arithmetic problem-solving. For the four low SES groups of different cultural group membership, significant differences in achievement at the fourth-grade level were indicated in the subtest areas of vocabulary and arithmetic concepts, with the white group achieving at a higher level. Significant differences in the achievement sub-test areas were not evident at later grades, with the exception of the work-study skill area at the sixth-grade level, where the American Indian group showed a decline in achievement from fifth the sixth grade.

In general, the rate of growth in achievement from fourth to fifth grade and from fifth to sixth grade was normal for the low SES groups,
and middle SES whites indicated a rate of growth somewhat greater than normal. Achievement for middle SES whites was at a level within the actual grade level placement, while low SES groups were achieving at a level within the range of one grade level below actual grade placement.

Significant differences in mean IQ were indicated for groups of different socioeconomic status and for groups differing in cultural group membership, with white groups obtaining higher mean scores. IQs were essentially constant for all groups from kindergarten to seventh grade, with the middle SES white, American Indian, and black groups indicating a slight gain. The Mexican-American and low SES white groups showed a slight decrease in mean IQ from kindergarten to fifth grade.


The purpose of this study was to investigate organizational processes in the free recall of children having average and high intelligence test scores. If existing IQ tests are in some way assessing individual differences in basic cognitive processes, we should expect to observe differences in the performance of psychometrically determined bright and average children on laboratory tasks designed to study these processes.
Subjects in the study were 88 public-school children, 44 in the third grade and 44 in the fifth grade. Twenty-two children at each grade level had IQ scores between 90 and 109. Equal numbers of males and females were tested at each IQ and grade level.

The children were individually administered four tasks, which were separated by at least two days. The four tasks consisted of a meta-memory interview concerning organization and memory, multi-trial free recall of unrelated words, multi-trial free recall of the categorized words, and a sorting task followed by free recall of the sorted words. The meta-memory and sorting tasks were presented first and last, respectively; the order of the remaining two tasks was counterbalanced across children.

Findings

The results of the multi-trial free recall tasks and the sorting task indicated that differences in psychometrically-defined intelligence are associated with differences in memory and organizational processes. Across the memory tasks, the bright children consistently showed greater amounts of recall organization than did the average children. Even in the sorting task in which the average children were required to achieve organization prior to recall, they did not utilize this organization at recall to the same extent as the bright children.
Shannon, Gregory Adville (1978) conducted a multivariate study of intellective and non-intellective factors related to the achievement of university freshmen in a Basic Skills Program (BSP).

This study focused upon the achievement of entering freshmen assigned to the Basic Skills Program (BSP) at the Pennsylvania State University during 1977-78 academic year. The BSP freshmen in the sample had deficiencies in mathematics or both mathematics and English. The program was established in response to the decline in academic competence observed among college students. Achievement was defined in two ways: scores earned on the Math Retake Test (MRT) taken by freshmen in the attempt to remove their mathematics deficiencies and winter term GPA. The MRT was administered once each term.

Stepwise regression analyses were computed in which each of the achievement measures was employed as a dependent variable. The prediction of MRT scores was most important since these scores were expected to be the most appropriate measures of academic success in the program. A stepwise regression analysis was also conducted to account for the variance of Academic Adaptiveness Questionnaire total score measures of the willingness to accept the ideals and student roles important to successful adjustment to academic life.
Two-way stepwise discriminant analyses were performed for enrollment in basic mathematics courses, type of deficiency, campus location and sex to gain a better understanding of factors which may influence the results of research studies of basic skills programs. A discriminant analysis was also performed between groups defined by freshmen who passed MRT on their first attempt and freshmen who failed the MRT on their first attempt.

The subjects were 184 BSP freshmen having either mathematics or both mathematics and English deficiencies. They were the freshmen from the University park and Altoona Campuses of the Pennsylvania State University who had returned attitude and information forms mailed to them. The return rate was 60.5 percent. The attitude measures included the Michigan State Self-Concept of Ability Scale, the “How Do you Feel About Mathematics?” scale, the study Habit Questionnaire. The achievement and aptitude measures were high school GPA, and scores from the SAT verbal and Maths subtests and the Pennsylvania State University mathematics and English placement tests.

All regression equations and discriminant functions were significant. High MRT scores were associated most with passing the MRT in fewer attempts, being enrolled in a basic mathematics course, and taking the MRT promptly. High winter GPA's were associated most with positive self-concept of ability, taking the MRT promptly, high mathematics placement scores, and the willingness to accept the
ideals and student roles important to successful adjustment to academic life. The intellective predictors were only minimally effective, probably because of the restriction in range resulting from the BSP freshmen's low achievement and aptitude scores.

One discriminant analysis had been performed between freshmen who passed the MRT on their first attempt and those who did not. The freshmen who passed the MRT were more positive on all attitude measures. This finding suggested that modification of these attitudes made early in the year may help freshmen prepare to pass the MRT on their first attempt.

Included among the recommendations was the concern that the standard error of measurement (SEM) of the Basic Math Operations scores, used to identify mathematics deficiencies, should be reduced. The current SEM could result in hundreds of misclassifications. Recommendations were also made to provide diagnostic feedback to freshmen regarding their MRT scores and to develop programs to modify attitudes related to academic achievement of BSP freshmen.

Komm, Richard Arnold (1978) has conducted a study on a comparison of the black intelligence test of cultural homogeneity with the Wechsler intelligence scale for children (revised) as measured by a conventional achievement test within a black population at different social class levels.
Although the problem of cultural or racial bias of various test instruments has always been present in test construction and validation, in recent years it has become acute. This is especially true in relation to the identification of mental abilities in minority group children. Jensen's statements that the heritability of intelligence accounts for about four-fifths of an individual's ability and that Black populations are innately lower along this dimension, touched off a controversy that is still ranging. Specific issues raised by Jensen's critics pursued several primary directions; first, that the offsetting influence of environmental factors affecting minorities had to be more carefully considered. Second, that the instruments used to assess Black intelligence were themselves selectively biased and could not be accepted as valid indicators of mental ability for minority groups.

One approach used to assess the unique sub-cultural factors underlying ability testing among Blacks was developed by Robert L. Williams. The Black Intelligence Test of Cultural Homogeneity (BITCH) focuses upon the Black youngster in light of the culturally different model. Williams states that standard intelligence tests describe minority populations in light of the culturally deficient model and, in so doing, commit a serious injustice to such individuals. The Bitch has never been validated against the Weschler Intelligence Scale for Children, Revised, while the WISC-R has included a representative Black sample in its norms which closely parallels the most recent census data. A comparison of these two instruments was in order, so
as to put to empirical test the assumptions attributed to them by their creators. As a further step, the relationship of the BITCH and the WISC-R as predictors of achievement, when measured by the California Achievement Test (CAT) was also considered.

A sample of sixty-five school attending, grade-appropriate Black subjects, ages 13 to 17, were randomly selected from secondary schools in the San Francisco Bay Area. The sample was evenly divided by sex, as well as socioeconomic status. A point scale delineating social class was created which served to pinpoint social class differences within the sample. The participants were administered the BITCH, WISC-R and CAT (Reading) in random-counter-balanced order by an interracial group of qualified examiners.

On the basis of the findings, the study's primary conclusions were:

1. The BITCH is significantly correlated with the WISC-R (P<0.05) a well-established measure of intelligence that includes a normative Black sample.

2. The BITCH is significantly correlated with the CAT (Reading) (P<0.01). The correlation between the WISC-R and the CAT is considerably higher, so that this latter instrument appears to possess greater predictive power for school related achievement than does the BITCH.

3. Although the BITCH does in fact very modestly discriminate between social class groups (P<0.05),
it does so in favour of the higher SES classification, this may reflect negatively upon some of its theoretical assumptions.

4. A comparison of BITCH means between this sample and the original (1972) standardization shows very significant differences in favour of the original group (P<0.01). The possibility of a marked regional difference and / or a significant shift in sub-culturally-related word usage over a six year interval must be considered.

5. The generalized finding the Blacks are about one S.D. below the United States' population mean was not borne out by this study. There was a social class difference of about one S.D. in favour of the middle-class group. Perhaps the selection of a school attending, grade-appropriate sample which is carefully dichotomized along social class variables has much to do with measured mental ability.

6. This study tends to refute the contention that appropriately standardized, norm-referenced intelligence tests are inappropriate. (i.e., biased) for racial minorities.

Bajtelsmit, John Wernher (1978) studied the effects of test anxiety, intelligence and test format on adult academic achievement.

The relationships between test anxiety and adult academic performance on multiple choice and essay tests at different levels of intelligence were investigated. Several psychometric researchers have
recently embraced the optimal arousal concept, or Yerkes-Dodson "Law", and have advanced the hypothesis that test performance is a curvilinear function of anxiety arousal. This function, shaped like an inverted-U, implies that there is a degree of anxiety which is optimal for performance on a given test. This theoretical rationale has been operationalized by a procedure which categorizes test-takers according to four anxiety types with an assumed position on the curve. The present study investigated these hypothesized curvilinear effects by means of a more precise analysis using the entire continuum of a test anxiety scale. Also of interest was Spielberger's hypothesized interaction effect of test anxiety and intelligence on performance. This interaction predicted that high anxiety would be debilitating at lower levels of intelligence and facilitating at higher levels. At extension of Spence's Drive Theory to encompass test format effects further suggested that essay performance would be lower relative to multiple-choice performance for highly test anxious persons within the middle range of intelligence.

The sample consisted of 98 adult males who were enrolled in the CLU program of the American college and who volunteered to participate in a study of adult cognitive abilities. A trained psychometrist collected aptitude (Wechsler Adult Intelligence Scale, Achievement Anxiety Test) measures. Multiple choice and essay scores reflecting performance on nationally administered CLU examinations were collected from the appropriate data files of the American college.
Since previous anxiety findings remain equivocal partly because of a reliance on restricted statistical techniques, in the present study, hypothesized linear, curvilinear and interaction relationships were investigated through multiple regression models. Such procedures enabled more precise and powerful analyses than are achieved through the typical variance analyses which employ discrete categorizations of subjects on the aptitude variables. Superimposed plottings of the resulting three dimensional regression surfaces were expected to provide meaningful characterizations of the hypothesized higher order interactive effects of individual differences and test format on the academic achievement of adult professionals. Visual inspection of scatter-grams and residual plots did not suggest the hypothesized inverted-U relationships between anxiety and the measures of examination performance. Statistical tests failed to indicate a significant contribution of the quadratic anxiety term to the simple regression equations. No support was found for the optimal arousal effect. Adding the appropriate product terms to the regression equations predicting examination performance tested the hypothesized interaction of test anxiety and intelligence. The interaction terms did not account for significant increase in variance. The hypothesis that test formats would interact with intelligence and test anxiety in their effects on exam performance also found no support. Zero order correlations between intelligence and examinations ranged from 0.35 to 0.50, while the linear correlation of
intelligence and test anxiety was -0.44. Power calculations indicated acceptable levels for the expected effect sizes. The effects of multicollinearity on the regression analyses were also discussed.

The present findings suggested a need to focus on the distinction between the cognitive worry and the physiological–emotionality components of test anxiety. Interaction effects would not be predicted under the cognitive-worry conceptualization of test anxiety, but might be more likely if emotional or physiological arousal were measured. Recommendations are discussed for future research concerning clarification of the test anxiety construct.

Wendell, Bart R. (1981) studied the relationship of selected non-intellective characteristics and high school performance.

The purpose of the research was to explore the relationship between life events, trait anxiety (A-Trait) and personal problems with grade point ratio (GPR), controlling for intelligence and social desirability response sets. Junior and senior, male and female high school social studies electives students (N=244) were selected for the research on the basis of their willingness to participate in the study, their parents approval, their completing the instruments administered as part of this study, and the availability of grade-point ratios and intelligence quotient data in their student files. The instruments used were the Life Events Scale-Adolescents (Coddington, 1979), the State-Trait Anxiety Inventory (Spielberger, Gorsuch and Lushene, 1970), the
Mooney Problem check list (Mooney and Gordon, 1950), the Otis-
Lennon Mental Ability Test (Otis and Lennon, 1967) and the Marlowe-
Crowne Social-Desirability Scale (Marlowe and Crowne, 1967).

It was hypothesized that (a) A significant curvilinear
relationship, controlling for social desirability, of mean GPR and A-
Trait would exist for students in the middle intelligence group; (b) Controlling for intelligence and social desirability, the mean GPR of students in the high undesirable life events, high total life events, and high personal problems groups would be significantly lower than the mean GPR of other students, and (c) The mean GPR of students in the high and low desirable life events groups would not differ.

To test the first hypothesis, analysis of variance was performed for A-trait, and sex with GPR for three intelligence groups. The remaining hypotheses were tested using analysis of variance for A-
Trait, life events, personal problems and sex, controlling for intelligence, with GPR. The social desirability response set was controlled through the use of regression analysis. Analyses were also performed using analysis of variance and correlation to investigate additional findings.

Hypotheses were accepted or rejected at the 0.05 level of probability. The hypothesis predicting a curvilinear relationship between A-Trait and GPR for the middle intelligence group was not supported. As predicted, the mean GPR of students in the high total
life events, high undesirable life events and high personal problems groups were found to be significantly lower than the mean GPR of other students. As predicted, no difference was found in the mean GPR of students in the high and low desirable life events groups. Additional findings including:

a. The mean GPR of males tended to be related curvilinear with A-Trail;

b. The mean GPR of males who experienced more undesirable and total life events and more personal problems was lower than the mean GPR of males who had experienced fewer undesirable and total life events and personal problems, while no such relationship was found for female students;

c. Students who had experienced more desirable life events and who were more trait anxious showed greater improvement in mean GPR than students who had experienced fewer desirable life events and were less trait-anxious;

d. The scoring of life events using readjustments weights or standard scores was found to offer no benefit compared to the use of simple unit counts of events;

e. Failure to control for the effect of social desirability would have resulted in both type I and type II errors;

f. The selection of items in the Mooney Problem Check List may have confounded the findings concerning personal problems. It was concluded
that future research concerning non-intellective factors and academic performance should include both males and females and should take into account the existence of social desirability response sets.

Olney, Cynthia Ann (1991) studied the development of recall from short-term and long-term memory in relationship with list length, word length, taxonomic relatedness, acoustic similarity and modality.

An emerging theory of short-term memory, called Fuzzy Trace Theory (FTT), postulates a link between memory and reasoning ability that might explain the relationship of performances on memory span tasks to other measures of intelligence. Two key assumptions regarding the encoding and retrieval of information in short-term memory (STM) are central to FTT.

First, stored memory traces are assumed to vary along a continuum of verbatim details to gist. Second, retrieval from STM is assumed to vary along a continuum of simple to reconstructive readout. The three experiments reported in this dissertation were designed to examine these two assumptions regarding encoding and retrieval by examining subject's performances on memory span tasks.

Memory span was the measure of choice for this series of experiments because span tasks have long been considered a pure measures of memory. Recall of items (item memory) and ordering of
items for serial recall (order memory) were factored and treated as independent memory processes.

The findings in the three experiments indicated that item memory relied more on simple readout of verbatim detail, while order memory relied on reconstruction from gist. More development was observed for order memory, indicating that age changes in memory span performance may be caused by development of gist extraction and reconstructive processes.

Hahn, Cathleen Conway (1991) conducted a study on a comparison of memory development in learning disabled and non-learning disabled children.

Memory development in children was examined by investigating the relationship between age and memory task performance in learning disabled (LD) and non-learning disabled (Non LD) groups of children aged six through twelve years.

Participants were 195 second through sixth grade students aged 6 years, 9 months through 12 years, 9 months in two predominantly white, middle-class suburban school districts on Long Island, New York and in Westchester County, New York. Within this group, 140 Non LD (IQ 85-129, M=112, SD=9.57) and 55 LD (IQ=85-120, M=101, SD=9.45) students were identified.
It was hypothesized that a positive relationship exists between age and memory in a Non LD population of children aged 6 through 12 years. A relatively weaker positive relationship between age and memory was expected in an LD population. It was further hypothesized that acquisition and delayed memory task scores would discriminate among LD and Non LD children in three age groups.

Memory was measured in this study by performance on the Randt Memory Test (Randt, Brown and Osborne, 1980). This instrument was selected primarily because it provided measured of several kinds of memory task performance and allows for investigation of acquisition of new information as well as retention of information over time.

The predicted positive relationship between age and memory in groups of school-age children was supported in the case of acquisition and delayed recall scores on the RMT. Although the LD groups did more poorly than Non LD groups on memory tasks at three age levels (7-8, 9-10 and 11-12 years), a significant difference in the pattern of improvement was not found. It was determined that two functions, retention and strategy use, were necessary to discriminate among LD and Non LD.

2.2 Structure of Intellect Model - Indian Studies

The studies conducted in the areas if SI model are reviewed in this section.
Girish Bala (1978) conducted a study regarding a factor analysis of reasoning ability of 13, 14, 15 years old children studying in Delhi higher secondary schools.

The major hypotheses were:

1. It is possible to identify the independent factors – CMC, CMR, CMI, NMC, NMR and NMI, and Guilford’s SI model constituting reasoning ability, among children of 13, 14 and 15 years of age, and

2. The factors constituting reasoning ability emerge more clearly with experience, i.e., they can be more clearly identified at 14 rather than at the lower age levels.

Nineteen tests to provide measures of the cognition and convergent production of semantic classes, relations and implications categories of the SI model, were adapted and devised. The initial try-out of these tests was conducted on 13 year, 14 year and 15 year old children of Hindi medium higher secondary schools of Delhi. Harper's item analysis chart was used to read indices of item difficulty and discriminations. Suitable items were retained for the final test.

The final test was administered to 182 children of 13 years age group, 205 children of 14 years age group and 153 children of 15 years age group. The reliability coefficients of the tests were above 0.50 – the minimum suggested by Guilford, except in case of Sequential Association test for age group 15 (.076) and Association IV
(4.87) for age group 13. After the varimax rotation and Cliff's targeted rotation were tried, the canonical correlations were calculated to see whether the various SI categories were really independent. The canonical correlations obtained were quite high and significant thus indicating that the various categories were not really independent. Thus oblique rotations were employed.

**Findings**

i. The first hypothesis was partially substantiated as much as factor Cognition of Semantic Implications (CMI) emerged clearly in age groups 14 and 15.

ii. The second hypothesis that the factors constituting reasoning ability emerged more clearly with experience, was partially substantiated.

iii. The following factor were identified inference or General Cognition and Convergent production, Perception of Abstract similarities or Convergent production of Semantic Classes and Relations, Induction or deduction of conceptual relations or Cognition of Semantic Classes and Relations, Association or Relational Thinking or Diffused Convergent Production and Cognition of Semantic Implications, Conceptual Foresight or Cognition of Semantic Implications, Deduction or General Convergent Production, and Apprehension of Relations or Mixed Classifications and Relations.

The study was undertaken to determine the differential effect of the type of task similarity (i.e., phonemic and semantic similarity), anxiety and imagery type (i.e., visible and audible) on short-and long-term memory.

The factorial design was used in which three independent variables (type of similarity, anxiety and imagery type), each varying in two ways and two measures of the dependent variable, retention (short-term recall and long-term recall) were employed. Thus, there were eight possible combinations for each of the two measures of retention. A mixed test of paired-associates consisting of phonemically similar stimulus items and semantically similar stimulus items, was presented to four groups of subjects with the order of presentation of the two sets of pairs being counter balanced for half of the subjects of each group.

The four groups of subjects, namely high anxious visile, high anxious audile, low anxious visile and low anxious audile, used in the experiment, were selected on the basis of scores obtained by them on the Sinha Anxiety Scale and on the adapted form of Bower and Krapelin's tests of imagery. The recall scores obtained by each of the four groups for phonemically similar items and those for semantically
similar items, though presented in a mixed test, were treated as separate observations. A modified form of 2x2x2 analysis of variance was used to analyse the data.

**Findings**

1. Phonemic similarity had detrimental effect on the short-term recall but had no such effect on the long-term recall.

2. Semantic similarity depressed the long-term recall but had no effect on the short-term recall.

3. Both anxiety and imagery type had no differential effects on the short and the long-term recall.

4. An interaction was found between imagery type and similarity in the case of long-term recall. No such interaction was found in the case of short-term recall.

**Samal, S. (1977)** developed a vocational interest inventory to study the interest pattern of high school seniors and its relationship with their intelligence, socio-economic status and academic success.

The objectives of the investigation were to have a differential study of the interest pattern of high school seniors sex-wise and place-wise; and to study the relationship of interest with intelligence, socio-economic status and academic success.

The study was undertaken on a stratified, randomized sample of 570 boys and 580 girls of tenth class of the recognised high schools of
orissa. the vocational inventory developed for the purpose was an interactive free response variety of self-reporting instrument giving measures on eight scales of vocational interest, business, social service, arts, clerical and administrative. the odd-even reliability of the interest scales ranged from 0.79 to 0.93. inter-correlations among the scales varied from –0.06 to 0.31. the instrument was validated against the california interest inventory.

assuming that education, occupation and income are the potential contributors of one's socioeconomic status, a scale was devised to measure this variable. inter-correlation among three aspects of the scale ranged from 0.36 to 0.62. correlation coefficients between partial and total weighted scores were 0.85 for education, 0.75 for occupation and 0.77 for income. the cfit scale 3 was used to measure the subjects intelligence.

school examination marks in three consecutive examinations in five curricular subjects were processed to give estimation of the subjects academic success. correlation between vocational interest and other variables was computed by the product-moment and chi-square methods. f-test and t-test were applied for differential study in respect of interest.

findings

sex-wise difference was found significant in administrative, business, social service and arts scales of interest. place-wise
stratifications had no impact on variation of interest scores. The sample displayed a very high degree of interest in social service, agriculture and science. Interest in agriculture, business and clerical activities correlated negatively with socio-economic status. None of the interest scales correlated significantly with intelligence groups. Trend of relationship between academic success and interest suggested that success in any curricular subject required interest in related vocational areas.

**Ravinder, S.** (1977) studied the effects of anxiety, psychological stress and intelligence on learning and academic achievement.

The major hypotheses of the study were:

i. Ego stress instructions would induce differential levels of drive in HA (High Anxiety) and LA (Low Anxiety) students.

ii. At the early learning stage HA would facilitate the performance of HI (High Intelligence) students, while leading to performance decrements in LI (Low Intelligence) students.

iii. Effects of anxiety and intelligence would further depend on experimental conditions of ego-stress and control.

iv. LA state would have facilitative effects on the performance of both HI and LI groups at all the stages of learning.
Anxiety and intelligence would have differential effects on the achievement of students in aggregate and in different school subjects.

The study was divided into two phases: Phase I included two laboratory learning tasks, namely serial verbal learning and paired-associate learning. Phase II included academic achievement in aggregate and five different school subjects. The sample of the study consisted of 240 girl students of Grade IX selected from a preliminary sample of 1,149 subjects.

The tools used for collecting data were Hindi version of State Trait Anxiety Inventory (STAI) of Spielberger (Sharma and Singh), Hundal’s General Mental Ability Test, Hindi version, lists of serial verbal learning task and paired-associate learning tasks prepared by the investigator. The marks obtained in the annual examination in aggregate and various school subjects were used to indicate academic achievement. Statistical techniques of analysis of variance and factor analysis were employed for analysing the data.

**Findings**

The major findings of the study were:

i. The performance of HA and LA students reflected differences in drive level only where experimental conditions contained some degrees of stress.

ii. Overall, under the experimental conditions of ego-stress, the performance of HI-LA students was
superior at all stages of learning, whereas it was most detrimentally affected in the case of LI subjects.

iii. The performance varied as an inverted U-function of physiological activation (drive).

iv. The performance of HI-HA students, under control conditions, was better than their HI-La counterparts and LI-HA students were better than LI-LA students.

v. For HI students, the drive level or experimental conditions were as important as they were for LI students.

vi. LA students performed significantly better than HA ones at all the stages of learning.

vii. Ego-stress and anxiety state effects were similar.

viii. Anxiety, as a main effect, was not significantly related to academic achievement, except in case of achievement in general science and mathematics.

ix. High aptitude students tended to perform better than low aptitude students irrespective of the anxiety level.

x. School courses demanding higher cognitive skills produced many error tendencies in HA students at HI level.

xi. The abruptly introduced stress in an experimental situation was more detrimental than the examination stress accumulated gradually over a period of time.
xii. General anxiety by itself had relatively little effect on academic achievement and the combination of anxiety with intelligence considerably increased the accuracy of predicting academic performance.


The major purpose of the study was to clarify the nature of relationship among creativity, intelligence and school achievement, and especially to test for interactive effects of intelligence and creativity upon achievement in different school subjects. It also examined the Getzels-Jackson Effect besides testing Anderson's ability gradient theory in terms of the existence or otherwise of the maximum and minimum intelligence thresholds.

A random sample of 400 urban pupils (200 boys and 200 girls) drawn from a dozen schools located in Guntur and West Godavari districts of Andhra Pradesh was used in this study. Torrance Test of Creative thinking (TTCT) both verbal and figural batteries which were translated into Telugu, provided the measures of creativity while Cattell's Culture Fair Intelligence Test (CFIT), Scale 2, Form B, provided the measure of intelligence. Achievement was based on two successive school examination marks in five subjects. Correlation and 7x3 factorial (fixed effects) analysis of variance designs were used besides Scheffe's contrasts for testing the hypotheses.
Findings

i. There were no sex differences in intelligence figural creativity and achievement in Telugu, general science and social studies. Significant sex differences in verbal creativity and achievement in English and maths were found in favour of girls. The performance of either sex was better on the verbal than on the figural TTCT.

ii. The average correlation between intelligence and verbal TTCT (r=0.21) was not only significant but was also higher than that between intelligence and figural TTCT (r=0.10). These correlations were higher for girls than for boys. Further the correlations between verbal TTCT and school achievement were as high as those between intelligence and school achievement.

iii. The hypotheses of interaction between intelligence and creativity as they affected school achievement were not supported in 34 out of the 35 sets of 7x3 factorial analysis of variance. There was a significant disordinal interaction between intelligence and figural elaboration, although no definite trend in their effect on the English language was noticed.

iv. The main effects of both intelligence and creativity were significant in 33 out of the 35 analysis of variance involving intelligence, verbal and figural creativity measures and school achievement and the form of relationship was such that intelligence...
and creativity tended to be additive and more or less linear in their effect on school achievement.

v. There was no evidence for the existence of maximum or minimum intelligence thresholds, and neither Anderson’s ability gradient theory nor Circirelli’s modification of it was supported.

vi. Getzels-Jackson effect was confirmed by the non-significant differences in achievement between the high intelligence and high verbal creativity groups despite significant differences in their intelligence and verbal creativity. But in the case of the high intelligence and high figural creativity groups the evidence for the Getzels-Jackson Effect was rather weak. The achievement of the high intelligence and high verbal creativity group in different school subjects was significantly higher than that of the high intelligence and high verbal creativity groups.


The study attempted to find out;

i. The differential role of different modes of presentation with the stimulus materials of different item length and meaningfulness and the organizing strategies uncontaminated by orienting instructions. and

ii. The nature of retention score in relation to study habits, attitude and certain personality variables
such as introversion-extraversion and neuroticism stability.

Seven hypotheses were formulated in relation to these variables. The total sample consisted of 640 students (320 males and 320 females) of classes XI and XII, randomly selected from fourteen urban academic institutions of Bareilly, Lucknow, Moradabad and Varanasi. The Ss of an institution were equally distributed to each of the sixteen experimental conditions within a block of sixteen students, one of whom worked under the same conditions. The study was based on 2x2x4 factorial randomized experimental group design with repeated measures on the last factor with three-way classification of variables. The factors with their levels were two levels of sense modalities (auditory and visual), male and female subjects, and four levels of meaningfulness (low and high meaningful CVC trigrams and low and high meaningful disyllables). Eight lists, each comprising twelve paired unrelated words, were prepared. There were four lists of CVC trigrams (two each with high and low levels of meaningfulness) and four lists of six-lettered disyllables (two each with high and low levels of meaningfulness). A tape recorder was used for auditory mode of presentation of the stimulus lists. The Hindi adaptation of study habits and Attitude Test (Joshi) and Hindi version of Maudsley Personality Inventory were used for studying the role of in divided differences on retention performance. Mann-Whitney U test, analysis
of variance and products moment correlation were used for analysing the data.

Findings

1. There was no significant difference in the retention performance of male and female subjects irrespective of different order, mode of presentation and levels of meaningfulness.

2. The visual mode of presentation, was found significantly better for retention than auditory mode of presentation.

3. High meaningful CVS's evinced better retention than low meaningful ones, high CVS's showed the highest mean retention.

4. The high level organizing strategies had higher correlation with the retention scores than that obtained by the low level organizing strategies.

5. There was low correlation between study habit and attitude scores and retention scores with different indices for the male and female subjects.

6. High scores on extraversion-introversion exhibited low positive correlation and low scores exhibited low negative correlation with retention scores.

7. The extreme scores on Neuroticism stability scale did not yield different correlation with retention scores.
D'Lima, C.D. (1979) conducted a differential study of high and low achievement syndromes of a selected group of creatively gifted and intellectually gifted children in the city of Bombay.

The main objectives of the study were:

i. To make a comparative study of the different types of achievers amongst the different types of gifted pupils, namely, creatively gifted and intellectually gifted.

ii. To find out the variable that significantly distinguish between the different pairs of groups of gifted pupils and

iii. To predict the achievement of gifted pupils with the help of the data gathered on psycho-social factors.

The sample consisted of students of IX Standard from twenty-five English-medium schools in Bombay. The tools used for data collection were Passi Test of creativity, Nafde's Non-Verbal tests of Intelligence and various psychological tests to collect data on psycho-socio variables.

Findings

i. The double-talent groups had a higher percentage age of high achievers and the single-talent groups had a higher percentage of low achievers.

ii. There was significant difference between the different types of gifted pupils.
iii. The different types of gifted groups formed on the basis of intelligence and creativity seemed to be highly similar in academic achievement, social interaction, self-concept, academic motivation and independence stability.

iv. The different types of gifted groups formed on the basis of intelligence and creativity differed in general intelligence, general talent and self-reliance-dominance.

v. There was significant difference between the low and the high achievers amongst the different types of gifted pupils.


The purpose of the present study was two fold: first, verification of the findings of the previous studies in the Indian context; second, investigation of sex differences in the pattern of predictor abilities in case of tenth grade algebra.

The main objectives of the study were:

1. To determine the pattern of selected SI abilities as predictors of achievement in tenth grade algebra.

2. To examine the relevance of previous findings in this regard to Indian situation.

3. To investigate sex differences in the role of SI abilities in the prediction of achievement in algebra.
Tests to measure the relevant abilities were selected from the list given by Guilford and Hoepfner (1971). These tests were developed by the investigator for the abilities like:

2. Convergent production of Symbolic Relations (NSR) – Correlate completion word.
5. Cognition of Semantic Units (CMU) – Synonyms

The above mentioned 8 tests were used as independent predictor variables for the present study. The marks obtained by students in the annual exams-criterion scores. These tests were administered to 203 students of Class X in selected schools of Delhi city. Inter-correlation and regression analysis were used to analyse the data.
Findings

1. Out of eight SI abilities selected for the present study, only three were found to be relevant for predicting achievement of students in algebra. They are CMU, CST and NSS.

2. The pattern of predictor variables exhibited sex difference. In case of boys, only the SI ability, namely NSS was found to be the best predictor of achievement in algebra, the remaining abilities were totally absent. In case of girls, two abilities, namely CSI and CMU were found relevant, the former being a measure of ability to draw inference and latter of verbal factor.

In case of boys, numerical ability played a prominent role in doing algebra and in case of girls verbal factor occupied significant position.

Zargar, A.H. (1980) conducted a study of expression, neuroticism and n-achievement in relation to intelligence, creativity and scholastic achievement.

The investigation aimed at studying personality correlates like expression, neuroticism and n-Achievement in relation to intelligence, creativity and scholastic achievement.

The study was conducted on a sample of 435 bachelor of arts students. The tools used were culture fair test of Intelligence, Scale 3,
Forms A and B, Maudsley Personality Inventory, Incomplete Sentences
Blank Test (Mukheijee) and Test of creative thinking (Mehdi)

Findings

i. A Moderate degree of neuroticism, to a specific level, did not impair the level of subjects whereas an extreme degree of neuroticism impaired their performances on intelligence tests.

ii. The high and the low neurotic groups did not show any significant differences in creativity.

iii. The level of expression (high and low) was not related to intelligence.

iv. There was no significant relationship between the level of expression and the scholastic achievement.

v. The high need achievers had a high degree of creativity (Verbal) whereas low need achievers had a high degree of non-verbal creativity.

vi. The high need achievers had a better scholastic achievement than the low need achievers.

Katageri, B.S. (1981) conducted a study on construction and analysis of Guilford's type tests for some selected Semantic abilities in school going children. The objectives of study were: (1) To develop tests for some Semantic abilities of the Structure of Intellect model for children studying in IX standard; (2) To analyse graphically the inter-relationship among tests hypothesized for the factors; and (3) To identify the tests that may possibly be good factor representative.
The study was carried out in two phases, in the first phase test items for Guilford’s Structure of Intellect factors such as (i) Cognition of Semantic Units (CMU), (ii) Cognition of Semantic Classes (CMC) (iii) Cognition of Semantic Systems (CMS), (iv) Memory of Semantic Implications (MMI), (vii) Divergent Production of Semantic Transformations (DMT), and (viii) Evaluation of Semantic Classes (EMC) were developed. In the second stage, graphical unit-relationship among the test hypothesized for the factors was done preparing correlation profiles. One hundred and fifty boys of class IX constituted the sample for the study.

The investigator concluded that:

i. Tests constructed for the eight factors when individually considered with those factors with which each significant correlation were different could be used in future.

ii. The factors are CMU, CMC, CMS, MMU, MMI, DMT and EMC.

Sharma, S. (1982) conducted a study on intellectual factors and academic achievement in arts, science and commerce courses at higher secondary stage.

The objective of the investigation was to study the predictive value of intelligence (verbal and non-verbal) and creativity for success in arts, science and commerce courses at the higher secondary stage,
with anxiety, study habits and socio-economic status as control variables.

The sample of the study comprised 750 male students studying in Class XI of nine intermediate colleges in Western Uttar Pradesh. Analysis of Covariance was employed to eliminate the effects of intervening variables.

Findings

i. The students of the scientific stream possessed a higher level of verbal intelligence than those of the literary and commercial streams.

ii. The students of the scientific and commercial streams possessed a higher-level non-verbal intelligence and creativity than those of the literary stream. There was no significant difference between the students of the scientific and commercial streams on these variables.

iii. The high achievers of only the scientific stream were significantly better than the low achievers on both verbal and non-verbal intelligence.

iv. The high achievers of only the commercial stream were significantly better than the low achievers of this stream on creativity.

Magotra, H.P. (1982) conducted a study regarding mental health as a correlate of intelligence, education, academic achievement and socio-economic status.

The specific aims of the investigation were:
i. To isolate the factors associated with mental health and to prepare a questionnaire on them.

ii. To make a comparative study of scores of boys and girls on the factors selected and the inventory on mental health.

iii. To determine the degree of relationship between the factors selected (independent variables) and mental health (dependent variable) of the students selected for the study.

iv. To study the effect of sex, levels of education and socio-economic status on mental health, and

v. To find out the constituents which dominated the mental health of boys and girls.

For the collection of data the tools used were General Intelligence Test (Joshi), Cultural level questionnaire, Socio-economic status questionnaire, Health condition questionnaire and Mental health inventory.

Findings

i. Girls scored higher in the intelligence test and in the socio-economic questionnaire than boys.

ii. Girls appeared to possess better mental health, were capable of facing the realities around them and were in a position to tide over the mental disequilibrium.

iii. The mental health of boys and girls appeared to be considerably influenced by the two factors, namely, intelligence and physical health.
iv. The mental life of boys was dominated by the feelings of depression and neurotic behaviour. On the other hand, girls were found to be suffering from a sense of insecurity and anxiety.

Singh, D.R. (1983) conducted a study of memory, symbolic representation and some other mental abilities in relation to achievement in chemistry at graduation level.

The main objectives of the investigation were:

a. To prepare mental ability tests such as:
   1. Test of Memory
   2. Test Reasoning
   3. Test of Numerical ability and
   4. Test of Symbolic representation

b. To prepare an achievement test in chemistry for B.Sc., students appearing in final examination in order to obtain criterion score.

c. To find out inter-correlation between the different sub-tests

d. To determine the amount of contribution made by different sub-tests to the criterion score.

e. To find out the parameters for the prepared tests.

The following hypotheses were framed with the above objectives in view:

1. The selected predictors are inter-correlated.
2. The predictors have significant relationship with the criterion, i.e., achievement in chemistry.
3. Sex differences have no effect on scores and on predictor-criterion relationship.

The total sample consisted of 400 students (250 males and 150 females) of ten Degree colleges of the eastern districts of U.P., selected through random sampling. The mental ability tests and achievement tests were administered. Reliability of tests was calculated by the split-half method. The criterion test was validated by the trs' estimate and validity was found to be 76.

On the basis of experts opinion four mental abilities were selected for this study, viz., reasoning, memory, numerical and symbolic representation. Tests for numerical ability, memory and symbolic representation were constructed by the researcher. A multiple-choice type achievement test was also constructed. The Reasoning ability test (constructed by L.N.Dubey) was adopted.

Inter-correlation, regression coefficients and multiple R, were used to analyse the data.

Findings

1. The four mental abilities selected under this study showed positive influence over achievement in chemistry at the graduation level.

2. The regression coefficient calculated from the scores of boys and girls revealed that reasoning and symbolic representation abilities contributed much to the criterion.
3. Regression equation can be used in predicting performance in chemistry of boys and girls at the graduation level.

4. The regression coefficient and multiple R calculated from the scores in the predictors provide raison d'etre for their inclusion in the determined variables.

Ari, P.G. (1984) conducted a study on development and detailed items analysis of Guilford's type tests of some Semantic abilities. The objectives of the study were: (i) To develop test for some selected Semantic abilities of Structure of Intellect model; (ii) To undertake item analysis in two stages: 1st stage (i) Determining difficulty index, and (ii) Test-factor total correlation coefficients as indicators of item discrimination 2nd stage: (i) Determining difficulty index, and (ii) Determining factor total correlation coefficients as indicators of discriminant validity; and (iii) To identify the test that are good representative of proposed factors.

The investigator constructed test items for Guilford's Structure of Intellect factors such as: (i) Cognition of Semantic Classes (CMC), (ii) Cognition of Semantic Relations (CMR), (iii) Cognition of Semantic Systems (CMS), (iv) Convergent Production of Semantic Classes (NMC) (v) Convergent Production of Semantic Relations (NMR), (vi) Convergent of Semantic Units (NMU), (vii) Divergent of Production Semantic Classes (DMC), (viii) Divergent Production of Semantic Relations (DMR), (ix) Evaluation of Semantic Classes (EMC), (x)
Evaluation of Semantic Systems (EMS), and (xi) Evaluation of Semantic Transformation (EMT). Thirty boys in class IX constituted the sample of the study. Biserial Co-efficient of correlation was used to analyse the data.

The investigator concluded that the tests —

i. whose difficulty index value for above factors was between 0.40-0.60 and discrimination index was above 0.25,

ii. the tests constructed for selected Semantic abilities, i.e., CMC, CMR, CMS, NMC, NMR, NMU, DMC, DMR, EMC, EMS, and EMT of Guilford’s Structure of Intellect model taking IX Standard children into consideration could be used in future.

Tehal Kohli and Harjit Grewal (1985) investigated into the prediction of academic achievement on the basis of memory abilities and data scores of rural academic over-achievers and under-achievers.

The purpose of this study was to study the phenomenon of over – and under – achievement and the predictive value of memory abilities and DAT scores for predicting the academic achievement of these over – and under – achievers.

Different memory abilities and DAT scores differentially predict the criterion. Variable of academic achievement of extreme and moderate over – and under – achievers.
The descriptive survey method of research was used.

The sample consisted of 400 IX class students of rural area of Ludhiana district. Equal representation to both the sexes was given. The respondents were selected on the basis of multi-staged randomization technique.

The tools used were:

1. Group test of general mental ability by Jalota (for \( V_{\text{int}} \)).
2. Raven’s Standard Progressive Matrices (1971), for \( (N V_{\text{int}}) \).
4. PGI Memory scale by Prashad and Wig (1977).

Besides the marks in the previous (Class VIII) Punjab School board final exams were also taken into account to identify academic over – and under – achievers.

Four hundred students were administered for all the above tests in groups with each of 20-25. On the basis of the regression equation method, under- and over-achievers were identified both at the severe and moderate levels by the following procedure:

The two raw scores of intelligence, i.e., verbal and non-verbal scores were converted into \( DIQ_1 \) and \( DIQ_2 \), respectively, and then combined together into \( DIQ_{\text{comb}} \) for each student. For identification of severe and moderate under- and over-achievers, firstly standard error of predictors was calculated. For identification of severe and moderate under – and over – achievers, arbitrary limits were set up.
Findings

1. In the present study, the under-achieving group seems to be the least predictive because only to F-values of severe UAs and two values of moderate UAs are found to be significant at .01 and .05 levels respectively.

2. Memory patterns and intellectual abilities contribute differentially to the prediction of academic achievement of OAs and UAs. However, a few of the variables did not contribute to the prediction of CRN.

This shows that probably the investigators did not select the variables which could adequately predict the academic achievement of the two levels of discrepant achievement particularly the under-achieving group. May be the variables which are not mere predictive and which are studied over here did not specifically go with the academic achievement of UAs, or may be the sample was too small to lead to adequate prediction of academic achievement. Therefore the hypothesis stands partially accepted.

Tiwari, N. (1986) conducted study on investigation into inter-relationship between measures of selected Guilford's Structure of Intellect Factors and Set concept achievement of secondary level students of Delhi state.
The objectives of the study were: (i) To identify conceptual hierarchies of the set concept component in the secondary mathematics curriculum through content analysis according to the sequential learning model proposed by Gagne, (ii) To construct a Set concept achievement test in order to assess achievement of class IX students, (iii) To identify the relationship between various reasoning ability tests involving Cognition and Convergent Production of Semantic Classes, Relations and Implications of Guilford's Structure of Intellectual Model, (iv) To identify the relationship between various Set concept achievement tested, (v) To identify the relationship between concept achievement tests and reasoning ability tests, (vi) To identify the reasoning ability structure of class IX students studying in higher secondary schools of Delhi on the basis of reasoning ability tests, (vii) To identify constructs of Set concept in secondary school mathematics as measured by the six concepts achievement tests, (viii) To identify factors common to the achievement of Set concepts and reasoning abilities, and (ix) To identify the contributions of the reasoning ability tests to the variance in the achievement of Set concept.

In order to secure the measures of Guilford's Structure of Intellect factors of Cognition and Convergent Production of Semantic Classes, Relations and Implications, the reasoning ability test battery (19 tests) to measure achievement of the Set concept in new mathematics. For the construction of the achievement tests, Gagne's
(1965) model of concept hierarchy of capability prerequisites was used to identify the model concept of 'Set' and action verb identified by Sullivan (1969) were used to specify test tasks for three levels corresponding to knowledge, understanding, and application of Set concept learning. Two hundred and five boys of class IX constituted the sample for the study.

Findings

i. Most of the reasoning ability tests had significant, low and positive correlations among themselves.

ii. Inter-correlations among six Set concept achievement tests (ranges from 0.142 to 0.469).

iii. Factor analysis of the inter-correlation matrix of 19 reasoning ability tests resulted in the identification of factors Inductive Reasoning or Cognition of Semantic Implications, Deductive Reasoning or Convergent Production and Convergent Production of Semantic Implications.

iv. Factor analysis of the inter-correlations of six Set concept achievement tests resulted in extraction of two factors Ach, I-concept of Set, and Ach, II-concept of function.

v. Correlations between reasoning ability tests and the composite of Set concept achievement, except for seeing problem tests, were all significant.

vi. Factor analysis of the inter-correlation matrix of 19 reasoning ability test together with composite Set concept achievement shared significant loadings on
deductive reasoning of Convergent production or Cognition of Semantic Implication factors.

vii. Multiple regression analysis revealed that five tests, namely, Effects, Figure concept test, Association IX test, Syllogism III test, and Sequential association test, contributed significant variance to the variance of composite Set concept achievement. Three tests, namely Word matrix test, Association IV test and Syllogism III test, contributed significant variance to the variance of the concept of Set and Word classification test, Effect test and Figure concept test contributed significantly to the variance of the achievement of the concept of function.

Mirajkar, R.G. (1987) studied some selected Figural, Symbolic and Semantic abilities by means of Structural Intellect factors tests. The objectives were: (i) To develop tests for some selected Figural, Symbolic and Semantic abilities of Structure of Intellect model; (ii) To establish reliability and validity of the tests; (iii) To establish only tentatively factor-wise and sum-wise norms for the test; (iv) To make comparative study pattern of abilities using profiles of factor-wise performance of selected student.

The investigator constructed test item for fifteen factors based on Guilford’s Structure of Intellect model. They were: (i) Evaluation of Figural Classes (EFC), (ii) Divergent Production of Figural Systems (DFS), (iii) Divergent Production of Figural Implications (DFI), (iv) divergent Production of Figural Transformations (DFT), (v) Convergent
Production of Figural Transformation (NFT), (vi) Cognition of Symbolic Transformations (CST), (vii) Convergent Production of Symbolic Transformations (NST), (viii) Evaluation of Symbolic Units (ESU), (ix) Divergent Production of Symbolic Units (DSU), (x) Divergent Production of Symbolic Relations (DSR), (xi) Divergent of Symbolic Implications (DSI), (xiii) Cognition of Semantic Classes (CMC), and (xiv) Divergent Production of Symbolic Units (DMU). Two hundred and fifty students of X Standard constituted the sample. Biserial correlation and Point-biserial correlation were used to analyse the data. The validity and reliability were calculated. (i) Validity: investigator constructed tests parallel to Guilford's tests on Structure of Intellect model. It is presumed that the tests have content and construct the validity as the test battery was established by correlating the present intelligence test marks with the achievement scores of terminal examinations. Reliability: the investigator found out the reliability of the whole test using Kuder-Richardson's formula. For establishing norms the factor-wise raw scores were converted into standard scores. Mean and standard deviation for composite total score were computed. For interpretation of profiles five students whose score was above one standard deviation were selected and profiles for five students were prepared separately.

Findings

i. The validity of the test battery was found to be 0.71.
ii. The reliability of the whole test is found to be 0.80.

iii. The mean and standard deviation scores were 700 and 67.6 respectively. The Skewness was 10.95 and Kurtosis was 0.258 which means that the given distribution was very much normal.

iv. Profiles showed that although the five individual total scores are more or less same, the profiles or each individual differs from the other. The ability of an individual varies form factor to factor.

v. The present study found that the performance of students was generally good in abilities like: CMC, DMU, DMC, DFT and DSR. The performance of students was relatively inferior to the abilities like CST, NST, DSI, DFS and NFT.

Rajeshwari, B. (1988) studied the levels of concept attainment in middle school children and their relationship with intelligence and scholastic achievement.

Variations in understanding taxonomic relations, problem-solving and principles of learning were particularly in the focus of this study.

The pupils of higher grades were found to score higher than those of lower grades at the concrete and identity levels of concept attainment including taxonomic relations and application of principles with evidence for minor differences for different types of concepts (e.g., tree, cutting tool, equilateral triangle). Boys generally scored higher
than girls on the classificatory and formal levels of concept attainment, and on problem-solving and application of principles.

A complex pattern of correlation between intelligence and various levels of concept attainment and between concept attainment and scholastic achievement was noted and the similarity in the factor structure of concept attainment of pupils of all grades was demonstrated.

Verma Kamini (1988) conducted an experimental study of short-term and long-term memory as determined by motivation, age, sex and sense modalities.

The main findings were: Both STM and LTM of 12-20 years of age subjects were studied with the help of a list of paired associates. The findings revealed better STM and LTM for the older than for the younger age-group, and for visual than auditor presentation condition. The high-motivation group showed better memory than the low-motivation group. Among personality variables (extroversion, neuroticism and psychoticism) only extroversion was found to be positively correlated with STM of 12 and 16 yrs of age samples.

Donga, Kurjibhai M. (1989) studied memory and affecting variables of students studying in Standards VIII to XII.

A variety of memory tasks were given to boys and girls of VIII and XII. Factor analysis revealed a set of five factors to account for
the memory of the subjects. These were numerical and alphabetical memory, picture content memory, numbers of alphabets and association memory, figure and colour association memory, and symbol and order memory age, birth order, family size and SES exercised significant influences on memory of the tasks. There were some differences according to grade level, but these were not systematic, and the effect of sex was not at all significant.

Khire, Usha (1989) constructed a battery of tests based on Guilford’s SOI model.

The purpose of the study was to construct 90 tests for measuring 90 factors from figural, symbolic and semantic areas in Guilford’s SOI model and to standardize for three high school levels, viz. Standards VIII, IX and X.

In the pilot study, 37 tests were administered to 45 adults from five occupational groups which yielded significantly different occupational profiles. In the main study, using the Latin Square design, representative samples of boys and girls were drawn from Grades VIII through X from 21 different rural zones. Around 4,322 subjects were considered for item analysis and 15,411 were considered for the normative study. Effective sample size for each test ranged from 48 to 151 in item analysis study and 248 to 512 for the development of final versions. The ICL 1904 S system was used for the computerization of the data and for most statistical analyses.
Various statistical techniques used included point biserial correlation, pass percentages, G index of agreement, ‘d’ score, ANOVA and ‘t’ test. The statistical analysis for internal consistency included split-half and rational equivalence. Further, the factor analysis by principal component method and varimax rotation were also used on 196 students of Grade IX boys from two schools.

**Findings**

1. The indices of internal consistency and homogeneity were mostly satisfactory. 2. Test-retest correlations ranged widely, were lower for tests of memory and higher for those of symbolic and semantic content and cognition. 3. Test-retest correlations for composite score from a single content-operation category were higher than those for individual product tests. 4. The sex difference was not always consistent and significant. Though urban-rural difference was observed very often, it was not always in favour of the urban group. 5. Metropolitan-urban difference was greater than urban-rural difference. The group means generally increased with grades but there were some reversals. The more striking observation was that our students were not acquainted with many processes of thinking involved in SOI tests. 6. The independence of factors was evidenced in the product-wise analyses. It was more so across the content. The content-wise and operation-wise analyses yielded some higher order factors common to products in the same content-operation category.
Thus the results suggested greater possibility of distinction between contents and operations than between products.

**Suri Ishwar Saran** (1989) investigated into the structure of reasoning ability of 14 year old students belonging to rural and urban areas.

Cultural diversity is one of the common characteristics shared by societies the entire world over. Hence, the structure of abilities is expected to vary considerably across groups. Investigator tested this assumption in a study of the reasoning ability of rural and urban students. Factor analysis of data yielded cognition of semantic classes, cognition of semantic relations and convergent production of semantic implications as 3 major factors accounting for the reasoning ability of rural children. For the urban group, on the other hand, convergent production of semantic classes emerged as the only factor to account for students reasoning ability.

**Harapanahalli, J. G.** (1994) conducted a comparative study of Guilford's Cognitive abilities among the advantaged and the disadvantaged students. The objectives of the study were: (i) To compare the Guilford's Cognitive factors of the advantaged and disadvantaged students; and (ii) To compare the Guilford's Cognitive factors of students when they are classified according to sex. The study was carried out in the following way. The first phase included the construction of the test items for Guilford’s Cognitive
factors, such as (i) Cognition for Figural Relations (CFR), (ii) Cognition of Figural Systems (CFS), (iii) Cognition for Figural Transformations (CFT), (iv) Cognition of Semantic Units (CMU), (v) Cognition of Semantic Relations (CMR), (vi) Cognition of Semantic Systems (CMS), (vii) Cognition of Semantic Implications (CMI), (viii) Cognition of Behavioural Implications (CBI). Further, the item analysis was carried out by the investigator. It includes: (i) Language difficulty (ii) Judging the Factor Validity – It was carried by judging item difficulty and discrimination index using Flanagan’s Biserial Coefficients of correlation and total correlation for Factor validity using Tetrachoric correlation. Lastly, the investigator selected ‘t’ test for the analysis of data. Two hundred and eighty nine students of standard IX, studying in and around Dharwad city constituted the sample for the study. Hartley’s ‘t’ test was employed to test the homogeneity of variance.

Findings

i. The advantaged and disadvantaged students differ significantly in their abilities factors like CMR, CMS, CFT and CBI.

ii. Both the advantaged and disadvantaged students were alike in their factors/abilities like CMU, CMI, CFR, and CFS.

Venugopal, G. (1994) conducted an intellect profile and achievement of middle school pupils.
The objectives of the study were: (1) To study the intellect profile of middle school pupils, (2) to measure the achievement of the pupils, (3) to ascertain the relationship between intellect profile and achievement, (4) to find out the relationship between intellect abilities and gender, (5) to find out the relationship between intellect abilities and socio-economic status of parents, and (6) to study the relationship between achievement and gender.

The sample comprised 300 pupils covering 210 boys and 90 girls from schools in Vellore town of North Arcot Ambedkar District in Tamil Nadu. This was done using multiple random sampling technique. Tools used were Guilford's Intelligence Test and an achievement test conducted Pearson's Product Moment Correlation were used to treat the data.

Findings

1. Boys and girls differed in their intellect abilities. 2. Pupils differed in their intellect abilities whose fathers differed in their educational status. 3. The intellect abilities influenced the total achievement of the pupils in biology. 4. Cognition, memory, convergent production, divergent production and evaluation intellect abilities under ‘operation’ influenced the total achievement in biology. 5. The intellect abilities influenced the achievement of pupils in knowledge, understanding, application and psychomotor skill objectives. 6. Educational status of the father was related to the achievement of the pupils. 7. There was no relationship between
achievement and the gender of the pupils. 8. Achievement was related to intelligence, parental educational status, occupation and income. 9. Pupils from low socio-economic strata needed compensatory education programmes.

Pednekar, R. G. (1995) conducted a comparative study of Guilford's Convergent Production Abilities among advantaged and disadvantaged students. The objectives of the study were: (i) To compare the Guilford's Convergent Production factors of advantaged and disadvantaged students; and (ii) To compare the Guilford's Convergent Production factors of students when they are classified according to sex.

The study was carried out involving 13 Guilford's Convergent Factors, such as: (i) Convergent Production of Figural Classes (NFC), (ii) Convergent Production of Figural Transformations (NFT), (iii) Convergent Production of Symbolic Implications (NSI), (iv) Convergent Production of Semantic Units (NMU), (v) Convergent Production of Symbolic Classes (NSC), (vi) Convergent Production of Symbolic Relations (NSR), (vii) Convergent Production of Symbolic Systems (NSS), (viii) Convergent Production of Symbolic Transformations (NST), (ix) Convergent Production of Semantic Classes (NMC), (x) Convergent Production of Semantic Relations (NMR), (xi) Convergent Production of Semantic Systems (NMS), (xii) Convergent Production of Semantic Transformations (NMT), (xiii) Convergent Production of Semantic Implications (NMI).
A test was constructed and validated on the basis of these 13 Convergent Production abilities. Further, the item analysis was carried out by the investigator in terms of judging the factor validity and difficulty index. A total of 250 students of IX Standard in the school in and around Dharwad and Karwar Districts constituted the sample for the study. Out of 125 advantaged students 75 were boys and 50 were girls. And among disadvantaged group 75 were boys and 50 were girls. The means of the advantaged and disadvantaged groups were compared using 't' test.

*Findings*

i. The advantaged and the disadvantaged students differ in their Convergent Production abilities like NFC, NFT, NSI, NSR and NMC.

ii. The advantaged and the disadvantaged students differ in their Convergent Production abilities like NMU, NSC, NSS, NST, NMR, NMS, NMT and NMI.

iii. The advantaged and the disadvantaged boys differ significantly in all the thirteen Convergent Production factors.

iv. The advantaged and the disadvantaged girls differ significantly in their Convergent Production abilities like NFC, NFT, NSI, NMU, NSC, NSS, NST, NMC, NMR, NMT and NMI.

v. The advantaged and the disadvantaged girls were alike in their Convergent Production ability NSR.

The objectives of the study were:

1. To compare the Guilford’s Memory factors among the advantaged and the disadvantaged students and

2. To compare the Guilford’s Memory factors of students when they are classified according to sex.

The memory factors selected for the study were: MFU, MFS-V, MSU, MSC, MSR, MSI, MMU, MMS, MMT and MMI.

Survey and analytical methods of research were found to be appropriate for the study. The researcher developed the test items by studying the memory abilities of S.I. Model and there were number of tests for each item out of which the investigator had selected two tests for each memory factor. The test items were tested for their validity and reliability through item analyses.

The sample which constituted the study was a total of 257 students of IX Standard, studying in the rural and urban high schools of Dharwad and its surrounding villages.

Tetrachoric ($r_t$) correlation technique ‘t’ test and ‘F’ test were used for analysis of data.
Findings

1. Both advantages and disadvantaged students differ significantly in all the memory factors.

2. Both advantaged and disadvantaged boys differ significantly in their memory abilities like MFU, MFS-V, MSC, MMU, MMS and MMI.

3. The advantaged and disadvantaged boys were alike in their memory abilities like MSU, MSR, MSI and MMI.

4. Both advantaged and disadvantaged girls differ significantly in their memory abilities like MFU, MSR, MMU, MMS and MMI.

5. Both advantaged and disadvantaged girls were alike in their memory abilities like MFS-V, MSU, MSC, MSI and MMT.


The objectives of the study were: (1) To determine brain preference of the gifted and unselected adolescent girls of VIII Standard, (2) To compare brain preference in the unselected girls, (3) To compare the relationship between brain preference and some of the intellectual abilities, and (4) To study and compare the effect of school environment on the brain preference of these girls.
The sample comprised 170 girls from the VIII Standard who were selected from the school for gifted (School-A) and two schools for unselected (School-B&C). There were 48 girls from school-B and 86 girls from School-C. They were further divided into two groups. Tools used in the study were Brain Preference Inventories, Behavioural Ability Tests and Raven's Standard Progressive Matrices. Statistical techniques used to treat the data were Mean, S.D., tests of significance, correlational and factor analysis.

Findings

1. There was a significant correlation in the Brain Preference of the Group II and of Group III girls. The Group II girls preferred to use Right Hemispherical and Integrated abilities whereas the Group III girls preferred to use Left Hemispherical abilities. 2. There was a significant difference in the abilities of Behavioural Intelligence among the Group II and Group III girls. 3. There was a significant correlation between the variables of Brain Preference and the abilities of Behavioural Divergent Production and Behavioural Convergent Production. 4. The girls from the school for gifted showed significantly high Right Hemispheric abilities and integration of Bihemispheric abilities, whereas girls from unselected schools (B&C) showed preference to Left Hemispheric abilities significantly. 5. The girls from the school for gifted showed significantly high scores on Behavioural Intelligence tests as compared to those of school B and C together. 6.
The difference in the school environment of all the three schools was reflected on all the tests and on the interview content.


The purpose of the study was to analyse 25 structure of intellect factor-based tests in Kannada language including 2 tests of creative thinking. Factor analysis yielded five prime factors which accounted for a major portion of variance in the intellectual performance of high school students. The analysis did not yield a separate factor which may be referred to as the 'originality' factor.


The objectives of the study were: (i) To compare the Guilford's Divergent Production Abilities among advantaged and disadvantaged students; and (ii) To compare the Guilford Divergent Production abilities of students on the basis of their sex. The study was carried out involving 10 Guilford's Divergent Production factors, such as DFU, DSU, DMU, DSR, DMR, DFS, DMS, DMT, DFI, DMI. A test was constructed by the investigator after consulting various sources and personal experience. A random sample of 145 students studying in VIII Standard in Belgaum city constituted the sample. Out of which
97 students were treated as advantaged group. Out of 97 advantaged students 52 were boys and 45 were girls. And out of 48 disadvantaged students 30 were boys and 18 were girls. The test was validated on the basis of these, 10 Divergent Production abilities. Further item analysis was carried out in terms of judging factor validity using Point-biserial Coefficient of correlation. ‘t’ test was used for analysis of data.

Findings

i. The advantaged and the disadvantaged students differ in their Divergent Production abilities like DFU, DSU, SMU, DSR, DMR, DFS, DMS, DMI, DFI and DMI.

ii. The advantaged and the disadvantaged boys differ in their Divergent Production abilities like DFU, DSU, DMU, DSR, DMR, DFS, DMS and DMI.

iii. Both advantaged and the disadvantaged boys were alike in their Divergent Production abilities like DMI and DFI.

iv. The advantaged and the disadvantaged girls differ in the Divergent Production abilities like DSU, DMU, DFI and DMI.

v. Both the advantaged and the disadvantaged girls were alike in their Divergent Production abilities like DFU, DSR, DMR, DFS and DMS.
Martha Pujar (2001) conducted a study of relative effectiveness of selected Guilford's evaluation factors in predicting changes in academic achievement.

The objectives of the study were: (i) To investigate the relationship between performance of boys in different evaluation abilities and their total academic achievement, (ii) To investigate the relationship between performance of girls in different evaluation abilities and their total academic achievement, (iii) To investigate the relationship between performance of secondary school students in different evaluation abilities and their total academic achievement, (iv) To determine the relative efficiency of different evaluation abilities of boys in predicting changes in total academic achievement, (v) To determine the relative efficiency of different evaluation abilities of girls in predicting changes in total academic achievement, (vi) To determine the relative efficiency of different evaluation abilities of secondary school students in predicting changes in total academic achievement, (vii) To compare the profiles of evaluation abilities among 'high achiever', 'average achiever' and low achiever.

The study was carried out involving 10 Guilford's Evaluation factors/abilities, such as (i) Evaluation of Symbolic Units (ESU), (ii) Evaluation of Symbolic Classes (ESC), (iii) Evaluation of Symbolic Relations (ESR), (iv) Evaluation of Symbolic Transformations (EST), (v) Evaluation of Symbolic Implications (ESI), (vi) Evaluation of Semantic Units (EMU), (vii) Evaluation of Semantic Classes (EMC), (viii)

Normative Survey and Analytical method of research were found to be appropriate for the present study. The method of random sampling was used in the selection of sample of VIII standard students. About 298 students from nine different schools in Hubli city constitute the sample for the study. Out of which 149 were boys and 149 were girls. The date required for the study were collected by administering the Guilford’s Type Tests of Evaluation Abilities for VIII standard students constructed and validated by the investigator. The total academic achievement scores were collected from VII standard marks cards of the respective students by the investigator personally. In pursuance of the objectives-1 to 3, the Karl Pearson’s product moment correlation technique was used. In pursuance of the objectives-4 to 6, multiple regression analysis technique was used. In pursuance of the objective-7 the frequency polygon of mean values was drawn in case of high, average and low achievers.

Findings

i) There is a significant relationship between ESU, ESC, ESR, EST, ESI, EMU, EMC, EMT and EMI and total academic achievement in boys.

ii) There is no significant relationship between EMR and total academic achievement in boys.
iii) There is a significant relationship between ESU, ESC, ESR, EST, ESI, EMU, EMC, EMR, EMT and EMI and total academic achievement in girls.

iv) There is a significant relationship between ESU, ESC, ESR, EST, ESI, EMU, EMR, EMT and EMI and total academic achievement in secondary school students.

v) EMI has the highest contribution to the total academic achievement and EMR has the suppressing effect on the total academic achievement of boys.

vi) EMC has the highest contribution to the total academic achievement and EMU and EMR has the suppressing effect on the total academic achievement of girls.

vii) EMC has the highest contribution to the total academic achievement and EMU and EMR has the suppressing effect on the total academic achievement of secondary school students.

viii) High achiever perform high in all the Evaluation abilities like ESU, ESC, EST, ESI, EMU, EMC, EMR, EMT and EMI.

ix) Average achiever perform above average in Evaluation abilities like ESU, ESC, EMT, EMU and EMI and perform below average in ESR and ESI.

x) Low achiever perform just above average in ESI and perform below average in ESC, ESR, EST, EMU, EMC, EMR and EMT.
Patil, B. S. (2001) conducted a study with a view to investigate main and interaction effects of locality and gender on Guilford’s Evaluation Abilities.

The study was carried out involving 10 Guilford’s Evaluation factors/abilities, such as (i) Evaluation of Symbolic Units (ESU), (ii) Evaluation of Symbolic Classes (ESC), (iii) Evaluation of Symbolic Relations (ESR), (iv) Evaluation of Symbolic Transformations (EST), (v) Evaluation of Symbolic Implications (ESI), (vi) Evaluation of Semantic Units (EMU), (vii) Evaluation of Semantic Classes (EMC), (viii) Evaluation of Semantic Relations (EMR), (ix) Evaluation of Semantic Transformations (EMT), (x) Evaluation Semantic Implications (EMI).

Normative survey and interactive method of research were found to be appropriate for the present study. About 300 students from VII standard studying in eight primary schools belonging to four different district in Belgaum division were selected using random sampling technique. Further the sample constituted 150 urban students and 150 rural students, 132 boys and 168 girls. The date required for the study were collected by administering the Guilford’s Type Tests of Evaluation Abilities for VII standard students constructed and validated by the investigator. In pursuance of the objectives of the study, 2-way Analysis of Variance technique and Scheffe’s test were used to find out the difference between urban and rural, boys and girls with regard to their evaluation abilities.
Findings

i) Urban boys, urban girls and rural boys are better than the rural girls in their ESU ability.

ii) Urban boys are better than the urban girls, rural boys and rural girls in their ESC ability. Further, urban girls are also better than the rural boys and rural girls in this ability.

iii) Urban boys are better than the rural boys and rural girls in their ESR ability. Further, urban girls are also better than the rural boys and girls in this ability.

iv) Urban students are better than the rural students in their EST ability. Further, boys and girls do not differ significantly on this ability.

v) Urban students are better than the rural students in their EST ability. Further, boys and girls do not differ significantly on this ability.

vi) Urban boys and girls are better than the rural boys and girls in their EMU ability.

vii) Urban boys and girls are better than the rural boys and girls in their EMC ability.

viii) Urban boys and girls are better than the rural boys and girls in their EMR ability.

ix) Urban students and boys are better than the rural students and girls in their EMT ability.

x) Urban students and boys are better in their EMI ability than the rural students and girls.
Sujatha, S. (2001) conducted a correlative study of the selected Guilford's memory factors in relation to the achievement of IX standard students studying in State schools and Central schools of Bangalore city.

The objectives of the study were: (i) to assess the level of Guilford's memory factors among the students studying in state schools and central schools of Bangalore city, (ii) to compare the Guilford's memory factors among the students studying in state schools and central schools of Bangalore city, (iii) to compare the Guilford's memory factors among male and female students, (iv) to compare the Guilford's memory factors among students studying in aided schools and government schools of Bangalore city, (v) to find out the relationship between the memory factors and academic achievement of students.

Normative survey and interactive method of research were found to be appropriate for the present study. A total of 250 students of standard IX studying in high schools (both state and central schools) in Bangalore south zone constitute the sample using random sampling technique. The data required for the study were collected by administering the Guilford's type tests of Memory abilities and achievement test for IX Standard students constructed and validated by the investigator. In pursuance of the objectives of the study,
percentage analysis, t-test, Pearson’s Product Coefficient of Correlation Technique, and graphical representation were used.

**Findings**

(i) There is a significant difference in the mean memory scores of state and central schools students with respect to MFU, MFS-V, MMU, MMS, MMT, and MMI. (ii) There is a significant difference in the mean memory scores of male and female students with respect to MFU, MSC, MMS, and MMT. (iii) There is a significant difference in the mean scores of government and aided school students with respect to MFU, MFS-V, MSU, MSC, MSR, MSI, MMU, MMS, MMT and MMI. (iv) There is no significant difference in the mean scores of state and central school students with respect to MSU, MSC, MSR, and MSI. (v) There is no significant difference in the mean scores of male and female students with respect to MFS-V, MSU, MSR, MSI, MMU and MMI. (vi) There is a significant relationship between the memory scores and academic achievement of students in total

**Shetti, P. N.** (2003) conducted a study on an effect of Guilford’s evaluation abilities in predicting changes in academic achievement in Mathematics.

The study was carried out involving 10 Guilford’s Evaluation factors/abilities, such as (i) Evaluation of Symbolic Units (ESU), (ii) Evaluation of Symbolic Classes (ESC), (iii) Evaluation of Symbolic Relations (ESR), (iv) Evaluation of Symbolic Transformations (EST), (v)

The objectives of the study were: (i) To study the relationship of Evaluation abilities with academic achievement in mathematics among SC, ST and General Category students. (ii) To determine the relative efficiency of Evaluation abilities in predicting changes in academic achievement in mathematics. (iii) To determine the direct and indirect effects of the Evaluation abilities on academic achievement in mathematics among SC, ST and General Category students. (iv) To determine the cluster of Evaluation abilities in terms of their contributions to variation in academic achievement in mathematics among SC, ST and General Category students.

Normative survey and interactive method of research were found to be appropriate for the present study. About 200 students from IX standard studying in ten high schools belonging to Hukkeri taluka, Belgaum district were selected using random sampling technique. Further the sample constituted 101 boys and 99 girls. The date required for the study were collected by administering the Guilford's Type Tests of Evaluation Abilities, and Achievement Test in Mathematics for IX standard students constructed and validated by the investigator. In pursuance of the objectives of the study, Pearson's Product Coefficient of Correlation Technique, Multiple Regression
Analysis (normal), Path Analysis and Principle Component Factor Analysis statistics techniques were used.

Findings

(i) There is a positive and significant relationship between Guilford’s Evaluation Abilities, Viz., ESU, ESC, ESR, EST, ESI, EMI, EMC, EMR, EMT, EMI and academic achievement in mathematics among SC category students. (ii) There is a positive and significant relationship between Guilford’s Evaluation Abilities, Viz., ESU, ESC, ESR, EST, EMI, EMC, EMR, EMT, EMI and academic achievement in mathematics among ST category students. However, the relationship between ESI and academic achievement in mathematics is not significant. (iii) The Guilford’s Evaluation Abilities like ESU, ESC, ESR, EST, ESI, EMI, EMC, EMR, EMT, EMI are positively and significantly related with academic achievement of general category students in mathematics. (iv) In case of Scheduled Tribe students the correlation between Guilford’s Evaluation Ability i.e., ESI and achievement in mathematics is not significant. This implies that the ST students are lacking behind in the attainment of the Guilford’s Evaluation Ability ‘ESI’. (v) In case of SC category students about 22.63% of the criterion variable is accounted for by variance in the ESU, about -14.95% by the ESC, about 20.92% by the ESR, about 0.51% by EST, about -09.81% by ESI, about 12.35% by EMI, about 4.62% by EMC, about 16.59% by EMR, about 34.49% by EMT and 6.59% by the EMI. Thus, EMT seems to be the best predictor, of all
the predictor variables. The next best predictors of total academic achievement in mathematics, in the order of priority are ESU, ESR, EMR, EMU, EMI, EMC, EST, and ESI, where as ESC and ESI has suppressing effect on the academic achievement in mathematics among SC category students. (vi) The multiple R of the regression equation is 0.8246. For testing the multiple correlation coefficient the F ratio (4.0376) was found to be not significant at 0.05 level. Therefore, the non-significance of R suggests that estimation of academic achievement in mathematics is not possible on the basis of ten Guilford's Evaluation Abilities, viz. ESU, ESC, ESR, EST, ESI, EMU, EMC, EMR, EMT, EMI. (vii) it is evident that in case of General Category students about 11.57% of the criterion variable is accounted for by variance in the ESU, about -07.44% by the ESC, 7.39% by the ESR, 10.63% by the EST, 9.01% by the ESI, 01.84% by the EMU 17.01% by the EMC, 9.64% by EMR, -00.15% by EMT, and 27.65% by EMI. Thus, EMI seems to be the best predictors of all the predictor variables : the next best predictors of total academic achievement in mathematics in the order of priority are EMC, ESU, EST, EMF, ESI and ESR. Whereas EMT, EMU and ESC have suppressing effect on the academic achievement in mathematics among General Category students. (viii) The Guilford's evaluation abilities, i.e., ESU and EMT have direct significant effect on academic achievement in mathematics with direct path coefficients as 0.1743 and 0.325 respectively. Moreover, ESR (0.194), EST (0.004), EMU (0.114), EMC (0.051), EMR (0.162), and EMI (0.081) having positive effect on academic
achievement in mathematics. However, ESC (-0.122), ESI (-0.115) having negative effect on achievement in mathematics. (ix) However ESC through ESR (0.7521), ESR through ESC (0.4547), EMC through EMR (0.410) and EMR through EMC (0.4344) are having significantly indirect effect on academic achievement in mathematics. (x) Guilford’s Evaluation Abilities, i.e., ESI through ESC (0.5095) ; EST through ESR (0.8005); ESR through EST (0.3819) ; EMT through EST (0.5431); ESC through ESI (0.3981) ; EMC through EMU (0.7831); EMU through EMC (0.4013); EST through EMT (0.815) are having indirectly significant effect on academic achievement in mathematics. (xi) The Guilford’s Evaluation Abilities EMC (0.1623) and EMI (0.3181) have direct significant effect on academic achievement in mathematics in case of general category students. (xii) However, ESC through ESU (0.3692) ; EST through ESU (0.1985) ; ESI through ESU (0.3800) ; EMC through ESU (0.2086) ; ESU through ESC (0.2652) ; ESR through ESC (0.2202) ; EMR through ESC (0.2546) ; EMI through ESC (0.3165); ESC through ESR (0.375) ; EMR through ESR (0.2521); ESU through EST (0.1811); EMC through EST (0.1792) ; ESI through ESR (0.3533) ; EMT through ESI (0.1724) ; ESI through EMU (0.2827); ESU through EMC (0.1835); EST, through EMC (0.1728) ; EMU through EMC (0.1535) ; EMT through EMC (0.1674) ; ESC through EMR (0.2689) ; ESR through EMR (0.1563); EMI through EMR (0.2323) ; ESU through EMT (0.1879) ; EST through EMT (0.1816) ; EMC through EMT (0.2057) ; EMI through EMT (0.3817) ; ESC through EMI (0.3128) ; EMR through EMI (0.2174) ; EMT through
EMI (0.2507) are having significantly indirect effect on academic achievement in mathematics. (xiii) However, EMI through ESU (-0.183); EMT through EMU(-0.216), and EMU through EMT (-0.153) are having negatively significant indirect effect on academic achievement in mathematics. (xiv) The key factors in case of SC students with respect to achievement in mathematics are EMC with factor loading 0.855 (Factor-1); ESI with factor loading 0.896 (Factor-2); ESR with factor loading 0.816 (Factor-3); EMU with factor loading 0.686 (Factor-4); EST with factor loading 0.687 (Factor-5); EMT with factor loading 0.641 (Factor-6); EMR with factor loading 0.733 (Factor-7); EMI with factor loading 0.777 (Factor-8); ESU with factor loading 0.696 (Factor-9); and ESC with factor loading 0.327 (Factor-10). (xv) The key factors in case of ST students with respect to achievement in mathematics are EMU with factor loading 0.917 (Factor-1); EMT with factor loading 0.938 (Factor-2); ESI with factor loading 0.888 (Factor-3); ESR with factor loading 0.857 (Factor-4); EMR with factor loading 0.763 (Factor-5); ESU with factor loading 0.819 (Factor-6); EMC with factor loading 0.653 (Factor-7); ESC with factor loading 0.621 (Factor-8); EMI with factor loading 0.868 (Factor-9); and EST with factor loading 0.393 (Factor-10). (xvi) The key factors in case of General category students with respect to achievement in mathematics are EMT with factor loading 0.824 (Factor-1); EMU with factor loading 0.883 (Factor-2); EMR with factor loading 0.692 (Factor-3); EMC with factor loading 0.691 (Factor-4); ESI with factor loading 0.760 (Factor-5); ESR with factor loading 0.788 (Factor-6);
EST with factor loading 0.672 (Factor-7); EMI with factor loading 0.776 (Factor-8); ESU with factor loading 0.635 (Factor-9); and ESC with factor loading 0.437 (Factor-10).

2.3 Synthesis of the Research Studies

Studies in Abroad

Williams (1969) investigated factors of Guilford's Structure of Intellect in Kindergarten boys using Meekers Structure of Intellect Analysis of Binet responses.

The Study was designed by Feldman (1970) to test the predictability of first-grade reading achievement from selected intellectual abilities that were defined in Guilford's SI Model.

Darrell (1971) sought to find whether some mental abilities measured by items on the Stanford-Binet scale are more closely related to the sex and social class status of preschool children.

Meeker (1971) studied short-term memory in its relation both to the structure of Intellect and to differential school success.

Holly (1971) conducted a study regarding structure of intellect factors and a self-concept measure in mathematics relative to performance in high school modern algebra.

Nye (1972) sought to find any significant difference in intellectual functioning between galactosemic children who never
ingested galactose and those children who ingested galactose prior to initiation of their dietary treatment.

Ball (1972) conducted a study on comparison of thinking abilities of five-year-old white and black children in relation to certain environmental factors.

Hays & Pereira (1972) studied the effect of visual memory training on reading ability of Kindergarten and first grade children.

Tucker (1974) developed an individualized educational plan based on strengths and weakness found on the 14 major dimensions, i.e., cognition, memory, figural, transformations for the mentally retarded.

Dailey, Joanne (1975) studied the difference in visual and auditory memory abilities and reading achievement between disadvantaged second grade pupils.

Warren (1975) studied the effect of using a Prescriptive Modulation Retrieval System (PMRS) on attention, concentration, and memory as measured by the Wechsler scale of intelligence of children.

D'Errico (1976) studied the relationship between conservation, academic achievement and non-verbal intelligence in children during the concrete operational period.
Carlson (1976) investigated the patterns of intellectual growth and academic achievement of children who experienced similar elementary school education but differed in cultural group and socio-economic status.

Susan (1978) examined organizational processes in the free recall of children having average and high intelligence test scores.

Adville (1978) conducted a multi-variate study of intellective and non-intellective factors related to the achievement of university freshmen in Basic Skills Program (BSP).

Arnold (1978) conducted a study on a comparison of the black intelligence test of cultural homogeneity with the Wechsler intelligence scale for children as measured by a conventional achievement test within a black population at different social class levels.

Wernher (1978) studied the relationship between test anxiety and adult academic performance on multiple choice and essay tests at different levels of intelligence.

Bart (1981) explored the relationship between life events, trait anxiety and personal problems with grade point ratio, controlling for intelligence and social-desirability response sets.

Olney (1991) studied the development of recall from short-term memory and long-term memory in relationship with list length, word length, taxonomic relatedness, acoustic similarity and modality.
Conway (1991) studied memory development in children by investigating the relationship between age and memory task performance in learning disabled and non-learning disabled groups of children in 6-12 years.

**Indian Studies**

Bala (1978) conducted a study regarding a factor analysis of reasoning ability in 13–15 years old children studying in Delhi higher secondary schools.


Samal (1977) developed a Vocational Interest Inventory to study the interest pattern of high school seniors and its relationship with their intelligence, SES and academic success.

Ravinder (1977) studied the effects of anxiety, psychological stress and intelligence on learning and academic achievement.

Acharyulu (1978) examined the nature of relationship among creativity, intelligence and school achievement and especially the interactive effects of intelligence and creativity upon achievement in different school subjects.
Gupta (1978) studied the role of organizing strategies, methods of presentation and individual differences on short-term retention.

D'Lima (1979) made comparative study of the different types of achievers amongst the different types of gifted pupils, namely, creatively gifted and intellectually gifted.

Chauhan (1980) determined the pattern of selected SI abilities, viz., CSS, NSR, NST, CSR, CMU, NSS, CSI and CMS as predictors of achievement in tenth grade algebra.

Zargar (1980) aimed at studying personality correlates like expression, neuroticism and n-achievement in relation to intelligence, creativity and scholastic achievement.

Katageri (1981) conducted a study on construction and analysis of Guilford’s type tests for some selected semantic abilities, viz., CMU, CMC, CMS, MMI, DMT, EMC in school going children.

Sharma (1982) identified predictive value of intelligence (verbal & non-verbal) and creativity for success in arts, science and commerce courses at the higher secondary stage with anxiety, study habits and SES and control variables.

Magotra (1982) conducted a study regarding mental health as a correlate of intelligence, education, academic achievement and SES.
Singh (1983) conducted a study of memory, reasoning, numerical ability and symbolic representation in relation to achievement in chemistry at graduation level.

Arti (1984) constructed and validated Guilford type tests on semantic abilities like CMC, CMR, CMS, NMC, NMR, DMU, DMC, DMR, EMC, EMS, and EMT.

Kohli & Grewal (1985) investigated into the prediction of academic achievement on the basis of memory abilities among rural over-achievers and under-achievers.

Tiwari (1986) identified relationship between various reasoning ability tests involving cognition and convergent production of semantic classes, relations and implications of Guilford’s SI model and achievement of Set concept in secondary school mathematics.

Rajeshwari (1988) studied the correlation between various levels of concept attainment and their relationship with intelligence and scholastic achievement.

Donga (1989) studied numerical and alphabetical memory, picture content memory, alphabets and association memory, figure and colour association memory and symbol and order memory in relation with age, birth order, family size and SES.
Khire (1989) constructed and standardized 90 tests for measuring 90 factors from figural, symbolic and semantic areas in Guilford’s SOI model for VIII, IX and X Standards.

Saran (1989) investigated relationship between factors CMC, CMR, NMI and reasoning ability of urban and rural children.

Harapanahalli (1994) conducted a comparative study of Guilford’s cognitive abilities like CMR, CMS, CFT, CBI, CMU, CMI, CFR, and CFS among advantaged and disadvantaged children.

Venugopal (1994) studied the influence of cognition, memory, convergent production, divergent production and evaluation intellect abilities on academic achievement in biology.

Pednekar (1995) conducted a comparative study of Guilford’s convergent production abilities like NFC, NFT, NSI, NMU, NSC, NSR, NSS, NST, NMC, NMR, NMS, NMT, and NMI among advantaged and disadvantaged students.


Ramachandrachar (1997) conducted a factor analytical study of some selected structure of intellect factor-based tests in Kannada for the children of school leaving age.

Morkar (1999) conducted a comparative study of Guilford’s divergent production abilities like DFU, DSU, DMU, DSR, DMR, DFS, DMS, DMT, DFI and DMI among advantaged and disadvantaged children.

Pujar (2001) conducted a study of relative effectiveness of selected Guilford’s evaluation factors like ESU, ESC, ESR, EST, ESI, EMU, EMC, EMR, EMT and EMI in predicting changes in academic achievement.

Patil (2001) studied interaction effect of locality and gender on attainment Guilford’s evaluation abilities such as ESU, ESC, ESR, EST, ESI, EMU, EMC, EMR, and EMR.

Sujatha (2001) conducted a correlative study of the selected memory factors MFU, MFS-V, MMU, MMS, MMT, MMI, MSC, MSU, MSR, and MSI, in relation to the achievement of students studying in State schools and Central schools.

Shetti (2003) conducted a study an effect of Guilford’s evaluation abilities ESU, ESC, ESR, EST, ESI, EMU, EMC, EMR, EMT, and EMI in predicting changes in academic achievement in mathematics.
The synthesis of the pertinent research studies conducted so far in the field reveals the following:

i. There are very few studies on the convergent production factor of Guilford's SOI model. The studies by Ari (1994), Mirajkar (1987), Ramachandrachar (1997) have tried test construction for selected convergent production factor and validate the same.

ii. Studies by Tiwari (1984), Venugopal (1994) have tried to understand the relationship between selected convergent production factor and achievement in set concept and biology respectively.

iii. While Saran (1989) investigated relationship between the ability convergent production of semantic implications (NMI) and reasoning ability of urban and rural students, Pednekar (1995) conducted a comparative study of convergent production abilities among advantaged and disadvantaged students.

However, there have been quite a number of studies relating different factors of intelligence with academic achievement Acharyulu (1978), Singh (1983), Tiwari (1986), Venugopal (1994), Sujatha (2001), Pujar (2001), Shetti (2003). Convergent production factors need to explored indepth for understanding their influence on academic achievement at the school level. This study aims at specifically studying the influence of convergent production factors under the
different content areas on academic achievement in science at the secondary level.

2.4 Conclusion

After reviewing available research studies concerning the problem, the investigator finds it difficult in searching for more relevant literature concerning to the testing of Convergent Production abilities. There are no extensive works undertaken to measure and analyze the Convergent Production factors in terms of Figural, Symbolic, Semantic and Behavioural contents. Guilford found that there are 24 factors in Convergent Production category. The association of these abilities with academic performance of the students is not studied comprehensively. Hence, there is an urgent need in the Indian context to construct appropriate tests in Convergent Production abilities based on Figural, Symbolic, Semantic and Behavioural contents and to study their relationships with academic achievement of students in Science.