Language disability and measures of intelligence in handicapped children: a comparison of the McCarthy scales of children's abilities and the Leiter international performance scale

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LANGUAGE DISABILITY AND MEASURES OF INTELLIGENCE IN HANDICAPPED CHILDREN; A COMPARISON OF THE MCCARTHY SCALES OF CHILDREN'S ABILITIES AND THE LEITER INTERNATIONAL PERFORMANCE SCALE

The College of William and Mary in Virginia

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LANGUAGE DISABILITY AND MEASURES OF INTELLIGENCE
IN HANDICAPPED CHILDREN;
A COMPARISON OF THE McCARTHY SCALES OF CHILDREN'S ABILITIES
AND THE LEITER INTERNATIONAL PERFORMANCE SCALE

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Presented to
The Faculty of the School of Education
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In Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

by
Shirley G. Vulpe
May 1983
Language Disability and Measures of Intelligence
in Handicapped Children;
A Comparison of the McCarthy Scales of Children's Abilities
and the Leiter International Performance Scale

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This study investigated a method to compare the effect of verbal language disability on measures of intelligence of young handicapped children. The purpose was to discover whether differences exist in the measures of intelligence when the verbal language requirements of an intelligence test are systematically varied. Two standardized tests that vary in the verbal stimulus response requirements were administered to 102 children ages 2-10 years classified as special education students in Hampton, Virginia.

Children were grouped according to patterns of performance on these tests: (a) LIPS 8+ > MSCA, (b) LIPS ~ MSCA, (c) MSCA 8+ > LIPS, where 8 = $\pm 2$ SEM (p < .05). A Pearson's Correlation Coefficient (r) was used to compare test results. The significance of the similarities and differences of the groups was tested using a $\chi^2$ statistic.

It was hypothesized that measures of intelligence of many young handicapped children are biased when testing procedures require verbal information processing. Results indicated that 65.6% of the handicapped population sampled had IQ scores that were greater than two standard errors of measurement and MA's that were 6-12 months higher on the Leiter than the McCarthy. Nineteen % of the sample had IQ scores and MA's that were approximately equal. Seven % had higher McCarthy GCI and MA's. The differences between the first two groups were significant at the .05 level, $z = 2.37$.

The results indicated that verbal language disabilities significantly influenced intelligence test scores for many young handicapped children. In addition, the two tests, when used together, differentiated the children's information processing and learning styles. This data is directly applicable to teaching and remediation strategies.
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TABLE OF CONTENTS

Acknowledgements i
List of Figures v
List of Tables vi

1. Introduction 1
   Justification for Study 1
   Theoretical Rationale 1
   Statement of the Problem 3
   Hypothesis 4
   Definition of Terms 4
   Overview of Investigation 11

2. Review of the Literature 12
   Summary of Rationale and Relationship to the Problem 12
   Intelligence Testing 13
   Education of the Handicapped 18
   Developmental Research 21
   Neurological Research 25
   Research on Adapted Tests for Handicapped Children 34
   Summary 44

3. Design 46
   Introduction 46
   Purpose 46
   Design Rationale 46
   Population 48
   Sample and Data Gathering Procedures, Study I 48

iii
| Sample and Data Gathering Procedures, Study II | 49 |
| Instrumentation | 56 |
| Organization of Data | 64 |
| Research Hypotheses | 65 |
| Rationale for Statistics | 67 |
| Summary | 68 |
| **4. Analysis of Data** | |
| Study 1 (HIMM) | 70 |
| Study II (HCS) | 75 |
| Test of Research Hypothesis 1 | 75 |
| Test of Research Hypothesis 2 | 83 |
| Other Results | 84 |
| Summary | 85 |
| **5. Conclusions, Implications and Recommendations** | |
| Conclusions | 86 |
| Implications | 90 |
| Recommendations | 93 |
| Summary | 94 |
| Appendix A - Form Letters | 96 |
| Appendix B - Technical Qualities of Test Instruments | 99 |
| Appendix C - Items for Leiter International Performance Test | 106 |
| Appendix D - Task Analysis Items on McCarthy Scale | 110 |
| Appendix E - Pearson Correlation Coefficients | 114 |
| Appendix F - Western Hills Area Education Agency | 123 |
| References | 126 |
LIST OF FIGURES

1. Map of Human Cortex 27
2. Dominant and Non Dominant Hemispheric Functions 29
3. Somatic Sensory Cortex and Motor Cortex 31
4. Localizations of Lesions Causing Disorders 33
5. Speaking a Heard Word, Speaking a Written Word 35
LIST OF TABLES

1. Census Data 48
2. Distribution by Age, Number and Percentage 51
3. Distribution by Race and Sex 52
4. Distribution by Diagnosis 53
5. Attrition of Sample Selected, Study II 55
6. Hypotheses Table 1 66
7. Hypotheses Table 2 66
8. Study I Group A 71
9. Study I Group B 72
10. Study I Group C 73
11. Summary Study I 74
12. Study II Group A 76
13. Study II Group B 79
14. Study II Group C 80
15. Summary Study II 81
CHAPTER 1
INTRODUCTION

Justification for Study

Accurate assessment of the intelligence of handicapped children is essential for appropriate special education. Inaccurate assessment of the mental abilities of a child can lead to misdiagnosis, ineffectively directed instruction and inappropriate achievement expectations. Thus, special education administrators need to evaluate critically child assessment instruments. This requires expertise in the theories, principles, practices and laws related to assessment of the mental abilities of handicapped children.

Theoretical Rationale

Many handicapped children are more defective in verbal language functions than in other higher cerebral processes (Millichap 1977). In the course of most intelligence tests, the testor establishes verbal communication with the testee. If the latter has a verbal language disability the results of the testing may reflect a composite measure of the child's deficiency in verbal language processing and intelligence. Thus, the language deficiency may result in systematic error in the test results.

Verbal language is the typical central link for human communication and the most frequent mode of communication used to measure intelligence. Verbal communication is also most representative of the
usual learning environment and, therefore, appropriate for the measurement of learning ability. Verbal communication of information is most efficient and effective for individuals with normally functioning language areas of the Central Nervous System (CNS). The opposite is usually true: individuals with an abnormal CNS frequently have an accompanying language impairment. Typically these persons develop compensatory problem solving mechanisms which bypass areas of the brain allocated to verbal language processing.

Language impairment can be either subtle or obvious. Children with subtle problems are easily overlooked since they appear to react normally when they respond verbally to semi-automatic speech and small talk ("Good morning. How are you?"). However, total confusion is the result when new ideas or concepts are presented to them verbally or when they try to convey a complex message or idea verbally.

The language disability may be mild, moderate or severe. In addition, the disability can affect various language functions differentially. Children may have a disability in understanding spoken language (receptive dysphasia), in using internal language or in expressing themselves verbally (expressive dysphasia). Thus a specific disability may result in mild to severe problems in any combination or permutation of the following: poor understanding of instructions, slow or incomplete processing of instructions and/or defective verbalization of required responses (even when the problem has been conceptualized and the answer is known). Intelligence
test items can involve language in any or all of these areas: as a mode of instruction, mechanism of central processing or response requirement. The degree of testing bias introduced by the use of language depends on the complexity of the verbal instruction and the required answer, as well as the type and degree of the child's language impairment.

The problem then is how to recognize systematically and accurately the influence of language disability on intelligence test scores. This study investigates one possible solution. Two standardized tests of intelligence which vary systematically in their language requirements are administered to each child in two sample populations of handicapped children. One test requires verbal processing both to understand the required problems and to communicate the solutions. The other test requires no verbal information processing either for the presentation of the tasks or communicating their solution. The scores of both tests are compared and analyzed to study the influence of verbal information processing on intelligence test scores.

Statement of the Problem

The purpose of this study was to discover whether differences exist in measures of intelligence for young handicapped children when the verbal language requirements of intelligence tests were systematically varied. That is, one test includes, the other excludes the requirement to process verbal information.
The following questions were asked to achieve this purpose.

1. What is the level of intellectual performance of young handicapped children on a standardized intelligence test (typical test) that includes tasks requiring the processing of verbal information?

2. What is the level of intellectual performance of young handicapped children on another standardized intelligence test (adapted test) with no tasks that require processing of verbal information?

3. What will an analysis of the two test results indicate when compared?

**Hypothesis**

Measures of intelligence of many young, handicapped children are biased when testing procedures require verbal information processing.¹

**Definition of Terms**

The following terms are defined: handicapped children, intelligence, intelligence test, mental age, standardized test, standard deviation, and standard error of measurement. The terms verbal language and information processing are operationally defined to clarify their meaning in the context of this investigation.

**Handicapped Children**

The adjective handicapped as defined by PL-94-142 (The Education for All Handicapped Children Act, 1975) refers to those children evaluated as being mentally retarded, hard of hearing, deaf, speech impaired, visually

¹The hypothesis is restated in testable form in Chapter 3.
handicapped, seriously emotionally disturbed, orthopedically impaired, other health impaired, deaf-blind, multi-handicapped, or as having specific learning disabilities, who, because of those impairments, need special education and related services.

**Deaf** means a hearing impairment which is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification, which adversely affects educational performance.

**Deaf-blind** means concomitant hearing and visual impairments, the combination of which causes severe communication and other developmental and educational problems that can only be accommodated in special education programs for deaf or blind children.

**Hard of hearing** means a hearing impairment, whether permanent or fluctuating, which adversely affects a child's educational performance but which is not included under the definition of "deaf."

**Mentally retarded** means significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior and manifested during the developmental period, which adversely affects a child's educational performance.

**Multihandicapped** means concomitant impairments (such as mentally retarded-blind, mentally retarded-orthopedically impaired, etc.), the combination of which causes such severe educational problems that they cannot be accommodated in special education programs solely for one of the impairments. The term does not include deaf-blind children.
Orthopedically impaired means a severe orthopedic impairment which adversely affects a child's educational performance. The term includes impairment caused by congenital anomaly (e.g. clubfoot, absence of some member, etc.), impairments caused by disease (e.g. poliomyelitis, bone tuberculosis, etc.), and impairments from other causes (e.g. cerebral palsy, amputations, and fractures or burns which cause contractures).

Other health impaired means limited strength, vitality or alertness, due to chronic or acute health problems such as a heart condition, tuberculosis, rheumatic fever, nephritis, asthma, sickle cell anemia, hemophilia, epilepsy, lead poisoning, leukemia, or diabetes which adversely affect a child's educational performance.

Seriously emotionally disturbed means a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree, which adversely affects educational performance: an inability to learn which cannot be explained by intellectual, sensory, or health factors; an inability to build or maintain satisfactory interpersonal relationships with peers and teachers; inappropriate types of behavior or feelings under normal circumstances; a general pervasive mood of unhappiness or depression; or a tendency to develop physical symptoms or fears associated with personal or school problems. The term includes children who are schizophrenic or autistic. The term does not include children who are socially maladjusted, unless it is determined that they are seriously emotionally disturbed.
Specific learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain disfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing or motor handicaps, of mental retardation, or of environmental, cultural, or economic disadvantage.

Speech impaired means a communication disorder, such as stuttering, impaired articulation, a language impairment, or a voice impairment, which adversely affects a child's educational performance.

Visually handicapped means a visual impairment which, even with correction, adversely affects a child's educational performance. The term includes both partially seeing and blind children.

Intelligence

Leiter (1959) and McCarthy (1970) use essentially the same operational definitions of intelligence, albeit with slightly different wording. Leiter (1959, p. 6) says "the Leiter International Performance Scale (LIPS) is a nonverbal intelligence scale designed to measure the ability of the subject to adapt to his environment;" McCarthy (1970, p. 5) says "the General Cognitive Index (GCI) of the McCarthy Scale of Children's Abilities (MSCA) represents the child's ability to integrate his accumulated
learnings and adapt them to the tasks of the MSCA when these are administered to him.

Intelligence Test

Intelligence tests are defined as "A standardized test used to establish an intelligence rating by measuring the individual's ability to form concepts, solve problems, acquire information, reason and perform other intellectual operations." Webster's New Collegiate Dictionary (1977).²

Intelligence Quotient (IQ)

The ratio of tested mental age to chronological age is usually expressed as a quotient multiplied by 100.

Mental Age (MA)

The age for which a given score on an intelligence test is the average or normal. (That is, the number of test items for which correct responses are given by average children of various sample ages).

Enabling Behaviors

This phrase is used by Anastasi (1976) to refer to the several behaviors that are assumed to be part of the child's repertoire in any test situation. An example is the child's ability to speak or hear.

²Unless otherwise noted, all definitions are taken from the Webster's New Collegiate Dictionary, 1977.
**Standardized Test**

Swanson and Watson (1981) define this as "a test in which all students answer the same questions, usually a large number, under uniform directions."

**Standard Deviation**

This is a unit of measurement based on the degree to which the scores deviate from the mean. It is referred to as being a certain number above (+) or below (-) the mean (Swanson & Watson, 1981).

**Standard Error of Measurement**

Swanson and Watson (1981) suggest that the Standard Error of Measurement (SEm) represents how close an individual's score compares with his or her true score. A band or interval of the SEm is used to indicate where the child's actual level or ability is likely to be. This band is assumed to project a normal curve and, therefore, 68% of the time a child's actual score will fall within ±1 SEm of the hypothetical true score, and 95% of the time it will fall within ±2 SEm.

**Information Processing**

This refers to the steps necessary to respond to information.

**Operational Definition.** For the purposes of this study information processing is considered to have three components: sensory input, internal processing and motor output.
Sensory Input is the totality of the sensory stimuli reaching the individual. This includes stimulation of the sensory end organ and conduction to the CNS via sensory nerves.

Internal Processing is the series of activities that occur in the CNS such as perception, memory retrieval and association of new material with memories and concepts.

Motor Output is the patterned, goal directed activity of the body in response to the sensory stimulation, or other forms of CNS activation.

Verbal Language

Verbal language is defined as "the expression or communication of thoughts and feelings by means of the vocal sounds and combination of such sounds to which meaning is attributed."

Operational Definition. This study considers three component parts of verbal language:

Receptive language is the ability to hear, perceive and understand what is said.

Internal language is the ability to think using language, including such skills as remembering, generalizing, abstracting, classifying and integrating the language stimuli received in order to respond appropriately.

Expressive language is the ability to communicate using speech with usual speed and correctness and culturally appropriate in syntax and grammar.
Overview of Investigation

In the next chapter the review of pertinent literature is summarized. This summary includes: (1) an explanation of the rationale for this investigation and its relationship to the problem being studied, (2) a discussion of current educational classifications of handicapped children and the related special educational concerns, (3) a review of testing theory particularly as it relates to handicapped children, (4) an overview of developmental and neurological foundations of language information processing, and (5) a discussion of research on the effects of adaptations of standardized tests for both normal and handicapped populations.

In Chapter 3, the design of this investigation is described. This includes the sample studied, the instrumentation used, the statistical and null hypotheses and the model used to analyze results. Chapters 4 and 5 present the analysis and discussion of the data. This is followed by conclusions and implications for further investigations.
CHAPTER 2
REVIEW OF THE LITERATURE

Summary of Rationale and Relationship to the Problem

Typically, development of receptive ability precedes expressive ability. Language involves the ability to comprehend and use symbolic representations of objects and events in our environment. Benson and Geschwind (1973) define as separate language abilities the following: spontaneous speech, comprehension of spoken language, repetition of spoken language, word finding (naming), reading aloud, comprehension of written material, writing, and drawing. They also state that language deficits are directly related to deficits in the functioning of central nervous system (Geschwind, 1979).

Verbal language is the most efficient and effective means to relay specific information between individuals, and this naturally leads to an efficient and effective means of testing the intelligence of an individual. Indeed, talking to a child and expecting the child to respond verbally is the most frequent method used to establish communication between a testor and a testee when standardized intelligence or educational criterion referenced tests are administered to handicapped children. Test scores thus reflect a composite measure of the child's language ability and intelligence. Thus, children with an unrecognized or not fully appreciated language handicap may receive a biased evaluation and this
bias would be proportional to the degree of language impairment. From this it follows that the results of verbally administered intelligence tests may erroneously and significantly magnify the extent of the intellectual disability of language impaired children. For valid testing of the intellectual abilities of language impaired children, it is essential to establish the effects of language dependent bias. The difficulty in doing this is recognizing and diagnosing the influence of subtle language deficits on measures of intellect.

**Intelligence Testing**

Systematic error or bias (Nunnally, 1967) is a problem related to the validity of all psychometric tests. Adequate norms, reliability and lack of bias are necessary conditions for validity. It is only when these conditions are met that systematic validation of instruments can proceed. A true score can be considered a composite of trait variance and the method used to measure the variance (Campbell and Fiske, 1959, p. 82). Salvia and Ysseldyke (1981) describe four ways bias can influence a test:

1. **The Method of Measurement** used to measure a skill or trait often determines the score a child will receive.

2. **Enabling Behaviors** are the several behaviors assumed to be part of a child's repertoire in any test situation, for example, the ability to speak or hear. Frequently such obvious limitations or absences of enabling behaviors are overlooked in test situations even if they invalidate the test results.
3. **Item Selection** for tests may include items a child has never had the opportunity to learn, that the teacher has not taught or the environment has not included.

4. **Administration Errors** occur when tests are not administered according to standardized procedures.

DuBose (1978) discusses other possibilities, each of which fit into the above categories: (a) lack of stimulus value or using tasks which do not attract the child's attention; (b) tasks requiring language behaviors, fine motor manipulations or speed of performance a child does not have (enabling behaviors); (c) out of date tasks (item selection); (d) any adaptation of a test including changes to procedures that violate standardization. DuBose also introduces the importance of the assessment milieu. Individuals do not act independent of outside forces in any situation but are continually responding to situational factors. Thus, bias can be introduced in test results by testing a child in an environment that he/she cannot cope with comfortably.

Bortner and Birch (1975) noted the glaring differences that occur in the estimates of an individual's potential when alterations are made in the conditions in which children are required to perform. For example, children who could not conserve number concepts on Piaget's test of conservation using the short row of eight clay pellets and the long row of five clay pellets suddenly were able to determine accurately which row had more pellets when the pellets became M&M's and the child
could eat the row with more M&M’s. Harpin (1978) also includes such bias factors as the child’s fatigue, anger or limited attending behavior. This discussion makes it evident that the sources of bias are complex and often interactive; they can be present in the assessment process, the test itself, and the skills and attitudes of the examiners.

It may be assumed that tests are biased against handicapped persons when the results of the test reflect not the tested persons’ deficits in achievement but their inability to perform in the medium chosen for testing such as language, drawing or motor coordination. Therefore it is important to know what test scores really measure and to be able to discriminate what is measured from how it is measured. For example, a lack of understanding of verbal direction may appear as an inability to solve the problem. On the other hand, lower scores on a test do not necessarily signify a testing bias. If this were the case, every spelling test would be biased against poor spellers, every typing test against slow typists or every hearing and vision test against those who neither hear and/or see well.

For some types of handicaps, bias is relatively obvious, even to those not familiar with the characteristics of handicapped children. For example, it is obvious that tests which require a blind child to see, a deaf child to hear, a poorly co-ordinated child to do fine penmanship, or an expressive aphasic to talk would be more a reflection on what the child did not hear, see, move, or say than what the child really knew.
This phenomenon of measurement is not at all obvious when the handicap is subtle.

Non-discriminatory testing of handicapped students has also become a legal issue for educators, mainly due to civil rights legislation since the 1960's. Two federal laws require that handicapped students be protected from bias when assessment takes place. Thus, the measurement should be influenced only by the skill being measured, not by the handicapping condition, and the test results must allow the handicapped person an equal opportunity to achieve. The Education for All Handicapped Children Act of 1975 (Public Law 94-142) details its requirements in Section 12a 532, Evaluation Procedures.

States and local education agencies shall insure, at a minimum, that tests are selected and administered so as best to insure that when a test is administered to a child with sensory, manual, or language impairment, the test results accurately reflect the child's aptitude or achievement level or whatever other factor the test purports to measure.

Section 504 of the Rehabilitation Act of 1973 (Public Law 93-112) states: "benefits and services to be equally effective are not required to produce the same educational result or level of achievement for handicapped and non-handicapped persons, but must afford handicapped persons the same opportunity to gain the same benefits or to reach the same level of achievement (45 C.F.R. 84.4(b))."
Anastasi (1976) describes modifications that are typically made in tests for various categories of handicapped children in standardized tests. The modifications used in the tests may change the method of presenting the test stimulus, the method the examinee uses to respond, or the procedures for administering the test.

Alternative methods of presenting test stimuli may include: giving instructions by demonstration, gesture, or pantomime, using sign language, Braille, or large print, providing easy practice exercises in tasks of the type required, and ensuring that the stimulus used is something the child has previously experienced.

Alternative methods of response may include providing for alternate response mechanisms such as: typing, Braille, signing, head, finger or eye pointing, and pictorial classification. Response requirements can also be modified to eliminate influence of speed of response by eliminating timed responses.

Altered procedures include frequent short testing sessions, testing in a familiar environment with familiar people, and comparing test scores only to those obtained from other similar children.

The problem with these forms of modifications is that the modifications may invalidate test results. The changes in the standardized test procedures may make any comparisons unreliable. Thus the tester has not solved the initial dilemma of valid test results for the handicapped child.
Intelligence tests are often used to classify handicapped students and make predictions about their ability. If the results have been more influenced by the handicap of the child (language processing abilities) than the abilities the test purports to measure (in this example intellectual ability and school performance), then the test discriminates against the handicapped person.

Katz (1955, p. 839) said "the literal administration of the Stanford Binet tends to underestimate a child's ability almost in proportion with the severity of the child's handicaps." Inaccurate test results have the potential of severely limiting the tested individual's potential for achievement since both the school personnel and society in general will have inappropriate achievement expectations for the child. Several sources provide evidence that the teacher's view of the student is a strong force in determining the nature of the interaction between a teacher and a student and, in turn, a student's achievement. (Rosenthal & Jacobson, 1968; Good, 1970; Brophy and Good, 1974; Parkey, 1970).

Education of the Handicapped

This discussion is confined to the broad educational methods of classifying handicapped children that have been incorporated into P.L. 94-142 (The Education for All Handicapped Children's Act) that were defined in the previous section (Definition of Terms).

These categories group children according to typical patterns of behaviors. The major problem associated with planning intervention for a child based on these labels is lack of specificity about the wide range
of individual differences present within each category (Hobbs, 1975). Sattler (1981, p. 355) says that "diagnostic labels provide no explanation of the child's difficulties and tell us nothing about the steps necessary for remediation. Teaching needs to be guided by the child's performance, not by a classification system with arbitrary cutoffs." For example, a mentally retarded child may have any number of specific handicaps in addition to a slower average rate of learning. He or she may have difficulty processing visual or auditory material and, therefore, learn better by one or another sensory presentation of materials to be learned. In addition the rate of learning may differ for different developmental areas. Petreshene (1982) discusses these factors and their relationship to learning styles. She states:

Learning styles are the way in which we learn best. Learning styles differ from person to person because they are influenced by a multitude of sociological, physical and psychological factors. Some students rely heavily on one particular sense: vision, hearing, or touch, for learning. Psychological research has determined some children process information most effectively by visualizing and retaining a mental image. They are primarily visual learners. Other students respond best to ideas if they are put to sound. They are auditory learners. Still others learn best when ideas are related to movement; in other words by doing. They are kinesthetic learners (p. 48).
The typical pattern for handicapped children, not always true for each individual child, is that language learning is slower than motor learning, while perceptual and conceptual abilities range somewhere between these two. O'Connor et al. (1970) researched the incidence of additional handicaps in a sample of 17,000 institutionalized retardates. The results indicate that speech is one of the most prevalent handicaps for the total population of young low IQ retardates. Myklebust (1973) reports that a large proportion of children referred for medical examinations are referred because of language problems. He also reports evidence suggesting that a large proportion of children with deficits in learning have poor integration of verbal and non-verbal abilities.

Neil (1976) also studied handicapped classification problems. He discusses the need for special education to be concerned with systems which consider variables that affect learning. Tarnpol (1971) has called for refinement of research techniques to separate children into categories according to specific processing deficits. This dialogue indicates the need for a method of testing children that is sensitive to both typical developmental patterns of handicapped children and individual differences in learning style.

Investigation of language bias in tests for the handicapped necessitates knowledge of the developmental and neurophysiological foundations of language information processing and test adaptations. The following is a brief review of some of this information.
Woolridge (1963, p. 10) says that if there is one capability that is uniquely human, it is the power of speech. Wang (1982) introduces a book on human communication with the following statements:

- Society is maintained for better or worse by means of language.
- Our inner selves are clearly dominated by language as well, as it helps us remember, plan and carry out the day's activities.
- We experience language even during sleep, occasionally talking out loud. (Preface)

Although the study of language change has developed along lines quite parallel to biological thinking it is important to emphasize a fundamental difference between the two. In biology, the transmission of genetic material is virtually all vertical, i.e. from parents to offspring. The transmission of linguistic traits is by no means constrained this way. Our linguistic behavior is significantly influenced by our peers (horizontal) and by speakers of other generations (oblique). Consequently, no language is pure in the sense that a biological species can be said to be . . . .

So many humans learn to speak effortlessly and naturally, indicating that there must be a significant influence from genetic facilitation, the situation is very different from reading and writing. Many societies still do not have written languages and in most literate societies there are people who cannot read or write either for social or organic reasons. (p. 37)
DeKaban (1970, p. 277) lists four functions which must be intact for the development of speech to proceed normally.

1. serviceable hearing
2. satisfactory intellectual endowment
3. intact cerebral centers subserving understanding and production of vocal symbols
4. intact neural and muscular component of articulation.

He then discussed the possibility that a psychological disturbance may alone impair speech development. Such conditions as social and emotional deprivation, serious chronic illness and physical pain may adversely affect the development of communicative language.

Moskowitz (1978) discussed the development of basic language skill. She maintains:

... by age five children have established themselves linguistically as a full fledged member of a social community. This includes knowledge about the most subtle details of the native language as it is spoken in a wide variety of situations. She also discussed factors which influence the development of language. She felt that as more parallels between language and other areas of cognition are revealed, there will be more reasons to believe that any language specialization that exists in the child is only one aspect of more general cognitive abilities of the brain (p. 121).
She elaborated these points by discussing some environmental influences on the development of language.

1. It is now known that a child who hears no auditory language learns no auditory language and that a child learns only the language spoken in his/her environment.

2. A child does not learn language, however, simply by hearing it spoken. It appears that in order to learn a language a child must also be able to interact with people in that language. A child can develop language only if there is language in his/her environment and if he/she can employ that language to communicate with other people in his/her immediate environment.

3. Until about the age of three a child models his/her language after that of his/her parents. Later, the language of his/her peer group tends to become more important. There is no question, however, that language environments which children inhabit are restructured, usually unintentionally, by the adults who take care of them. Recent studies show there are several ways caregivers systematically modify the child's environment making the task of language acquisition simpler.

4. It is known that children benefit less from frequent adult correction of their errors than from true conversational interaction. Practice does appear to have an important function in the child's language learning process.

Vulpe (1977, p. 1) discusses the interaction of environmental and biological influences on development with the following statement:
The question is whether altered behavior causes structural changes in the brain. That changes in the brain do occur as a result of experiencing certain events is supported by much research but there are still many questions. What really appears to be the case is that some aspects of human development are affected solely by genes whereas others can be modified in response to environmental stimuli. How much modification can occur also appears to be genetically controlled.

Later Vulpe (p. 8, 9) discusses the roles of the child caregiver in fostering acquisition of developmental skills with particular emphasis on the handicapped child:

Caregivers shape a child's behavior by selecting and mediating the interaction that occurs between the child and his environment ....

.... This mediating is particularly hard for the parent of an atypical child, as the child may have special sensitivities, exceptional strength in reaction, slow or uneven developmental progress, physical illness, neurological handicap, and/or emotional disturbances which require a special effort to adapt to the variations in environment. This makes atypical infants much more vulnerable as they can be expected to have impairment in their ability to have satisfactory interactions with the social and/or physical environment. Additionally the
problem of responding to and handling these children can make adverse reactions in parents which in turn may have a negative effect on the child. The child may be left alone or may not receive the most appropriate level of stimulation, or the child's developing sense of competence can be damaged by the faulty or unsuccessful interactions in its own environment because of inherent difficulties as well as the difficulties the caregiver (parent, teacher, etc.) has in mediating between the child and the environmental experiences.

**Neurological Research**

In addition to environmental influences, there is a neurophysiological basis for all information processing. Damage to specific areas of the Central Nervous System (CNS) results in malfunction of specific behaviors. There are, however, adaptive mechanisms in the CNS whereby it is possible to bypass damaged pathways and use alternate pathways as compensatory mechanisms.

Brain or higher nervous system functioning can be divided into two major categories: response to outside stimulation and spontaneous activity. Response to stimuli is exemplified by looking towards light, stopping motor activity in response to auditory stimulation, pushing away disagreeable tactile stimulation or fantasizing about food on olfactory stimulation. Each one of these responses form separate yet interrelated neural mechanisms. Since each of these sets of mechanisms are different adaptive mechanisms through which the individual protects himself or
adapts to the demands of his surroundings, the more intact mechanisms the individual has the better his adaptive functioning, and the more intelligent the child is considered. Damage to any of these mechanisms is not an all-or-none phenomenon, but a gradual loss depending on the location, extent and severity of organic damage.

Cortical functions include all tasks which involve conscious processing of incoming sensory impulses and their interpretation. Dominant and non-dominant hemispheric functions refer to the two sides of the brain; the left side of the brain is usually dominant for speech. This dominance is associated with anatomical asymmetry; certain parts of the dominant side of the brain are larger than the non-dominant side. It is important to realize that the classification of functions to the right or left brain is a generalization based on the fact that the left cortex is usually dominant for language. Vitale (1982, p. 4) says that:

For many years the dominant hemisphere automatically has meant the hemisphere dominant for language or the left hemisphere. Since new research has indicated that in some people dominance for language is the right hemisphere, the above concept is no longer appropriate. The dominant hemisphere is the hemisphere actuated for most tasks, the hemisphere that is the stronger of the two.

The most understandable way to present the localization of brain functions to either the dominant or non-dominant hemisphere is maps of brain functions. Figure 1 is a modified illustration by Geschwind (1979) which
Map of the Human Cortex shows regions whose functional specializations have been identified. Much of the cortex is given over to comparatively elementary functions: the generation of movement and the primary analysis of sensations. These areas, which include the motor and somatic sensory regions and the primary visual, auditory and olfactory areas, are present in all species that have a well-developed cortex and are called on in the course of many activities. Several other regions are more narrowly specialized. Broca's area and Wernicke's area are involved in the production and comprehension of language. The angular gyrus is thought to mediate between visual and auditory forms of information. These functional specializations have been detected only on the left side of the brain; the corresponding areas of the right hemisphere do not have the same linguistic competence. The right hemisphere, which is not shown, has its own specialized abilities, including the analysis of same aspects of music and of complex visual patterns. The anatomical regions associated with these faculties, however, are not as well defined as the language areas. Even in the left hemisphere the assignment of functions to sites in the cortex is only approximate; some areas may have functions in addition to those indicated, and some functions may be carried out in more than one place.

Adapted from Geschwind (1979)
shows the parts of the brain and indicates the allocation of generalized functions to both sides of the brain and specific functions to the dominant or non-dominant cortex. Figure 2 is a modified diagram by Rennel (1976) of functions which are specialized in the left (dominant hemisphere) and right (non-dominant) hemisphere.

Witelson (1976, p. 48) reports that "the development of dominance for speech and other functions is age dependent and is influenced by sex. Boys performed in a manner consistent with right hemispheric specialization as early as at age 6. Girls show evidence of belated representation until the age of 13. The results suggest a sexual difference in the plasticity of the development of neural organization underlying cognition and learning during a major period of childhood." The sexual differences in the plasticity of the nervous system is also supported by stroke research which indicates that women recover language and other cognitive functions more readily than males. This plasticity is important to teachers because it enhances the possibility for individuals to develop alternative brain pathways to accomplish various behaviors.

The relationship between mental activity, learning or task performance and specific areas of the brain has been investigated by four different types of studies:

1. Studies involving destruction of specific areas of the brain and how loss of these areas correlate with specific loss of function.

2. Studies involving electrical stimulation of various parts of the brain and the behaviors this stimulation elicits.
Figure 2

Dominant and Non Dominant Hemispheric Functions

Resident Functions of Left and Right Hemispheres

Left
1. Verbal
2. Numerical
3. Linear
4. Euclidean
5. Rational
6. Logical
7. Geometric

Right
1. Visual
2. Spatial
3. Perceptual
4. Intuitive
5. Imaginative
6. Fantasy
7. Imagery
8. Metaphoric
9. Sensory

Adapted from Rennel (1976)
3. Studies involving evoked potential or recording of the electrical phenomena in various parts of the brain during modality specific functions, e.g., electrical activity in the occipital lobe on seeing something.

4. Studies of differential blood flow or metabolism by proton emission tomography to areas of the brain for different types of activities or learning.

Milner (1972, 1973) reported research which demonstrated that damage to the non-dominant hemisphere resulted in deficits in non-verbal memory systems. Gilbert (1977) found that skills involving spatial orientation and appreciation of geometric shapes and musical melodies were considerably impaired as a result of right hemispheric damage. Penfield and Jasper's (1950) now classical electrical stimulation studies led to the localization of brain functions in the motor and sensory cortex. Somatic sensory and motor regions of the cerebral cortex are specialized in the sense that every site in these regions can be associated with some part of the body. Figure 3 is an illustration of these associations. The distortions in the human representation come about because the area of the cortex dedicated to a part of the body is proportional to the precision with which it must be controlled. Thus, in man, the motor and somatic sensory regions given over to the face and to the hands are greatly exaggerated. Only half of each cortical region is shown: the left somatic sensory area (which receives sensations primarily from the right side of
Somatic sensory and motor regions of the cerebral cortex are specialized in the sense that every site in these regions can be associated with some part of the body. In other words, most of the body can be mapped onto the cortex, yielding two distorted homunculi. The distortions come about because the area of the cortex dedicated to a part of the body is proportional not to that part's actual size but to the precision with which it must be controlled. In man the motor and somatic sensory regions given over to the face and to the hands are greatly exaggerated. Only half of each cortical region is shown: the left somatic sensory area (which receives sensations primarily from the right side of the body) and the right motor cortex (which exercises control over movement in the left half of the body).

Adapted from Geschwind (1979) and Penfield & Roberts (1959)
the body) and the right motor cortex (which exercises control over movement in the left half of the body).

Lux (1977, p. 252) in a study using evoked potentials found that "learning disabilities are significantly correlated with slower latency differences of visually evoked potential." Childers (1977, p. 379) reported "that the spectrum analysis of normal and dyslexic data show significantly different visual evoked potential patterns for normal and dyslexic children." Larsen et al. (1977) did research which illustrated differential blood flow in different parts of the cortex, depending on the type of sensory stimulation. For example, reading aloud involved nearly the same area as automatic speech, as well as the parietal temporal junction of the cortex.

A functional map of the brain is evolving due to these research studies. These areas represent the central hub for specific activities and are not to be viewed as the sole center or the repository of an engram for a specific sensory or motor function. A useful way to translate this data into information relevant to teachers is to classify information related to traditional classroom activities.

Millichap (1977) and Benson (1978) have illustrated (Figure 4) these activities by associating the name of a disability with a specific area of the brain. Agraphia refers to the inability to write. Auditory agnosia is the inability to identify the meaning of sounds. Receptive aphasia refers to the inability to understand what is said. Amnesic aphasia is the inability to remember what was said or what was heard. Expressive
Neuroanatomical Localization of Lesions Causing Disorders of Language and Learning

Millichap (1977) Left Cortex

Benson (1978) Left Cortex
aphasia is the inability to say what you know. Dyslexia is the impaired ability to read, and dyscalculia is the impaired ability to learn mathematics. Anarthria is the inability to pronounce sounds. Astereognosis is the inability to identify the meaning of touch. Ideo-motor apraxia is the inability to plan motor activities. Visual agnosia is the inability to identify the meaning of visual stimuli. Changes of personality and character appear when there is damage or dysfunction in the frontal areas of the brain, and the individual experiences difficulty in behaving appropriately in the context of different social and environmental expectations.

Geschwind (1979) illustrates the different paths of nervous activity in the brain which occur when someone says a word he heard, or reads a word and then speaks it (Figure 5).

Thus there is ample evidence that localization and lateralization of specific learning related behaviors in the brain does occur. In addition, the evidence indicates that various stimulus response requirements of tasks activate different parts of the brain.

**Research on Adapted Tests for Handicapped Children**

Research on issues related to adapted testing is conflicting. Strother (1945) and Braen and Masling (1959) noted that test norms cannot be used when standardized tests have been altered. Maisel, Allen and Tallarico (1962) reflect the fact that it has not been established to what extent test modifications for handicapped children invalidate comparison to the norms established on a non-handicapped population. However, as
Linguistic Competence requires the cooperation of several areas of the cortex. When a word is heard (upper diagram), the sensation from the ears is received by the primary auditory cortex, but the word cannot be understood until the signal has been processed in Wernicke's area nearby. If the word is to be spoken, some representation of it is thought to be transmitted from Wernicke's area to Broca's area, through a bundle of nerve fibers called the arcuate fasciculus. In Broca's area the word evokes a detailed program for articulation, which is supplied to the face area of the motor cortex. The motor cortex in turn drives the muscles of the lips, the tongue, the larynx and so on. When a written word is read (lower diagram), the sensation is first registered by the primary visual cortex. It is then thought to be relayed to the angular gyrus, which associates the visual form of the word with the corresponding auditory pattern in Wernicke's area. Speaking the word then draws on the same systems of neurons as before.

Modified after Geschwind (1979)
Sattler (1977) points out, regardless of the difficulties in using test norms, it is still important to compare the performance of the handicapped child with that of the normal child. Michel-Smith (1955, p. 15) makes the same point when he says "no testing is valid if it is so unique that it cannot measure or place the child within accepted standardized normative ranges of mental development."

Thus, if adapted versions of standardized tests do yield more valid test results for handicapped children and do not invalidate the normative data, research results should indicate that:

1. there are no significant differences between adapted and standard versions of a test for the normal population.

2. the adapted tests significantly improve the performance of handicapped individuals.

The research reviewed on this topic has produced contradictory results and some methodological discrepancies.

Eighteen research studies comparing adapted and standard administration of standardized tests were reviewed. These are discussed in three categories: those that studied only normal populations, those that studied only handicapped populations, and those that compared performance of normal and handicapped persons.

The following six studies used normal children as their sample population:

1. Tozier (1968) studied the effects of a pointing modification of the block design subtest of the WISC (Wechsler, 1949). A board with
six blocks showing the various possible positions of the blocks used in
the construction of designs was presented as the key for all experimental
group subjects (adolescent non-handicapped males and females). Their
task was to point to one of the blocks on the board and then to indicate
where the block should be placed on a white, unlined sheet of paper.
The experimental and control (standard administration) groups did not
obtain significantly different scores. Since Tozier did not use a repeated-
measures design, the relationship between the scores obtained using the
two procedures is not known.

2. Wamba and Marzolf (1953) modified the Progressive Matrices
Test by having non-handicapped subjects between the ages of six and
eleven indicate their responses by means of eye movements. The subjects
achieved similar scores under both standard and eye-movement response
conditions.

3. Maisel, Allen and Tallarico (1962) gave the Leiter International
Performance Scale (Leiter, 1952) to normal children between the ages of
five and eleven, using the standard procedure and also using a modified
procedure which consisted of having the children indicate by pointing
where they wanted the examiner to place the blocks. Because the adapted
and standard methods of administration did not yield significantly different
scores, the authors suggested that the standardized Leiter Scale norms
could be used with both administration procedures.

4. Arnold (1951) also studied the effects of having non-handicapped
children, who had either average or retarded mental ability, indicate
where to place the Leiter Scale blocks. In addition, he also studied the effects on the Porteus Mazes (Porteus, 1959) test of a pointing modification which consisted of having the subjects motion where to draw the lines. All subjects, too, were administered the Stanford-Binet Scale (Form L) (Terman and Merrill, 1937) under standard conditions. Because the correlations between the Leiter Scale (modified) and the Stanford-Binet (standard) and between the Porteus Mazes (modified) and Stanford-Binet (standard) were highly significant in both groups (rs ranged from .81 to .94), Arnold concluded that both the Leiter Scale and the Porteus Mazes provided valid scores with the modified procedures.

5. Graham and Schapiro (1953) found that in a group of normal children between the ages of 6-3 and 12-2, pantomime instructions led to significantly lower WISC Performance scores than did standard instructions.

6. Koppitz (1970) studied the effect of presenting three to seven digits in an auditory and visual modality and the effect of having an aural and written response modality. The subjects were normal children in grades one through five. The visual modality of presentation consisted of showing to the child all of the digits simultaneously on a card for ten seconds. This procedure differs from the usual digit span procedure in which the stimuli are presented successively. The visual presentation resulted in higher scores than the auditory presentation.

Four of these six studies indicate that modifying test procedures for normal children makes no difference in test scores and therefore using
the adapted procedure with handicapped children should not invalidate
the test norms. Two of these six studies indicate that modifying test
procedures for normal children also change their test scores, one decreased
the scores and one increased the scores. The use of these procedures
then would possibly invalidate test scores obtained.

The following nine research studies used handicapped children as
their sample populations.

1. Saigh and Payne (1979) examined the effect on performance of
response reinforcers (token, verbal praise) and two levels of reinforcement
schedule (fixed and continuous ratio). Results indicated no interaction
between type of reinforcement and schedule, no main effect for type of
schedule and a statistically significant positive effect on scaled scores
for verbal and token reinforcers on the Arithmetic, Digit Span, and
Picture Completion subtests of the WISC-R. No effect on block design
was noted. The sample population was 120 educable mentally retarded
subjects. No comparison was made to non-handicapped children. The
descriptors of the handicapped included the diagnosis mental retardation,
their IQ and the fact that they were from a non-token institution.
Significance at .05 level was defined using an analysis of variance and
a Scheffé after test which revealed a significant difference in mean
scaled scores for both verbal and token groups relative to verbal neutral
groups.

2. Zigler and Butterfield (1968) showed that the performance of
socio-economically deprived children on standardized tests (IQ or Peabody
Picture Vocabulary) can be significantly increased by altering the conditions of testing. Significance was defined in statistical terms. In the study the children were given IQ tests under standard or under optimizing conditions. The latter included a mixture of easy and hard items and more time and encouragement for answers instead of the usual easy-to-hard sequence and neutral attitude. Under optimum conditions performance increased an average of 10 percent.

3. Zigler, Abelson, and Seitz (1973) showed that socioeconomically deprived children's performance on the Peabody test could be significantly increased if they were tested by someone familiar to them. No comparable effects of this treatment were noted on normal children whose slight increase in scores was significant statistically but was still within the standard error of measurement.

4. Carlson and Wiedl (1978) tested various testing-the-limits procedures in administering the Raven Colored Progressive Matrices Test on 108 subjects with learning difficulties. Both picture and puzzle forms of tests were employed in a repeated measures format. Results of repeated measures of the analysis of variance for unequal cell size revealed statistically significant improvement in performance due to testing condition. The effect of testing conditions involving verbalization and feedback was most salient. Performance on second testing was higher than on the first. Normal children were not studied and learning difficulties were not elaborated on. Multiple Scheffe post hoc comparisons
of means were used to determine which conditions were differentially effective. Standard error of measurement was not discussed.

5. Dillon (1979) found that hearing impaired children performed significantly ($p < .001$) better on the Raven Colored Matrices (pictures and forms) and a Piagetian Battery under partial elaborative and fully elaborative conditions as compared with non-elaborative conditions. Non-elaborative conditions are standard and simple feedback. Partial elaboration included the child's verbalization (after problem solution and verbalizing) before and after solution, while fully elaborative conditions are feedback and verbalization before and after solution. The data supported the hypothesis that performance would vary as a function of the method of test administration and that treatment effects did not differ as a function of the testing instrument.

6. Budoff and Hamilton (1976) found that the reliability of intelligence measures was increased for moderately and severely retarded institutionalized adolescents and adults by the incorporation of instruction within the assessment procedure. No comparisons were made with a normal population.

7. Katz (1956) proposed a pointing-scale method for scoring the Stanford-Binet (Form L) which involved scoring only those items that could be answered by pointing, and then pro-rating the score to obtain the mental age. He reported that a group of cerebral-palsied preschool children obtained equivalent scores under the standard and pointing-scale methods. Normal children were not studied.
8. Livingston (1957), studying partially sighted children between the ages of eight and ten, reported that enlarging the visual items of the Stanford-Binet (Form L) did not produce significant differences between the experimental and control groups. Non-handicapped children were not studied.

9. Ritter (1976) compared the test results of the Arthur Adaptation of the Leiter International Performance Scale, Raven's Colored Progressive Matrices (pictures and forms) and the performance sections Wechsler Intelligence Scale for Children for 31 children with mild to moderate hearing impairments. A comparison of test results indicated moderate convergent validity among the measures, while average intellectual estimates of the three tests were statistically significant for mean scores of Arthur Adaptation and WISC Performance Section and the Raven Matrices and WISC-P; the actual point differences were 6.6 and 7.8. The author felt that given the interpretation of intelligence as fluid and the test standard error of measurement that the score differences of 6 to 8 were not dramatic discrepancies. Non-handicapped children were not studied.

Six of these nine studies indicated that the adaptations made in testing procedures improved the performance of the handicapped children studied. The last three, studies 7, 8 and 9, were interpreted that the changes in test procedures did not improve performance.

Three studies compared normal and handicapped children's performance on adapted and standard versions of intelligence tests.
1. Wattron (1956) first studied blind children between the ages of seven and seventeen. The scores they obtained on a block design test, which required the use of tactile-kinesthetic perception, correlated highly with their Hayes-Binet scores. He then found that a non-handicapped group (matched for age and sex with the blind group) did not differ from the blind group in their scores on the modified test. However, the non-handicapped group was not given a standard block design test, and therefore, it is not known to what extent the modified block design test produced scores which were different from those which would have been obtained using the standard procedure.

2. Sattler and Anderson (1973) administered the Stanford-Binet, the Modified Stanford-Binet and the Peabody Picture Vocabulary tests to 80 normal and 20 cerebral-palsied children. Results indicated that there were no significant differences among the tests for the normal and cerebral-palsied groups.

3. Sattler (1972) reported a comprehensive study found in literature. He compared the performance of normal, mentally retarded and cerebral-palsied children on the Stanford-Binet and the Modified Stanford-Binet. A repeated measures design was used. The specific handicaps of the cerebral palsied children were elaborated and controlled for. There was an average trend for increased IQ scores of 2.93 points for the mentally retarded and 1.82 points for the cerebral palsied (CP). The summary analysis stated that although the results were interpreted as non-significant because differences were within the SEm, the scores on both
versions of the test were not as highly correlated for the handicapped population as for the normal, and 13 of the CP subjects were unable to be administered all parts of the standard version of the test because they did not have the required enabling skills.

Few conclusions can be drawn from this review because of the varying results, methods and tests used, and sample populations and statistical approach in determining significant differences. The study by Sattler (1972) was the largest, most carefully controlled. However, the results were interpreted as nonsignificant because average differences in scores for adapted and non-adapted tests were within the SEM.

Summary

The following conclusions were reached:

1. The sources of bias in testing are complex, often interactive and may include the assessment process, the test itself, as well as the skills and attitudes of the examiners.

2. An unsuspected or subtle language handicap may bias intelligence test results for a large number of handicapped children.

3. There are legal and ethical mandates for special educators to attempt to eliminate this bias.

4. Current educational diagnostic labels for handicapped children provide no explanation of the child's difficulties, patterns of performance or the teaching steps required for remediation.

5. Neurophysiological research provides abundant evidence for localization and lateralization of specific behaviors, therefore, different
stimulus response requirements of intelligence test tasks involve different parts of the brain. Thus tests involving verbal language as stimulus and response are likely to tap dominant brain functions, while tests not involving verbal language are likely to tap the ability of the non-dominant brain.

6. Attempts to solve problems of bias related to enabling behaviors (required stimulus response modes) have focused on making adaptations in standard test procedures and comparing results of adapted and standard administrations of the test. The major problem with the approaches taken is that adaptations of the test to compensate for the handicap may invalidate comparisons to the norms on which the test was standardized.
CHAPTER 3
DESIGN

Introduction

In this chapter the following matters relating to the design of this study will be considered:

1. The purpose of the study.
2. The rationale for selection of this design.
3. The population under consideration, the sample derived from it and the data gathering procedures.
4. A description of the instrumentation selected for the investigation.
5. The organization of the data.
6. The specific research hypotheses guiding this study and the statistics selected to test these hypotheses.

Purpose

This investigation was designed to determine whether differences exist in measures of intelligence of young handicapped children when the verbal language requirements of the intelligence test were varied systematically. In this study one test that includes, and one that excludes, processing of verbal information.

Design Rationale

This study investigated the effects of language processing on intelligence test results in young handicapped children who had not been
classified as language impaired. It attempted, to take into account, the conclusions reached, after the study of the literature, by investigating the problem of test bias for the handicapped in a different manner. Instead of adapting a test and risking invalidating test norms, two separate standardized tests were used. The use of standardized tests provided greater control of variation in skills and attitudes of testors. The tests chosen required stimulus response patterns which differ according to the bias being studied, namely bias caused by an unsuspected or subtle language handicap. Although both tests are used to estimate a child's intelligence they appear to tap different brain functions. Used together, it is likely that they tap the functions of both the dominant and non-dominant brain.

Bias, related to a disability that may be present in any diagnostic category of handicapped children, was investigated rather than study bias related to one diagnostic category. Bias related to subtle language disability was studied because many handicapped children are more defective in verbal language functions than in other higher cerebral processes. In addition, a child's ability to process verbal information is related to educational difficulties, pattern of task performance and choice of teaching and remediation strategies.

The study defined a significant difference in test scores to be larger than 2 SEM because this difference has a 95% confidence level. An attempt to control for the loss of significant individual differences by the statistical analyses, was made by grouping children according to the
differences of their performances on the two tests. Then the statistical significance of the difference between these groups was calculated.

Population

The population in this study consisted of: (1) all the handicapped students who attend the Hampton Institute Mainstreaming Model Program, and (2) all children classified as Special Education students by Hampton City Schools. U.S. Census data for 1980 shows the City of Hampton to be representative of other U.S.A. metropolitan areas (see Table 1).

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**TABLE 1**

**CENSUS DATA**

Comparison of Hampton City and U.S.A.

<table>
<thead>
<tr>
<th>CENSUS DATA</th>
<th>U.S.A.</th>
<th>HAMPTON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons Per Household</td>
<td>2.73</td>
<td>2.83</td>
</tr>
<tr>
<td>Median Family Income</td>
<td>$19,547.00</td>
<td>$19,228.00</td>
</tr>
<tr>
<td>% Poverty Level</td>
<td>12.5%</td>
<td>11.7%</td>
</tr>
<tr>
<td>Median Educational Attainment for 25 and over</td>
<td>12.5</td>
<td>11.5</td>
</tr>
</tbody>
</table>

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**Sample and Data Gathering Procedures, Study I**

The 22 handicapped children in this sample all attend the Hampton Institute Mainstreaming Model Mainstreaming Program which is part of
the Early Childhood program at Hampton Institute. These children come
from four Virginia school districts: Hampton, Newport News, Isle of Wight
and Poquoson. Four diagnostic categories were represented, four children
had Downs Syndrome, one had Cerebral Palsy, one was Other Health
Impaired, and 16 are classified Non-Categorical Pre-school Handicapped.
There were fourteen boys and eight girls, sixteen black and six white
children. The chronological age ranged from two years 10 months to
seven years seven months. As a routine admission procedure, each parent
signed permission for intelligence testing. Each child was administered
two standardized tests of intelligence. The Leiter International
Performance Scale (LIPS) and the McCarthy Scale of Children's Abilities
(MSCA). The tests were administered when the child entered the program.
The time between tests was a few days to one month. Tests were
administered by two trained, qualified testors, a certified early childhood
special educator and a child psychologist. Both testors had several years
experience working with young handicapped children. The tests were
administered during the school day, at a convenient time for the teacher
and child. Frequently a student watched the testing. The testing
environment was a room arranged to limit extraneous visual and auditory
stimuli.

Sample and Data Gathering Procedures, Study II

The sample for the second study was drawn from children diagnosed
as handicapped and receiving special education services at Hampton City
Schools. Permission to conduct the study was granted to the investigator
by the school superintendent, director of special education and director of psychological services (see letter of approval Appendix A). It was agreed that Hampton City Schools would receive a copy of test results for each child tested and that a representative of Hampton City schools would be able to attend any parent informing interview.

A random sample of 120 children was selected from a population of 298 handicapped children who ranged in age from two to ten years. A number was assigned to each child, then the numbers were put into a hat and 120 were drawn. A sample size of one hundred and twenty were selected as an attrition rate of 20% was anticipated. The following diagnostic categories were represented: Educable Mentally Retarded (EMR), Trainable Mentally Retarded (TMR), Learning Disabled (LD), Transitional Non-Categorial (TNC), and Emotionally Disturbed (ED). EMR children have IQ's between 68 and 50. TMR children have IQ’s below 50. TNC are children who have been identified as handicapped before 5 years of age and have not been classified.

Deaf, blind and multi-handicapped children were excluded because either test was inappropriate. The distribution of age, sex, race and diagnostic categories within the sample are represented in Tables 2, 3 and 4.

The parents of each child selected received a letter (Appendix A) explaining the study and asking for cooperation. The letter was followed by a telephone call to explain the research further and make an appointment to see the child in the home at the parents convenience.
TABLE 2

Distribution of Sample, Study II, by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 yrs</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>3 yrs</td>
<td>5</td>
<td>4.1</td>
</tr>
<tr>
<td>4 yrs</td>
<td>8</td>
<td>6.6</td>
</tr>
<tr>
<td>5 yrs</td>
<td>15</td>
<td>12.5</td>
</tr>
<tr>
<td>6 yrs</td>
<td>22</td>
<td>18.3</td>
</tr>
<tr>
<td>7 yrs</td>
<td>26</td>
<td>21.6</td>
</tr>
<tr>
<td>8 yrs</td>
<td>32</td>
<td>26.6</td>
</tr>
<tr>
<td>9 yrs</td>
<td>5</td>
<td>4.1</td>
</tr>
<tr>
<td>10 yrs</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>12 yrs</td>
<td>1</td>
<td>.83</td>
</tr>
</tbody>
</table>

Note: Mean Age = 6.5
**TABLE 3**

Distribution of Sample, Study II, by Race and Sex

<table>
<thead>
<tr>
<th></th>
<th>Caucasian</th>
<th>%</th>
<th>Black</th>
<th>%</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>62</td>
<td>52</td>
<td>58</td>
<td>48</td>
<td>67</td>
<td>56</td>
<td>53</td>
<td>44</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Number</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>--------</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educable Mentally Retarded (E.M.R.)</td>
<td>29</td>
<td>24.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trainable Mentally Retarded (T.M.R.)</td>
<td>23</td>
<td>19.2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Learning Disabled</td>
<td>31</td>
<td>25.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transitional Non-Categorical (T.N.C.)</td>
<td>30</td>
<td>25.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotionally Disabled (E.D.)</td>
<td>7</td>
<td>5.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Of the 120 parents with whom contact was attempted 25 were unreachable because the parents had moved or changed telephone numbers. Thirteen families declined to participate. Table 5 illustrates this administrative attrition.

Eighty-two children were then tested from January to April 1983. The two tests were administered by two professionals. Both have Masters degrees, one in early childhood special education and one in guidance and counseling. Both have had considerable training in the use of tests for young handicapped children. The specific training in the administration of the McCarthy was provided by a psychologist with ongoing supervision while testing. The Leiter training was provided by a psychologist to one of the testors who then trained the other testor. One of the testors was the principal investigator. The principal investigator tested 50 children. The other testor tested 33 children. Both testors used the following procedures: upon arrival at the home the family was greeted, and the parents were given a copy of a written explanation of the study (Appendix A). The study and the testing procedures were discussed with the parents. An appropriate place for the testing was selected; a dining room, kitchen, or coffee table. After this discussion, the parents signed permission to have their child tested and indicated if they desired an informing interview. Parents were told informing interviews would be held in May, that representatives of Hampton's Special Education program might attend, that they could have a copy of the results and that Hampton City Schools would also have one.
<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative attrition</td>
<td>25</td>
<td>20.8</td>
</tr>
<tr>
<td>Declines/no response</td>
<td>13</td>
<td>10.8</td>
</tr>
<tr>
<td>Tested</td>
<td>82</td>
<td>68.4</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100.0</td>
</tr>
</tbody>
</table>
The testors had no prior knowledge of the handicapped children other than their age, sex, and diagnosis. Tests were administered according to standard directions. The sequence of test administration was altered to eliminate any bias on the order of presentation. There was always a break between tests for the child. This varied from 5-15 minutes depending on the child's needs.

Five children received a second visit because their ability to attend to task was significantly altered during the second testing. Three of these children were being administered the McCarthy and two the Leiter. One family requested a second visit one day later because they had forgotten a previous engagement when they made the appointment. That child received the Leiter on the first visit and the McCarthy on the second. Two children who were tested were not used in data analysis, one was 12 years old and one was deaf.

Instrumentation

This study uses two standardized intelligence tests. The McCarthy Scale of Children's Abilities (MSCA) requires, for every task, some verbal information processing. The Leiter International Performance Scale (LIPS) does not require verbal information processing for any tasks. The MSCA is typical of tests designed to assess the intellect of children functioning over 2½ years. That is, most directions are verbal, many responses are also and most items require age appropriate language processing. The LIPS was designed to bypass language as a method of communication between testor and testee. It was designed in Hawaii to test the
intelligence of the multi-cultural population who spoke languages other than English. It uses non-verbal directions requiring age appropriate visual processing ability and simple, developmentally very young, untimed fine motor responses. The fine motor requirements of the LIPS, picking up a block deftly and controlled voluntary release are typically developed before 1 year of age (Vulpe, 1977). The McCarthy and Leiter tests are standardized and recommended respectively as a test of choice for young handicapped children or children with language deficits (Anastasi, 1976; Salvia and Ysseldyke, 1978; Sattler, 1982). The norms, reliability and validity for each test have been extensively researched.

The McCarthy Scale of Children's Abilities (MSCA)

The MSCA was chosen to represent typical IQ tests because it is an intelligence test which is extremely well normed and standardized. It is recommended as a test of choice for pre-school children functioning between 3 and 6½ years. Kaufman & Kaufman (1977) say:

For youngsters aged 3-6½ the contributions and advantages of the battery far outweigh any shortcomings and the McCarthy provides excellent measurement for children within this age range. The battery should also be extremely useful for special groups of school age children such as the mentally retarded and learning disabled and for 2½ year olds who are average or above average in ability (p. 26).

In another review Davis (1975 p. 251) concluded that the McCarthy "is probably the best test that has been developed so far for testing the
mental abilities of individual young children." The McCarthy is individually administered and takes 45-50 minutes. In addition to the general level of intellectual functioning it provides a profile of abilities. The profile includes measures of verbal ability, non-verbal reasoning ability, number aptitude, short term memory and co-ordination. The MSCA contains 18 tests grouped into one or more of six scales: verbal, perceptual, performance, quantitative, memory and motor. An index which is a standard score with a mean of 50 and a SD of 10 is computed for each scale. The GCI has a mean of 100 and a SD of 16. McCarthy interprets the GCI as representing the child's ability to integrate his or her accumulated knowledge and adapt it to the tasks of the scale. As already mentioned Kaufman & Kaufman (1977, p. 26) feel that the GCI is an index of intellectual functioning and may be used interchangeably with the IQ. Sattler (1982) also comments that the terms are comparable because (a) the descriptive classifications associated with the GCI are almost the same as those used for IQ's on Wechsler's tests and (b) mental ages (ranging from 1-4 to 6-12 years) which are available for the GCI can serve, McCarthy suggests, as indications of mental competence and can be used for other legal decisions. For all practical purposes the GCI and the IQ are considered interchangeable.

Reliability and Validity

The standardization of MSCA was done on a sample based on the 1970 Census data. Stratification included age, sex, color, geographic
region, father's occupation and urban-rural residence. A total of 1,032 children between 2$\frac{1}{2}$ and 8$\frac{1}{2}$ were tested.

Coefficients of reliability and standard errors of measurement are reported. The split half reliability of the GCI = .93 and the SEM is 4 points. Reliability over one year = .85 (Davis & Slettedahl, 1976).

Concurrent validity was established using Stanford-Binet, WISC, WISC-R, WPPSI as comparisons, the correlations ranging from .45-.91 (median of .75). Predictive validity was determined using the Metropolitan Achievement Tests. The correlations ranged from .34 to .54 (McCarthy, 1972). Construct validity appears to be adequate as factor analysis indicates that the subtests possess a certain amount of uniqueness (Kaufman, 1975). The MSCA appears to be tapping the same theoretical abilities for both black and white children (Kaufman & DiCuio, 1975). In addition the manual is convenient to use, general guidelines for testing are thorough, materials are well constructed and tasks are likely to appeal to children.

The Leiter International Performance Scale (LIPS)

The LIPS, which represents adapted IQ tests, is a nonverbal intelligence scale designed to measure the ability of the subject to adapt to his environment (Leiter, 1959). The hypothesis is that general intelligence is the ability to solve problems with which the individual has had no previous experience. The LIPS is arranged in age scale format from 2 to 18 years. It was used in some of the first attempts at cross-cultural research, and was developed through use with different ethnic
groups in Hawaii (Leiter, 1929, 1936). Porteus (1937) applied an abbreviated version to several African groups. Following revisions in 1938 and 1940 to parallel the 1937 revision of the Stanford Binet Intelligence Scale the most current LIPS issued in 1948 was based upon further testing of American children, high school students and Army recruits in World War II (Leiter, 1938, 1940, 1950, 1959). The scale consists of 54 items, arranged in an age scale format, 2-18. An MA and IQ are obtained. The tasks in the Leiter consist of having the child select blocks bearing the appropriate symbols or pictures and inserting them in the appropriate recess of a frame. This technique is called matching and ranges in difficulty from simple pairing to more complex relationships of design, analogies, etc. Materials are unusual so that the influence of coaching and previous experience is minimized. There is a time limit for three of the 54 items.

Instructions are given non-verbally, the child matches a visual stimulus to a visual stimulus. The LIPS provides an opportunity to teach the child how to manipulate materials successfully and provides repetition of missed items before scoring. The first test in the examination is begun at an age level that is two years below the subject's estimated mental age. Since there are no verbal instructions, tasks for early levels are simple so that it is obvious what is expected. Ceiling performance requires that the student fail all items at two consecutive age levels. The test takes 30 - 45 minutes to administer and is given individually. It was designed to cover a wide range of functions similar to those found
in verbal scales. They include matching colors, shades of gray, forms or pictures to copy, block design, picture completion, recognition of human age differences, spatial relations, footprint recognition, object similarities, memory for a series and classification of animals. Smith (1975) also points out that the Leiter is basically developmental in its make-up because tasks are oriented to permit an individual to move sequentially through the items to allow an evaluation of developmental stages. For example, one of the early stages of development in the preschool child is the recognition of color, then form, then color and form. Language, for the concept is not required, only the visual recognition of concepts.

Reliability and Validity

Reliability and validity studies were extensive on the 1938 LIPS and 1940 LIPS with different ethnic groups. Craig (1938), Molino (1939), Micheal (1941) and L. J. Golelard (1949) investigated its reliability and validity for use with Mexican American children. The effectiveness of the LIPS in measuring general intelligence in Negro children was studied by Dean (1941). Earle (1943) applied the LIPS to native children in India. Studies by Darby (1940) and S. E. Goulard (1940) involved American born Japanese children in California. Caucasian children were assessed by Boehncke (1938), Williams (1941) and Madeley (1946). The consensus was that the LIPS measured intellectual capabilities with a high degree of accuracy.
With the exception of the blind, the following areas of exceptionality have been studied on the 1948 LIPS. The visual component was studied in three groups of mentally retarded persons (Hunt, 1961). Of 60 persons, 30 neurologically handicapped with visual disabilities, and 30 neurologically handicapped without visual disabilities, those with visual problems scored significantly lower. Gallagher (1964) designed a study to evaluate changes in verbal and non-verbal abilities of neurologically handicapped mentally retarded children, in which the experimental group was tutored for two years and then received no training for a two-year period. After one year of no training, the control group was given one year of special stimulation, then tested one year later. The removal of special stimulation from 42 subjects resulted in lowering of verbal abilities but not in non-verbal skills measured by LIPS.

Brenglemann and Kenny (1961) reported a study using the 1948 LIPS, the revised Stanford-Binet, Form L, and the Wechsler Adult Intelligence Scale (WAIS) on 75 mentally retarded residents of an institution. These subjects had a wide range in IQ scores. The LIPS was thought to discriminate more sensitively between the moderately and severely retarded than the Stanford-Binet or the WAIS. Beverly and Bensberg (1952) tested 50 mentally retarded children from 6 to 16 years of age with the 1948 LIPS and the revised Stanford-Binet, Form L, and reported a correlation coefficient of .62. Bensberg and Sloan (1951) correlated the AALIPS with the revised Stanford-Binet, Form L, obtaining a coefficient of .77 on 55 neurologically handicapped and 55 familially
retarded persons 11 to 30 years of age; retest reliability was .86. The mean IQ scores remained unchanged over two administrations (83.6 versus 83.5). Fifty children with functional disorders but without language impairment were examined by Korst (1966). The mean IQ scores on the LIPS and the PPVT did not differ significantly.

The main concern in regard to the use of the LIPS has been the need for more evidence of validity and reliability. A doctoral dissertation by Smith (1975) addressed these issues. She investigated the relationship between the results of the LIPS and the Stanford-Binet Intelligence Scale, Form L-M 1972 (Thorndike 1973) on 376 randomly selected individuals with racial and ethnic proportions comparable to the 1972 Census. The results of her study indicated an internal consistency reliability of .97. The standard error of measurement was 3.3. Validity coefficient was .89. Smith's (1975) findings also indicated that the frequency of the IQ scores were derived from a random sampling of a normally distributed population and that the sample closely approximated the ethnic distribution of the United States. The conclusion of this dissertation was that the LIPS met stringent statistical standards.

An extensive comparison of the technical qualities of the LIPS and the MSCA appears in Appendix B. The LIPS is considered to have a definite place in psychologists' test battery because many physically, neurologically and intellectually impaired persons may be evaluated more realistically with the LIPS than with any other standardized test of intelligence. Sattler (1982) recommends that it can be used to evaluate
children who have sensory or motor difficulty in reading or speaking. Swanson and Watson (1982) recommend it for the assessment of individuals who are deaf, bilingual and multi-handicapped.

**Organization of Data**

The following steps were used to prepare the data for analysis:

1. The IQ and MA were calculated for the total sample in each study.

2. The differences between the IQ's and the MA's on each test were calculated.

3. If the differences between the IQ's were more than 8 points (2 SEm), the difference was considered significant. This difference was chosen because Swanson and Watson (1982) report that there is a 95% confidence band for any particular IQ score if the score differences are more than 2 SEm. Differences between MA's, that were more than 6 months for children 5 and under or more than 12 months for children 6 and over, were considered significant. This approach was recommended by Kaufman and Kaufman (1977) in their discussion of significant differences in mental ages.

4. The children were grouped according to patterns of score differences on the two tests, into:

   Group A - LIPS IQ and MA significantly greater than MSCA IQ and MA.

   Group B - LIPS IQ and MA approximately equal to MSCA IQ and MA.
Group C - LIPS IQ and MA significantly less than MSCA IQ and MA.

5. The number and percentage of children in each group was calculated.

6. The distribution of age, sex, race and diagnosis in each group was compared with their distribution in the total sample.

7. The average difference between IQ's and MA's was calculated for each group.

8. Pearson's Correlation coefficients were calculated between the IQ's and MA's for each group in each study.

**Research Hypotheses**

The research hypotheses considered for this investigation concern similarity of correlations between the various groups in each study. These hypotheses fall into two groups. First, there will be no difference in correlations of test scores for those children in each study who were placed in similar groups. These groups and the hypothesis regarding them are stated in Table 6.

Second, there will be no difference in correlation of test scores for children in the three groups of the study. These groups and the related research hypotheses are shown in Table 7.
### Table 6

#### Hypotheses Regarding the Three Difference Groups for LIPS and MSCA

<table>
<thead>
<tr>
<th>Difference Group</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>LIPS 8+ &gt; MSCA</td>
</tr>
<tr>
<td>Group B</td>
<td>LIPS = MSCA</td>
</tr>
<tr>
<td>Group C</td>
<td>MSCA 8+ &gt; LIPS</td>
</tr>
</tbody>
</table>

There will be no difference between Group A of Study 1 and Group A of Study 2.

There will be no difference between Group B of Study 1 and Group B of Study 2.

There will be no difference between Group C of Study 1 and Group C of Study 2.

---

### Table 7

#### Hypotheses Regarding the Three Difference Groups for LIPS and MSCA

<table>
<thead>
<tr>
<th>Difference Group</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A, Study 1 and 2</td>
<td>LIPS 8+ &gt; MSCA</td>
</tr>
<tr>
<td>Group B, Study 1 and 2</td>
<td>LIPS = MSCA</td>
</tr>
<tr>
<td>Group C, Study 1 and 2</td>
<td>MSCA 8+ &gt; LIPS</td>
</tr>
</tbody>
</table>

There will be no difference between Group A and any other group in the studies.
Rationale for Statistics

It is important to know the relationship between the results of the two treatments for obtaining intelligence results as well as the statistical significance of this relationship (Sattler, 1977). Blalock (1972) reaffirms this position by saying:

Sometimes, in the case that one has obtained several correlations and wishes to establish that one is significantly higher than another . . . . As long as he is content to describe relationships within his particular sample he may simply compare the relative sizes of the two r's and note the magnitude of the difference. If he wishes to generalize to some other population the question will arise as to whether or not the obtained difference is likely to be due to chance; e.g. one r of .50 has been obtained and another of .30 and you want to test the null hypothesis that two population correlations are identical, $H_0: p_1 = p_2 \quad H_a: p_1 \neq p_2$ (p. 405).

Thus the statistical analysis for this investigation included obtaining Pearson correlation coefficients for the test scores of each group and the method Blalock (1972) and Hinkle et al. (1979) recommend to establish the significance of the differences between the correlations for testing the null hypothesis $H_0: p_1 = p_2$ using independent samples. This procedure involves establishing the difference between two population correlation coefficients and transforming the r's into z's using Fisher's log transformation. Then the estimated standard error of the difference between independent transformed correlations coefficients is established using this formula.
The test statistic is $z$ and is calculated as follows:

$$z = \sqrt{\frac{1}{n_1-3} + \frac{1}{n_2-3}}$$

Summary

This study analyzed the effects of language processing on measures of intelligence for young handicapped children. Two standardized tests were used. The MSCA is a typical language based test and the LIPS is an non-language test. In Study I both tests were administered to 22 handicapped children. They were tested during the school day as a part of their school program. In Study II both tests were administered to a random sample of 82 young handicapped children from a typical urban area. The order of the test administration was altered randomly for both studies. All testing was done with parent and school permission following standard administration procedures in the child's home. Two children tested were excluded from data analysis because one was too old and the other was deaf. The data were collected, analyzed and grouped according to the significance of the difference of the test results. Statistical analysis included correlation coefficients and a $z$ statistic which was used to establish the significance of the differences ($p<.05$) between the correlations for each group. It was hypothesized that organization of the data in this manner, would indicate the effects of verbal language processing problems in young handicapped children on intelligence test
scores. The two research hypotheses concerned similarity of correlations between various groups in each study:

1. There should be no difference in correlations of test scores for those children in each study who were placed in similar groups.

2. There should be no difference in correlation of test scores for children in the three groups of the study.
Study 1 (HIMM)

Fourteen of twenty-two children, or 63.6 percent, scored eight or more points higher on the LIPS than on the MSCA (Group A). The mean difference between the scores was 25.4. Two children achieved scores on the LIPS but it was not possible to achieve a score on the MSCA. Both children became very anxious when tested on the MSCA and testing was unable to be completed. Data for this group is presented in Table 8. The correlation coefficient for the IQ's was .70, \( p = 0.01 \).

Five of the twenty-two children, or 22.7 percent, scored approximately equal (Group B). The mean difference between the scores was +2 points. Data for this group is presented in Table 9. The correlation coefficient for the IQ's was .96, \( p = .092 \).

Three of the twenty-two children, or 13.6 percent, scored more than 8 points higher on the MSCA than on the LIPS (Group C). The mean difference in the IQ scores was 17.3 points. One child was unable to achieve a base line performance on the LIPS. Data for this group is presented in Table 10. The correlation coefficient for the IQ's was not calculated by the computer. Table 11 is a summary of the data for this study.
<table>
<thead>
<tr>
<th>#</th>
<th>Sex</th>
<th>Age</th>
<th>Race</th>
<th>Dx</th>
<th>LIPS IQ</th>
<th>MSCA GCI</th>
<th>LIPS-MSCA yr/mo</th>
<th>LIPS MA</th>
<th>MSCA GCA</th>
<th>LIPS-MSCA yr/mo</th>
<th>LIPS Dx</th>
<th>MSCA Dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>2</td>
<td>B</td>
<td>TNC</td>
<td>128</td>
<td>**</td>
<td>**</td>
<td>3/6</td>
<td>**</td>
<td>**</td>
<td>Superior</td>
<td>----</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>4</td>
<td>B</td>
<td>TNC</td>
<td>107</td>
<td>60</td>
<td>47</td>
<td>4/6</td>
<td>3/0</td>
<td>1/6</td>
<td>Average</td>
<td>MR</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>4</td>
<td>B</td>
<td>TNC</td>
<td>96</td>
<td>**</td>
<td>**</td>
<td>4/6</td>
<td>**</td>
<td>**</td>
<td>Average</td>
<td>----</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>6</td>
<td>B</td>
<td>TNC</td>
<td>95</td>
<td>54</td>
<td>41</td>
<td>6/3</td>
<td>3/6</td>
<td>2/9</td>
<td>Average</td>
<td>MR</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>4</td>
<td>B</td>
<td>TNC</td>
<td>99</td>
<td>66</td>
<td>36</td>
<td>4/2</td>
<td>3/0</td>
<td>1/2</td>
<td>Average</td>
<td>MR</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>6</td>
<td>B</td>
<td>TNC</td>
<td>105</td>
<td>76</td>
<td>29</td>
<td>5/3</td>
<td>3/10</td>
<td>1/5</td>
<td>Bright Normal Borderline</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>5</td>
<td>B</td>
<td>TNC</td>
<td>121</td>
<td>93</td>
<td>28</td>
<td>4/4</td>
<td>3/0</td>
<td>1/4</td>
<td>Superior</td>
<td>Average</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>7</td>
<td>B</td>
<td>TNC</td>
<td>105</td>
<td>78</td>
<td>27</td>
<td>5/2</td>
<td>4/2</td>
<td>1/0</td>
<td>Bright Normal Borderline</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>4</td>
<td>B</td>
<td>TNC</td>
<td>89</td>
<td>67</td>
<td>22</td>
<td>5/1</td>
<td>3/1</td>
<td>2/0</td>
<td>Dull Normal</td>
<td>Dull Normal</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>4</td>
<td>C</td>
<td>D</td>
<td>65</td>
<td>* 50</td>
<td>15</td>
<td>4/8</td>
<td>4/0</td>
<td>0/8</td>
<td>MR</td>
<td>MR</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>4</td>
<td>C</td>
<td>TNC</td>
<td>82</td>
<td>65</td>
<td>17</td>
<td>3/6</td>
<td>2/10</td>
<td>0/8</td>
<td>Dull Normal</td>
<td>MR</td>
</tr>
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<td>12</td>
<td>F</td>
<td>3</td>
<td>C</td>
<td>D</td>
<td>68</td>
<td>54</td>
<td>14</td>
<td>3/7</td>
<td>2/7</td>
<td>1/0</td>
<td>MR</td>
<td>MR</td>
</tr>
<tr>
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<td>F</td>
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<td>C</td>
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<td>* 50</td>
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<td>/9</td>
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Note:
B=Black
C=Caucasian
Dx=Diagnosis
IQ=Intelligence Quotient
M=Mental Age
F=Female
D=Downs Syndrome
TNC=Transitional Non Categorical
*Lowscore Possible on MSCA
**Unable to administer MSCA

Very Superior 130-above
Superior 120-129
Bright Normal 110-119
Average 90-109
Dull Normal 80-89
Borderline 70-79
Mentally Retarded 69-below
### TABLE 9

Study 1 HIMM  
Group B  LIPS≠MSCA

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<tr>
<th>#</th>
<th>Sex</th>
<th>Age</th>
<th>Race</th>
<th>DX</th>
<th>LIPS</th>
<th>IQ</th>
<th>MSCA</th>
<th>GCI</th>
<th>LIPS-MSCA</th>
<th>LIPS MA</th>
<th>MSCA GCA</th>
<th>LIPS-MSCA</th>
<th>LIPS Dx</th>
<th>MSCA Dx</th>
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<td>50</td>
<td>0</td>
<td>--</td>
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<td>--</td>
<td>MR</td>
<td>MR</td>
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<td>7</td>
<td>B</td>
<td>D</td>
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<td>50</td>
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<td>MR</td>
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<td>C</td>
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<td>B</td>
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<td>F</td>
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<td>B</td>
<td>TNC</td>
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<td>97</td>
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</table>

**Note:** Legend same as for Table 8.
TABLE 10

Study I HMM
Group C MSCA > LIPS

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<th>Sex</th>
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<th>Race</th>
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<th>LIPS IQ</th>
<th>MSCA GCI</th>
<th>MSCA- LIPS</th>
<th>LIPS MA yr/mo</th>
<th>MSCA GCA yr/mo</th>
<th>LIPS-MSCA yr/mo</th>
<th>LIPS Dx</th>
<th>MSCA Dx</th>
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<td>Average</td>
</tr>
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<td>2</td>
<td>M</td>
<td>3</td>
<td>B</td>
<td>TNC</td>
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<td>71</td>
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<td>--</td>
<td>MR</td>
<td>Borderline</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>4</td>
<td>B</td>
<td>OHI</td>
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<td>123</td>
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<td>Superior</td>
</tr>
</tbody>
</table>

Note: Legend same as for Table 6.
TABLE 11
Summary Study I

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<th>MSCA &gt; LIPS</th>
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<td>N/%</td>
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<td>14/63.6%</td>
<td>5/22.7%</td>
<td>3/13.6%</td>
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<tr>
<td>NF/%</td>
<td>7/31.8%</td>
<td>5/35%</td>
<td>2/40%</td>
<td>0/0</td>
</tr>
<tr>
<td>NM/%</td>
<td>15/68.1%</td>
<td>9/64%</td>
<td>3/60%</td>
<td>3/100%</td>
</tr>
<tr>
<td>NB/%</td>
<td>16/72.7%</td>
<td>10/71%</td>
<td>3/60%</td>
<td>3/100%</td>
</tr>
<tr>
<td>NC/%</td>
<td>6/27.2%</td>
<td>4/28.5%</td>
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<td>Mean Age</td>
<td>4.6</td>
<td>4.7</td>
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<td>4</td>
</tr>
<tr>
<td>Mean LIPS IQ</td>
<td>85.5</td>
<td>93.2</td>
<td>72.3(a)</td>
<td>78.3</td>
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<tr>
<td>Mean MSCA GCI</td>
<td>80.3</td>
<td>65*</td>
<td>80.3(b)</td>
<td>95.6</td>
</tr>
<tr>
<td>Mean Difference</td>
<td>5.2</td>
<td>+25.4**</td>
<td>+2.5</td>
<td>+17.3</td>
</tr>
<tr>
<td>Mean LIPS MA</td>
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<td>4yr.2mo.</td>
<td>4yr.3mo.</td>
<td>4yr.9mo.</td>
</tr>
<tr>
<td>Mean MSCA GSA</td>
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<td>3yr.8mo.</td>
<td>3yr.3mo.</td>
</tr>
<tr>
<td>Mean Difference</td>
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<td>6mo.**</td>
<td>2mo.</td>
<td>1mo.</td>
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<tr>
<td>Dx Rep/TNC</td>
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<td>12/86%</td>
<td>4/80%</td>
<td>2/66%</td>
</tr>
<tr>
<td>OHI</td>
<td>1/5%</td>
<td>0</td>
<td>0</td>
<td>1/33%</td>
</tr>
<tr>
<td>D</td>
<td>3/14%</td>
<td>2/14%</td>
<td>1/20%</td>
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</tr>
</tbody>
</table>

Note:
* Only 12 MSCA scores available
** Calculated for 12 subjects because MSCA not available for 2 subjects
(a) Calculated on 4 scores
(b) Calculated on 3 scores
Study II (HCS)

Fifty-three of eighty children, or 66 percent scored eight or more points higher on the LIPS than the MSCA (Group A). The mean difference between the scores was 22.3 points. Three children were unable to achieve a score on the McCarthy. Data for this group is presented in Table 12. The correlation coefficient for the IQ's was .72 ($p = 0.00$).

Fourteen of the eighty children, or 17.5 percent, scored approximately equally on the two tests (Group B). Data for this group is presented in Table 13. The mean difference between the scores was .68. The correlation coefficient was .9305, $p = 0.001$.

Four of the eighty children, or 5 percent, scored more than eight points higher on the MSCA than the LIPS (Group C). Data for this group is presented in Table 14. Three of the children were unable to achieve a basal on the LIPS. Therefore no mean difference or correlation coefficient were calculated. A summary of the data from Study II is presented in Table 15.

The distribution of age, sex, race and diagnosis in each group in each study were similar to their distribution in the total sample for each study.

Test of Research Hypothesis 1

There will be no difference in correlations of test scores for those children in each study who were placed in similar groups.
TABLE 12
Study II HCS
Group A \text{LIPS} > \text{MSCA}

<table>
<thead>
<tr>
<th>#</th>
<th>Sex</th>
<th>Age</th>
<th>Race</th>
<th>Dx</th>
<th>LIPS IQ</th>
<th>MSCA GCI</th>
<th>LIPS-MSCA yr/mo</th>
<th>LIPS MA GCA yr/mo</th>
<th>MSCA GCA yr/mo</th>
<th>LIPS-MSCA yr/mo</th>
<th>LIPS Dx</th>
<th>MSCA Dx</th>
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<td>58</td>
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<td>5/9</td>
<td>3/6</td>
<td>2/3</td>
<td>Bright Normal</td>
<td>MR</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>2</td>
<td>C</td>
<td>TMR</td>
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<td>99</td>
<td>51</td>
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<td>2/6</td>
<td>2/0</td>
<td>Superior</td>
<td>Average</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>6</td>
<td>C</td>
<td>LD</td>
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<td>47</td>
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<td>Dull Normal</td>
</tr>
<tr>
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<td>TNC</td>
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<td>2/5</td>
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<td>MR</td>
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<td>TMR</td>
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<td>1/8</td>
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<td>C</td>
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<td>EMR</td>
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Note: Legend same as for Table 8.
### TABLE 12
(continued)

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<th>MSCA GCA yr/mo</th>
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<td>EMR</td>
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<td>6/4</td>
<td>5/0</td>
<td>1/4</td>
<td>Average</td>
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<td>B</td>
<td>EMR</td>
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<td>0/9</td>
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<td>Dull Normal</td>
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### TABLE 13

**Study II HCS**  
**Group B  LIPS ≤ MSCA**

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<th>LIPS MA yr/mo</th>
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**Note:** Legend same as for Table 8.
### TABLE 14

Study II HCS
Group C  MSCA > LIPS

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<th>LIPS</th>
<th>MSCA</th>
<th>LIPS-MSCA</th>
<th>LIPS-MA</th>
<th>MSCA</th>
<th>LIPS-MSCA</th>
<th>LIPS-Dx</th>
<th>MSCA-Dx</th>
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<td>B</td>
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<td>89</td>
<td>11</td>
<td>7/6</td>
<td>8/3</td>
<td>9</td>
<td>Borderline</td>
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<td>B</td>
<td>TMR</td>
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<td>6</td>
<td>B</td>
<td>TMR</td>
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**Note:** Legend same as for Table 6.
TABLE 15
Summary Study II
HCS

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<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>No Score</th>
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<td>4/5%</td>
<td>9/7.5%</td>
</tr>
<tr>
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<td>35/44%</td>
<td>47/47%</td>
<td>6/42%</td>
<td>2/50%</td>
<td>2/22%</td>
</tr>
<tr>
<td>NM/%</td>
<td>45/56%</td>
<td>53/53%</td>
<td>8/57%</td>
<td>2/50%</td>
<td>7/77%</td>
</tr>
<tr>
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<td>38/48%</td>
<td>22/42%</td>
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<td>6/66%</td>
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<tr>
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<td>42/52%</td>
<td>31/58%</td>
<td>7/50%</td>
<td>2/50%</td>
<td>3/33%</td>
</tr>
<tr>
<td>Mean Age</td>
<td>6yr.5mo.</td>
<td>6yr.5mo.</td>
<td>6yr.6mo.</td>
<td>5yr.5mo.</td>
<td>5yr.3mo.</td>
</tr>
<tr>
<td>Mean LIPS IQ</td>
<td>86.6</td>
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<td>--</td>
</tr>
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<td>73.8</td>
<td>67.2</td>
<td>84.3</td>
<td>70</td>
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<td>11.42</td>
<td>22.3</td>
<td>.6</td>
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<tr>
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<td>6yr.</td>
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<td>6yr.</td>
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<tr>
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<td>4yr.</td>
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<td>1yr.3mo.</td>
<td>7mo.</td>
<td>9mo.</td>
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<td>3/21%</td>
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</tr>
</tbody>
</table>

Note:
TMR=Trainable Mentally Retarded IQ 50
EMR=Educable Mentally Retarded IQ 69
ED=Emotionally Disturbed
LD=Learning Disabled
TNC=Transitional Non-Categorical
a) There will be no difference between Group A of Study 1 and Group A of Study 2.

\[
\begin{align*}
\text{HIMM A} & \\
r = .70 & \\
z = .877 & \\
\text{HCS A} & \\
r = .71 & \\
z = .877 & \\
\end{align*}
\]

\[
\begin{align*}
P_1 - P_2 = 0 & \\
Z_{p1} = Z_{p2} = 0 & \\
r_1 - r_2 = .70 - .71 = .1 & \\
Z_{r1} - Z_{r2} = .877 - .877 = 0 & \\
z = 0 & \\
\end{align*}
\]

Research hypothesis is retained as tenable because the observed value of the test statistic does not exceed the critical values. 

\[\pm 1.645.\]

b) There will be no difference between Group B of Study 1 and Group B of Study 2.

\[
\begin{align*}
P_1 - P_2 = 0 & \\
S_{z_{r1} - z_{r2}} = 1.886 - 1.658 = .228 & \\
r_1 - r_2 = .96 - .93 = .03 & \\
\end{align*}
\]

Standard error of statistic = .333

\[z = .685\]

The critical value of \[\pm 1.645\] was set, the research hypothesis is retained as tenable since the observed value of the test statistic does not exceed the critical values.

c) There will be no difference between Group C of Study 1 and Group C of Study 2. This research hypothesis could not be tested because of the inability to obtain a correlation coefficient for the scores of the children in these groups.
**Test of Research Hypothesis 2**

There will be no difference in correlation of test scores for children in the three groups of the study.

a) There will be no difference between Group A and Group B of Study 1.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r = .70$</td>
<td>$r = .96$</td>
</tr>
<tr>
<td>$z = .877$</td>
<td>$z = 1.9$</td>
</tr>
<tr>
<td>$n = 10$</td>
<td>$n = 3$</td>
</tr>
<tr>
<td>$P_1 - P_2 = 0$</td>
<td>$Z_{P_1} - Z_{P_2} = 0$</td>
</tr>
<tr>
<td>$r_1 - r_2 = .25$</td>
<td>$Z_{r_1} - Z_{r_2} = -1.009$</td>
</tr>
</tbody>
</table>

Standard error of statistic = .377

$z = 2.68$

Null hypothesis is rejected since the observed value of the test statistic $z$ exceeds the critical values $± 1.96 \quad p < .05$

b) There will be no difference between Group A and Group B of Study 2.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r = .72$</td>
<td>$r = .93$</td>
</tr>
<tr>
<td>$z = .877$</td>
<td>$z = 1.658$</td>
</tr>
<tr>
<td>$n = 36$</td>
<td>$n = 12$</td>
</tr>
<tr>
<td>$P_1 - P_2 = 0$</td>
<td>$Z_{P_1} - Z_{P_2} = 0$</td>
</tr>
<tr>
<td>$r_1 - r_2 = .21$</td>
<td>$Z_{r_1} - Z_{r_2} = .781$</td>
</tr>
</tbody>
</table>
Standard error of statistic = .375

\[ z = 2.82 \]

Null hypothesis is rejected since the observed value of the test statistic \( z \) exceeds the critical values \( ± 1.96 \quad p < .05 \)

c) There will be no difference between the combined Groups A and Groups B.

<table>
<thead>
<tr>
<th>All A</th>
<th>All B</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ r = .72 ]</td>
<td>[ r = .90 ]</td>
</tr>
<tr>
<td>[ z = .89 ]</td>
<td>[ z = 1.5 ]</td>
</tr>
<tr>
<td>( n = 46 )</td>
<td>( n = 15 )</td>
</tr>
<tr>
<td>( P_1 - P_2 = 0 )</td>
<td>( Z_{p_1} - Z_{p_2} = 0 )</td>
</tr>
<tr>
<td>( r_1 - r_2 = -.19 )</td>
<td>( Z_{r_1} - Z_{r_2} = -.761 )</td>
</tr>
</tbody>
</table>

Standard error of statistic = .321

\[ z = 2.37 \]

Null hypothesis is rejected since the observed value of the test statistic exceeds the critical values \( ± 1.96 \quad p < .05 \)

**Other Results**

Although it was postulated that the lack of recognition of the effect of verbal enabling behavior has an effect on intelligence testing, the magnitude of this factor was unsuspected. A post hoc analysis of variance on the test results of the two testors was conducted to investigate possible bias. It was possible that the investigator influenced the other testor by training her. The \( F \) was 2.23, significant at a .01 level.
Therefore it is very unlikely that testor bias played a significant role in results of this investigation.

**Summary**

In Chapter 4, the data collected for this study and the tests of the research hypothesis has been presented. Research hypothesis 1 was retained and research hypothesis 2 was rejected. Conclusions, recommendations and implications of this analysis are presented in Chapter 5.
CHAPTER 5

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Conclusions

This study investigated a method to establish systematically the effect of verbal language processing disability on measures of intelligence of young handicapped children.

The review of the literature revealed that:

1. The sources of bias in testing are complex and often interactive; they can be present in the assessment process, the test itself and the skills of the testors.

2. An unsuspected or subtle language handicap may bias intelligence test results of handicapped children.

3. The most frequent disability of young handicapped children irrespective of their diagnosis is language.

4. There are legal and ethical mandates for special educators to attempt to eliminate this bias.

5. Current educational diagnostic labels for handicapped children provide no explanation of the child's learning difficulties, information processing abilities nor the steps required for remediation.

6. Neuropsychological research provides abundant evidence for localization and lateralization of specific academic behaviors, and demonstrates that different stimulus response requirements of intelligence test tasks will involve different parts of the brain. Therefore tests with
tasks that involve verbal language as stimulus response modalities most likely tap mainly dominant brain functions, while tests with tasks that involve visual-perceptual information processing will predominantly tap functions of the non-dominant brain.

7. Many attempts have been made to solve the problem of bias related to enabling behaviors. The major difficulty with most of these attempts is that the adaptations required to eliminate bias violate standardized administration procedures and therefore invalidate comparisons to the test norms. In addition, much of the research has failed to demonstrate the value of testing adaptations to eliminate bias across categories of handicapped children.

This investigation attempted to take the above factors into account. Verbal language bias was chosen because this language deficit is the most common across all categories of young handicapped children. Rather than adapting the tasks of a test to eliminate verbal information requirements, a standardized intelligence test which requires no verbal stimuli or responses was selected. The intelligence of handicapped children was determined by applying the two standardized intelligence tests, one requiring verbal information processing, the other requiring no verbal language processing. The scores on both of these tests for the two sample populations of young handicapped children (n=102) 2-10 years of age were compared. The test chosen to represent those which require processing of verbal information was the McCarthy Scale of Children's Abilities. It was chosen because it is widely recommended as an
intelligence test of choice for young handicapped children and meets stringent statistical testing standards. The Leiter International Performance test which requires visual perceptual stimuli and simple motor responses, for all tasks, was chosen to represent an intelligence test which requires no verbal information processing skills. This test is sometimes criticized for questionable technical standards. However in a recent dissertation, Smith (1975) compared the Stanford Binet and The Leiter International Performance Scale. She used a stratified random selection procedure to select 376 children from a normal population to ensure racial and ethnic proportions comparable to 1972 census data. Her findings included a validity coefficient of .89 and a frequency distribution of IQ scores that closely approximated a normal population distribution. Her conclusions were that the Leiter International Performance Scale met stringent statistical standards.

The Results of this Investigation Indicated

1. Comparisons of the correlation coefficients for Group A from each sample indicated that it is unlikely that they are different. Group A Study 1: \( r = .70 \quad p = .012 \). Group A Study 2: \( r = .93 \quad p = .000 \).

2. Comparisons of the correlation coefficients for Group B from each study indicated that it is unlikely they are different groups. Group A Study 1: \( r = .96 \quad p = .092 \). Group B Study 2: \( r = .93 \quad p = .000 \).

3. Because of the above, the results of the two studies can be combined, as the two samples were very similar.
4. Comparisons of the correlation coefficients for Group A and Group B in each study indicated that the groups were significantly different.

\[
\text{Study 1 Group A } r = .7041 \quad \text{Group B } r = .9588 \\
\text{Study 2 Group B } r = .7177 \quad \text{Group B } r = .9305 \\
\]

\[ z = 2.37 \quad p = .05 \]

5. As 65.5 percent of the samples studied scored significantly better on the intelligence test which does not require verbal information processing, it appears that measures of intelligence which rely on verbal information processing may underestimate the abilities of many handicapped children.

6. These differences in scores are further exemplified by the fact that 19 percent of the sample studied scored approximately equally on both tests. They process verbal and non-verbal information equally.

7. In addition, 7 percent of the population scored significantly better on the test requiring verbal information processing. This indicates that a non-verbal test may under estimate their intelligence, but a verbal test may not reveal the difficulties they have processing non-verbal information.

8. The patterns of processing information observed in this study appeared to cross diagnostic, age, sex, and race categories. As the representation of the categories were approximately equal to their distribution in the total sample.

The result of these studies leads to the following conclusion:
Within the population of young handicapped children studied, there were children who scored significantly better on nonverbal measures of intelligence, some who scored equally well on verbal and nonverbal measures of intelligence and a small percentage of children who scored higher when verbal measures of intelligence are used. Thus the use of only verbal intelligence tests may significantly underestimate the true potential of those children who function better under nonverbal environmental circumstances. Likewise, if only a nonverbal measure of intelligence is used it is likely to overestimate the actual potential of children with language handicaps. Therefore, both testing methods are needed to obtain a balanced view of a child's intellectual potential and information processing pattern.

**Implications**

The different performance requirements of these two tests appear to be tapping behaviors localized in different areas of the brain. The McCarthy Scale of Children's Abilities appears to be tapping behaviors localized in the dominant cerebral hemisphere. While the Leiter International Performance Scale appears to be tapping behaviors localized in the non-dominant hemisphere. Therefore used together the functions of both cerebral hemispheres are tapped by the testing procedures. Since both tests are standardized, and meet stringent statistical standards it is possible that valid indications of the functioning of both hemispheres may be obtained. Thus when used together the two tests differentiated
the children's information processing and learning styles. This data is
directly applicable to teaching and remediation strategies.

Support for this approach is given in the light of knowledge of
neuropsychological basis for behavior and learning. It appears that for
educational testing an adequate global assessment of intelligence is
indicated. Thus testing methods should be used which tap behaviors of
both the dominant and nondominant cerebral hemispheres. Therefore,
special education administrators should review tests to establish which
hemispheric behaviors are actually being tested. This can be done by
analyzing testing procedures: the assumed enabling behaviors of tests,
the information processing requirements and the cerebral localization of
the academic behavior being tested. In the case of the two tests used
for this study, the McCarthy Scale of Children's Abilities appears to be
testing predominantly dominant hemispheric behaviors while the Leiter
International Performance Scale appears to be testing predominantly
nondominant hemispheric behaviors.

Additional support for the implications of this study is provided by
computer analysis of educational testing data from a school district in
Iowa (Logan, 1983). See Appendix F. The data were collected on 185
preschool children ages 2 to 5. They were referred to the school district
because the children were not developing normally. Eighty percent of
these referrals were generated by concern for delayed speech/language
skills. Because of this language delay school administrators felt it was
absolutely necessary to administer a non-language intelligence test as
well as the traditional Stanford Binet. This school system chooses the Merrill Palmer Scale as the non-verbal scale because it is intrinsically interesting to young children and seems to elicit their best effort. The school psychologists were concerned because the normative data was old but have since decided on the basis of long-term follow-up that the Merrill Palmer is a better predictor of average mental ability in young children than the Stanford Binet.

The school system's data was summarized in the following way:

1. For children classified "mental disability" test scores on both instruments are one or more SD below 100. The Merrill Palmer mean is 9 points higher than Binet in 51 children.

2. For children classified "communication disability" the mean Binet was 79; Merrill Palmer mean was 100 (n=44).

3. For children classified not handicapped the mean Binet was 89 and the Merrill Palmer was 101 (n=60).

4. For children with "other" handicaps, physical disability, learning disability visually or auditorally impaired, etc., the mean Binet was 78, the mean Merrill Palmer was 92 (n not reported).

5. For normal children in a college based preschool the mean Binet and Merrill Palmer scores were both +1 SD the norm (n=14).

These findings, support the present conclusions and implications. The mean difference in test scores for children who were diagnosed as having communication disorders is 21. This is very close to the mean differences of 25.4 and 22.3 of those children placed in Group A of this
study. Certainly the present educational diagnosis of some of the children placed in Group A is worthy of close scrutiny.

**Recommendations**

The generally higher performance of all young handicapped children on nonverbal measures of intelligence, indicated by this present study and the results just reported, is of considerable educational interest because most educational methods tend to emphasize verbal learning and neglect avenues of nonverbal teaching. This has become a recent area of educational concern (Vitale, 1982) which is discussed as right brain (non-dominant/ non-verbal) or left brain teaching (dominant/verbal). This concept is well supported by current neurobehavioral research which demonstrates that there are different rates of development of the hemispheres and that competition exists during development for growth and migration of brain cells within the two hemispheres of the cortex (Geschwind 1979). It is also well documented that damage during development to one hemisphere will stimulate the development on the non-damaged hemisphere, including the actual take-over of neural functions normally located in the damaged hemisphere. This is certainly an area worthy of further educational investigation and research.

One limitation of this study was the age constraints imposed by the tests. The basal effect of both tests at 2½ years accounted for the fact that 9 children were unable to take either test as they were functioning developmentally below this age level. The ceiling effect of the MSCA prevented the inclusion of older handicapped children in the study.
Another limitation was the lack of a sample of normal children. These limitations lead to the following recommendations:

1. Include a sample of normal children to see if the patterns of performance on verbal and non-verbal measures of intelligence are similar to that of handicapped children.

2. Study an older handicapped population, to see if the distribution of children across the three patterns of performance changes.

The final recommendation is made because of a recurring observation of the testors for this study. This was the striking behavioral differences of some of the children under the two different test situations. Therefore, the addition of an instrument to reliably rate children's organizational behaviors and activity levels during testing would be very useful.

Summary

In this chapter, conclusions were drawn and discussed. The limitations of the study were presented. Recommendations for further investigations were made based on the limitations and implications of the results.

The results of the investigation indicated that verbal language disabilities significantly influenced intelligence test scores for many handicapped children. In addition, the two tests, when taken together, differentiated the children's information processing and learning styles. This data is directly applicable to teaching and remediation strategies.

It is hoped this study will act as a stimulus for further investigations. Certainly it is realized that it is only one step towards the recognition
that the requirement for verbal communication during testing may introduce a significant negative bias in the evaluation of the skills and abilities of many young handicapped children.
Appendix A

Forms
May 4, 1982

Dear Mrs. Hicks:

Enclosed is a brief summary of the research proposal I discussed with you and Dr. Harold. Also enclosed are sample letter and permission forms. I would appreciate your approval; please forward this proposal to others in the system whose approval is required.

The following steps are necessary for me to begin to implement this project:

1. Review records on preschool handicapped children
2. Select appropriate handicapped children
3. Obtain parental approval on selected children
4. Set up appointments to test children
5. Test children
6. Schedule appointment for parent reporting with all parents desiring feedback in conjunction with special education and/or Department of Psychology.

As there is considerable work to be done, please let me know when I can proceed reviewing the records.

I appreciate your attention to this matter.

Sincerely yours,

Shirley Vulpe, M.Ed.,
O.T.R.
December 13, 1982

Ms. Shirley Vulpe
804 North First Street
Hampton, VA 23664

Dear Ms. Vulpe:

It is a pleasure to respond to your recent request to the Superintendent, in my capacity as the person responsible for student records and information in this school division. Your proposal to do a research study relating to the abilities of the handicapped child in our school division has been reviewed by Dr. Martin and by me. Your thesis has merits and appears to me that you have thought out the methods and procedures. The safeguards you have underlined, that is, parental permission and the testing of children in the home environment, will help to meet our requirements. In addition, I would request you work closely with Dr. Martin and the school principals and teachers, so they are kept informed of your work with the children involved.

Please secure the permission signature from the parents before you begin work with the children and let us have a copy for our files. Your thesis seems quite worthwhile and I wish you luck in your efforts.

Very truly yours,

Joseph H. Lyles, Ed.D.
Administrative Assistant

JHL/bl
Dear Parent:

Mrs. Shirley Vulpe, teacher and Co-Director of a federally funded preschool mainstreaming program at Hampton Institute and a candidate for the Doctor of Education degree at William and Mary, is requesting our Department's support in research needed to complete the degree requirements. She plans to study differences in two different types of measures of intelligence of young handicapped children. Both the McCarthy Test of Children's Abilities and the Leiter International Performance Test will be used for each student participating in the study. She would like to include one hundred handicapped children. Each test takes about one and one-half (1½) hours and will be administered at your home by a qualified tester. Children's names will not be used in the study. If you wish to discuss your child's test results, Mrs. Vulpe will schedule an appointment with you. Also, any questions regarding the research project.

Sincerely,

[Signature]

Lee Martin, Ph.D.

Student's Name __________________________ Home Room ____________

I give my permission to have my child participate in the research study.

Yes ________ No ________

I would like to discuss my child's test results

Yes ________ No ________

[Signature]

Parent Signature
Dear Parent:

My name is Shirley Vulpe, I am an occupational therapist and teacher of preschool handicapped children. Presently I am working as Co-Director of a federally funded preschool mainstreaming program at Hampton Institute. I am also a candidate for the Doctor of Education degree at William and Mary. I am writing to ask your support in the research needed to complete the degree requirements. I plan to study differences in two different types of measures of intelligence of young handicapped children. Both the McCarthy Test of Children's Abilities and the Leiter Internationall Performance Test will be used for each selected child. One hundred handicapped children will be selected. Each test takes about 1-1/2 hours, and will be administered at your home by a qualified tester. Children's names will not be used in the study. If you wish to discuss your child's test results, I am happy to schedule an appointment with you. Feel free to ask me any questions about the tests or the research project.

Thank you for your attention.

Sincerely,

Shirley Vulpe

Student's Name ____________________  Home Room ______

I give my permission to have my child participate in the research study.

_________  __________
Yes  No

I would like to discuss my child's test results

_________  __________
Yes  No

__________________________
Parent Signature
APPENDIX B

Technical Qualities of Test Instruments
<table>
<thead>
<tr>
<th>Technical Quality</th>
<th>Category of Quality</th>
<th>Determined By</th>
<th>LIPS</th>
<th>MSCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useability</td>
<td>Cost</td>
<td>Is approach cost effective</td>
<td>30-45 minutes</td>
<td>45-60 min to administer</td>
</tr>
<tr>
<td></td>
<td>i) time</td>
<td>i) expensive to but-some-what more expensive than similar test kits, protocols very inexpensive</td>
<td>i)easy to score ii)easy to interpret iii)results readily interpretable hiear profile available to help with qualitative analysis (Sattler, 1982) iii)results readily used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) money</td>
<td>i) scoring ease ii) ease of interpreting iii) useability of results for stated purpose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Techn. Quality</td>
<td>Category of Quality</td>
<td>Determined By</td>
<td>LIPS</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------</td>
<td>---------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Validity</td>
<td>Predictive</td>
<td>Correlation, coefficient with future performance and measured trait</td>
<td>- 35 deaf children correlation of .71 on LIPS IQ &amp; student achievement 1-3 years later, 11 years later for 25 of 35 significant weight can be given LIPS unpredicting school successes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCA</td>
<td></td>
</tr>
<tr>
<td>Construct validity</td>
<td>Define construct and relate to Theory empirical research supporting construct that compare test results with other measures accepted as testing relevant construct.</td>
<td>In studies of Stanford-Binet and WISC correlations range from .56-.92 with median of .83 (Sattler, 1981)</td>
<td>Factor analysis indicates tests possess a certain amount of uniqueness Kaufman (1975 b)</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>Category of Quality</td>
<td>Determined By</td>
<td>LIPS</td>
<td>MSCA</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------</td>
<td>---------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Criterion Validity Concurrent</td>
<td>Define criteria completely &amp; accurately Define limits to generalizability correlation, coefficient with other similar tests and measurements</td>
<td>Item sample only represents non-verbal cognitive activities appropriate for test of problem solving or intelligence in this area. Several correlation coefficients with other similar tests</td>
<td>Criteria accurately &amp; completely described McCarthy (1972), p. 40 reports correlations of .71 &amp; .81 with WPPSI &amp; Binet Davis &amp; Rowland (1974).77 between GCI &amp; Binet. Davis (1975) GCI &amp; Binet of .91 for 53 normal youngsters DeBoer (1974) .56 between GCI &amp; IQ for 41 learning disabled children. This last study indicates need for study of this thesis</td>
<td></td>
</tr>
</tbody>
</table>

Correlations with Stanford-Binet, WISC range from .56-.92 with median correlation of .83 Sattler (1981)

<table>
<thead>
<tr>
<th>Technical Quality</th>
<th>Category of Quality</th>
<th>Determined By</th>
<th>LIPS</th>
<th>MSCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item Selection</td>
<td>Analysis of tests requirement for &amp; availability of experience with test items</td>
<td>Items designed to be novel so previous experience is unnecessary</td>
<td>Items designed to appeal to children, sturdy, well designed</td>
<td></td>
</tr>
<tr>
<td>Administration Error</td>
<td>Standard Administration procedures</td>
<td>Standard administration procedures - but may be hampered by unclear manual descriptions</td>
<td>Standard administration procedures manual exceptionally well done</td>
<td></td>
</tr>
<tr>
<td>Validity</td>
<td>Content Validity</td>
<td>Defining normative populations&lt;br&gt;Examining item sample representativeness for scope, content sequence process&lt;br&gt;Defining purpose of test</td>
<td>Poorly defined in test manual but has been studied extensively with all types of handicapping conditions&lt;br&gt;Scope content and sequence defined as appropriate by Smith (1977)</td>
<td>Tasks correspond closely to type of items in Stanford-Binet&lt;br&gt;WPSSI &amp; WISC-R&lt;br&gt;Kaufman &amp; Kaufman (1977)&lt;br&gt;Scope content and sequence considered very appropriate for young children&lt;br&gt;Davis (1977)</td>
</tr>
<tr>
<td>Technical Quality</td>
<td>Category of Quality</td>
<td>Determined By</td>
<td>LIPS</td>
<td>MSCA</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------</td>
<td>---------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Threats to Reliability</td>
<td>Method of Measurement</td>
<td>Analyzing method of measurement. Bias is not present if there is no interaction between trait scored and method of measurement.</td>
<td>Method of measurement may bias results if child is use to talking and uncomfortable with nonverbal situation, also require ability to attend &amp; perform in standard situation.</td>
<td>May be interaction between trait scored and language ability, receptive, expressive, internal, speed, motor-ability measurement criteria well described.</td>
</tr>
<tr>
<td>Enabling Behaviors</td>
<td>Analysis of target populations ability to receive stimulus and express response.</td>
<td>Eliminates bias caused by verbal transmitting verbal &amp; complex fine motor responding behavior not appropriate for visually impaired individuals.</td>
<td>Limits of generability alluded to in Kaufman &amp; Kaufman (1977) as are methods to assess blind, hearing impaired &amp; motorically impaired. Reliability of test still questionable.</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Leiter International Performance Scale (LIPS) and the McCarthy Scales of Children's Abilities Using Recommended Technical Qualities for Psycho-Educational Tests

<table>
<thead>
<tr>
<th>Quality</th>
<th>Categories of Quality</th>
<th>Determined By</th>
<th>LIPS</th>
<th>NSCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>liability</td>
<td>Test Re-test Stability</td>
<td>stability coefficient - correlation of scores on tests administered at two different times, shorter time interval increased reliability coefficient - two scores of alternate forms of test are correlated, shorter time between administering forms increases reliability - 2 week interval recommended.</td>
<td>.80 x .90 have been reported for populations of handicapped children (Sattler, 1982)</td>
<td>.85 over 1 year reported by Davis &amp; Slettedahl 1978</td>
</tr>
<tr>
<td></td>
<td>Alternate Form</td>
<td></td>
<td>none - alternate form does not exist</td>
<td>.90 for GCI - 1 month</td>
</tr>
<tr>
<td></td>
<td>Internal Consistency</td>
<td>Split-half reliability estimate correlate scores on 24's of a test - usually odd/even numbers coefficient alpha average split-half correlation based on all possible division of test into two parts</td>
<td>Kuder Richardson Formula 20 based on proportion of persons passing each item and the standard deviation of the total scores - result is equal to average of all possible split-half coefficients for group tested. Interpret with caution unless speed of work is negligible factor.</td>
<td>Split-half reliability for GCI = .93 McCarthy (1977) for scale indexes many fall short of desired criteria of .80 recommend cautious interpretation of some indexes at certain ages</td>
</tr>
</tbody>
</table>

All references are sources of reports from several studies on these tests.
APPENDIX C

Items from Leiter International Performance Scale
YEAR II
(4 tests, 3 months each)
1. Matching colors (present one block at a time)
2. Block design (present one block at a time)
3. Matching pictures (present one block at a time)
4. Matching circles and squares (present one block at a time)

YEAR III
(4 tests, 3 months each)
1. Four forms (present one block at a time)
2. Block design
3. Picture completion (demonstrate first notch)
4. Number discrimination (one of three forms; a demonstration follows each failure)

YEAR IV
(4 tests, 3 months each)
1. Form and color
2. Eight forms (present one block at a time)
3. Counts four (two of three forms)
4. Form, color, number

YEAR V
(4 tests, 3 months each)
1. Genus
2. Two color circles (color only correct)
3. Clothing
4. Block design (colors only)

YEAR VI
(4 tests, 3 months each)
1. Analogous progression
2. Pattern completion test (demonstrate Form A; corrections allowed on marked notches in Form A)
3. Matching on a basis of use
4. Block design

YEAR VII
(4 tests, 3 months each)
1. Reconstruction (demonstrate sigma)
2. Circle series
3. Circumference series
4. Recognition of age differences

YEAR VIII
(4 tests, 3 months each)
1. Matching shades of gray
2. Form discrimination
3. Judging mass (two of three forms)
4. Series of radii

YEAR IX
(4 tests, 3 months each)
1. Dot estimation
2. Analogous designs
3. Block Design (angles +)
4. Line completion (Demonstrate first notch)

YEAR X
(4 tests, 3 months each)
1. Foot print recognition
2. Block design (in 5 minutes)
   Time ______________
3. Concealed cubes (demonstrate first notch)
4. Block design (in 5 minutes)
   Time ______________________

YEAR XII
(4 tests, 6 months each)
1. Block design (in 41/2 minutes)
   Time ______________
2. Similarities; two things
3. Recognition of facial expressions
4. Classification of animals
YEAR XIV
(4 tests, 6 months each)
1. Concealed cubes
2. Analogous designs
3. Memory for a series
4. Form completion

YEAR XVI
(4 tests, 6 months each)
1. Code for a number series (demonstrate, using practice set and key; see manual)
2. Reversed clocks (demonstrate; see manual)
3. Dot estimation
4. Block design (in 21/2 minutes)

YEAR XVIII
(6 tests, 6 months each)
1. Position analogy
2. Dot estimation
3. Form completion (give practice set)
4. Concealed cubes
5. Spatial orientation
6. Concealed cubes (demonstrate first two notches)
Following are two examples of test items:

Two-year test

Test 1: Matching colors (black, red, green, blue, yellow).

Description: The five colored blocks are matched to a sheet containing pictures of the five colors.

Procedures: The examiner places the black block in the first stall and tries to get the subject to put the red block in place by putting it on the table, then in the appropriate stall, then on the table again, nodding to the subject to do it and at the same time pointing to the second or red stall.

Scoring: Accurately places four colors without assistance during any one trial.

Nine-year test

Test 1: Dot estimation.

Description: Fifteen dots are on the left end of the strip and eight-five on the right end. The blocks have varying numbers of dots on them between 15 and 85.

Procedures: Place the blocks in random order before the subject.

Give no help.

Scoring: All blocks must be properly placed to match the strip.
APPENDIX D

Task Analysis Items on
McCarthy Test of Children's Abilities
A. Task Analysis  McCarthy Scales  Tasks  Verbal Tasks

Pictorial Memory:
- little verbal expression
- memory short term
- meaningful content
- visual and auditory stimuli
- rote memory simple
- semantic memory (Guilford)
- figural memory (Guilford)
- early language development
- attention
- lowest on scale on factor analytic findings of verbal tests

Word knowledge 1+11 - Much Verbal Expression:
- verbal conceptualization (p. 137)
- acquired knowledge (Baunatyne)
- language (Sutter)
- semantic cognition (Guilford)
- early language development

Verbal Memory I:
- auditory stimuli
- sequencing
- rote memory simple
- little verbal expression required
- meaningful content
- semantic memory (Guilford)
- verbal comprehension
- attention

Verbal Memory II:
- auditory memory - much verbal expression
- meaningful content
- complex memory
- sequencing
- conceptual task
- semantic memory (Guilford)
- concentration

Verbal Fluency:
- verbal conceptualization p. 137
- much verbal expression required
- categorical think - logical classification
- solve intellectual problems quickly
- language (Sattler)

Opposite Analogies:
- verbal conceptualization p. 137
- little verbal expression required
- conceptual thinking (Sattler)
- semantic cognition (Guilford)
- early language development
- verbal reasoning
Conceptual Grouping: Verbal Skill p. 87, Kaufman & Kaufman
- nonverbal reasoning
- categorical thinking (logical classification skills)
- verbal concept formation
- thinking
- convergent production of figural products
- conceptual thinking (Sattler)

- verbal
  - number concepts
  - mental manipulation of numbers
  - acquired knowledge
  - numerical reasoning (Sattler)
  - semantic cognition (Guilford)
  - symbolic memory (Guilford)

Numerical Memory I:
- verbal
  - sequencing
  - rote auditory memory simple
  - non-meaningful context
  - auditory stimuli
  - symbolic memory (Guilford)

Numerical Memory II:
- auditory stimuli
  - complex auditory memory
  - sequencing
  - mental manipulation of #5
  - non-meaningful content
  - auditory stimuli
  - symbolic memory (Guilford)

Counting & Sorting: Relate Tool to Perceptual Performance Index
- verbal
  - visual stimuli
  - motor response
  - number concepts
  - mental manipulation of #5
  - acquired knowledge
  - numerical reasoning
  - symbolic memory (Guilford)

Perceptual Performance: Block Building
- visual motor coordination (Sattler)
- imitation
- spatial
  - convergent production of figural products
  - figural cognition (Guilford)

Puzzle Solving:
- fine motor skill
- nonverbal spatial reasoning (Sattler)
- spatial relations
- visual perception
visual motor coordination
solve intellectual problems quickly
thinking
figural cognition (Guilford)

**Tapping Sequence:**
visual motor coordination
fine motor skills
sequencing
rote memory, short term, simple
non-meaningful content
visual and auditory stimuli
imitation
figural memory (Guilford)
attention

**Right-Left Orientation:**
verbal concept formation
thinking
spatial
nonverbal & spatial reasoning (Sattler)
directionality

**Draw-a-Design:**
imitation
visual motor coordination (Sattler)
spatial
convergent production
figural products
fine motor
paper & pencil
visual perception
convergent production of figural products

**Draw-a-child:**
imitation
visual motor coordination (Sattler)
spatial
convergent production
figural products
fine motor
paper & pencil
thinking
convergent production of figural products
nonverbal concept formation
body image

**Conceptual Grouping:**
verbal skill
logical classification
nonverbal reasoning
verbal concept formation

**Counting & Sorting:** On Body Performance & Verbal Scale
visual stimuli, motric response - relates to perceptual Performance Index
APPENDIX E

Pearson Correlation Coefficients
Key to Abbreviations Used

HIMM  Hampton Institute Mainstreaming Model (Study I)
HCS   Hampton City Schools (Study II)
MIQ   McCarthy IQ
MMA   McCarthy Mental Age
LIQ   Leiter IQ
LMA   Leiter MA
DX    Diagnosis

Statistics are listed: Coefficient
Number of Cases
Significance

A value of 99.0000 appears if a coefficient could not be computed
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APPENDIX F

Western Hills Area Education Agency Personal Communication
March 31, 1983

Mrs. Shirley Vulpe
Hampton Institute,
Hampton, Virginia 23668

Dear Shirley;

The data referred to in our phone conversation was collected on 185 preschool children between the ages of 2 to 5. They were referred to us by parents, professionals, or interested persons because they felt the child was not developing normally. The most common cause of referral was concern for delayed speech/language skills. Because of this delay in language, we feel it to be not only important, but absolutely necessary, to administer a non-language intelligence test, as well as the traditional Stanford Binet. The makeup of the Binet is such that it penalizes children who do not have good command of language, or whose articulation is such that they cannot make themselves understood. I believe that about 80% of our referrals are generated by language concerns.

We have chosen the Merrill Palmer Scale because it is intrinsically interesting to young children, and seems to elicit their best effort. We have been concerned because the normative data is old; but we have found that children who have scored in average range on this test, in spite of Binet scores which might indicate retardation, will have subsequent IQ scores on the Binet or revised WISC which rise to meet the Merrill Palmer scores, to indicate normal mental ability. In other words, we are finding that the Merrill Palmer is a better predictor of average mental ability in a young child than is the Stanford Binet.

To summarize our data; for children who are classified "mental disability", test scores on both instruments are 1 or more SD below 100. Merrill Palmer mean is 9 points higher than Binet on 51 children.

For children who were classified "communication disability", the mean Binet was 79, Merrill Palmer mean 100 (44 children).

For children classified "not handicapped", the mean Binet was 89, Merrill Palmer mean 101 (60 children).

For children with "other" handicaps (physical disability, learning disability, visually or auditorially impaired etc), the mean Binet was 78, the mean Merrill Palmer 92.
For normal children in a college based preschool, the mean Binet and Merrill Palmer scores were both +1 SD, N=14 children.

You have mentioned that your work is with the Binet and Leiter tests, and have found similar results. I would appreciate your sending me a brief resume of your study. Somehow we'll have to encourage all professionals working with young children to look at all aspects of development!

I hope I have been of help. Good luck in your dissertation completion.

Sincerely,

I. J. Logan
Psychologist, Preschool Services
REFERENCES


Braen, B. & Masling, J. M. Intelligence test used with special groups of children. *Journal of Exceptional Children, 1959, 26, 42-5.*


Department of Education, Division of Special Education Administration and Finance. Report of handicapped children counted in local educational agencies as of December 1, 1981.


Leiter, R. G. The Leiter International Performance Scale directions for application and scoring of the individual tests. Vol. 1, Santa Barbara, CA: Santa Barbara State College Press, 1940.


U.S. Department of Education, Office of Assistant Secretary for Special Education and Rehabilitative Services, Special Education Programs. Most recent statistics on numbers of handicapped children by age and diagnostic category, March 25, 1983.


Vita

Shirley G. Vulpe

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1975-1983 The College of William and Mary in Virginia
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1962-1964 Wayne State University
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