EXPLORATION OF A RELATIONSHIP BETWEEN ABILITY TO CLASSIFY AND LEVEL OF READING COMPREHENSION

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ABSTRACT

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This study investigated whether elementary school children who can classify at a higher level are also able to comprehend reading passages at a higher level. Also explored was the predictive value of the ability to clasify and IQ for level of reading comprehension.

The study provided data on elementary school children in grades 1 through 4 over a four-year period. The independent variable in this study was the ability to classify. Dependent variables included reading comprehension, IQ, grade, and sex.

Results showed that: (1) The ability to classify and reading comprehension were correlated. (2) The ability to classify was a better predictor of the level of reading comprehension than was IQ. (3) There was no difference between the classification abilities of males and females. (4) IQ was not related to the grade of acquisition of Stage III classification skills. (5) Classification skills increased with grade level. (6) There was no significant difference in reading gain scores and classification stage gains from Stage I-II, II-III, or I-III within a period of one year compared to those who did not change stages within a period of one year.

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CHAPTER I

IDENTIFYING THE PROBLEM

Introduction

As scholars construct models for the processes of reading, a pervasive debate within cognitive theory concerns whether language contributes to the development of thought or whether thought stimulates language. Theory and research have contributed to both perspectives, but not adequately to settle the debate. Vygotsky (1962) argued that language stimulates the development of thought, whereas Piaget (1955) postulated that language is a verbalization of established cognitive structures and can only occur as a result of the development of cognitive structures. This is an important theoretical issue for the development of a reading model with implications for the instruction of young children, as well as the psychology of the development of language and thought.

Many children who ought to be able to read proficiently are unable to do so, and the answer to the question of why they cannot is still not thoroughly understood. Possibly during the early years of the development of thought and language that precedes formal development, unique variables are operating. The process by which elementary-school children are able to comprehend meaning from symbols, specifically written language, in order to learn by reading is an aspect of cognitive development that needs further study.

Another factor that needs investigation is the issue of intelligence quotient (IQ) versus intelligence as it is used in determining placement for children and instructional practices. Divergent views exist concerning the linkage between IQ and the level of cognitive development, as well as the role of language in both of these areas. The present study includes data on intelligence quotients, level of comprehension of a written passage, and the ability to classify in order to explore whether a significant relationship exists between these variables. The investigator explores whether children who can classify at a higher level are also able to comprehend reading passages at higher levels. Also explored is the predictive value of IQ and ability to classify for level of reading comprehension.

Language and Cognitive Development

Furth (1981) wrote that although language plays a necessary part in one's attainment of conceptual systems that involve the manipulation of symbols, language is insufficient as the primary mechanism of concept formation. He argued that this seems to be because

> the component operations constituting logical classes as a congruent system show evidence of being linked by a markedly continuous progression through such elementary behaviors as "to bring together," to "take apart," and to anticipatory and retrospective processes that precede and go beyond the use of linguistic associations or connections. (p. 36)

Sachs (1971) wrote that theories of language acquisition that consider only the linguistic aspect are not able to explain why the child learns new forms when he does or, in fact, why he ever changes his form of expression. Only through more research on the complex relationship between cognitive development and language acquisition will a fuller understanding of either concept be achieved. In this study the investigator did not attempt to address this relationship directly, but considered the correlate idea of the comprehension of written language in a reading passage and the cognitive ability to classify.

Classification is the ability to form classes by attributes into more and more complex class-inclusion structures. The ability to classify may be a developmental correlate for learning to read comprehensively without which the child is unable to comprehend a written passage fully.

Intelligence Quotients and Cognitive Development

The intelligence quotient is a psychometric measure of capability as determined by correct responses to test items, formulated with chronological age to determine a quotient. Intelligence has also been used by Piaget and others to mean the totality of a person's available schemes (Furth, 1981), which is considered the product of gradual development.

McClelland (1973) challenged the validity of IQ tests as measures of intelligence. He argued that the correlation between IQ scores and occupational success is likely a result of social class rather than intelligence.

Kohlberg and Mayer (1973) suggested that Piagetian cognitive stages of development provide a "rational standard for educational intervention where psychometric intelligence tests do not" (p. 489). This statement concurs with McClelland's (1973) argument that tests with scores that "change as the person grows in experience, wisdom and ability to perform effectively on various tasks that life presents to him" (p. 8) may be more appropriate than one psychometric measure for assessing ability.

DeVries (1974) concluded that Piaget's cognitive-development tasks do provide a more valid assessment of intelligence than do psychometric measures. However, psychometric measures are useful as a first approximation (Inhelder, 1943) in assessing a child's intelligence. If it is found that better classifiers, with lower IQ's, are better comprehenders of a written reading passage, the present study will lend greater understanding to the role of developmental intelligence versus intelligence quotients in planning reading instruction for students.

Language, Cognitive Development, and Reading

Among models for the reading process are those that assume reading is a language-based skill. Mattingly (1972) and Sapir (1972) both wrote that linguistic awareness is required before one is able to read.

Sachs (1974) wrote that language (reading) represents operations--thinking that matches language (reading) operationally equates comprehension. Teaching language (reading words, decoding) does not facilitate higher comprehension. "Teaching thinking does" (p. 119).

Kirkland (1978) used the stages of cognitive development as postulated by Piaget to develop a model for teaching reading. She concluded,

> We need a great deal more research in order to know precisely what to teach when. . . . But we are making progress and it is indicative of the genius of Piaget that his theories are finding applications in reading language instruction. (p. 503)

Purpose of the Study

The purpose of this study is to explore whether there is a relationship between elementary-school children's cognitive ability to classify concretely, their measured intelligence as a quotient, and their level of reading comprehension of written passages. The writer describes concrete classification tasks and explores the correlation between children's performance on them and their level of reading comprehension of written passages, using standardized tests of reading in grades 1 through 4 over a four-year period.

If a positive correlation is found to exist on these measures, the study will provide data that may be relevant to theories concerning the development of thought and language, as well as intelligence, as factors in planning reading instruction. All of these factors have implications for models of the reading process. In addition, if a positive correlation is found to exist, the study will provide additional data for curriculum and instruction in reading in terms of what kinds of abilities may be operative for children in grades 1 through 4 which correlate with the ability to comprehend written passages.

Need for the Study

Inhelder (1974) proposed the need for research to

> point the way to an application of developmental theory in the field of education. Piaget's theory and the extensive experimentation attached to it can be applied to educational practice only in a very indirect way. Although learning studies certainly do not close the gap between cognitive psychology and classroom practice, they constitute a link in the chain that may eventually unite the two.

Athey (1976) speculated that the application of Piaget's theory of intelligence to the process of reading comprehension would be a highly fruitful field of inquiry. She wrote that it would be reasonable to suppose that an understanding of the child's cognitive development in terms of Piaget's concepts would have implications for the kinds of reading materials suitable for different age groups.

If the relationship among classification ability, intelligence, and reading comprehension were better understood, more effective instruction in reading could take place. The learning of reading skills may be only part of the tasks needed to become a functional reader. This study is an attempt to explore one aspect of cognitive development--the ability to classify--and the relationship between this concrete ability, intelligence quotient, and the level of reading comprehension.

Importance of the Study

The study is important for the following reasons:

1. The study may have important theoretical implications because it may provide additional data regarding the development of cognitive abilities and language.

2. It may contribute empirical research data concerning cognitive models of the reading process.

3. It may have practical implications for reading instruction in terms of elementary-school children's reading comprehension.

4. It may shed light on the divergent views on intelligence quotients versus intelligence as a developmental process with implications for curriculum planning.

Theoretical Implications of the Study

The relationship between language and reading, from the perspective of theories about the link between thought and language, is a current issue in developing models for the reading process. Among the important contemporary theories of language and thought, this study includes only the Piagetian viewpoint. This writer also investigates the relationship between one aspect of cognitive development (the ability to classify) and intelligence quotient, and their relationship to the level of reading comprehension.

Definition of Important Terms

The following terms are defined in the context in which they are used in this study.

Ability to classify: The independent variable in this study was ability to classify: the ability to operate on objects in order to combine them into classes. To classify is to coordinate and integrate different variables or dimensions at the same time to form logical classes. Inhelder (1974) discussed the concept of class inclusion as applicable to situations in which all the information is present from the outset. An understanding of class inclusion implies that each element is regarded as belonging to both a subclass and a more general class. A comparison of the number of objects in Class B with the number in Class A implies a change of criteria because the criteria of the subclass include all those of Class B plus a number of others.

Furth (1981) discussed the ability to shift criteria, allowing the subject to consider a collection of objects from several points of view--either in succession or simultaneously. He considered this a conceptual activity rather than a perceptual one. Furth considered the mobility of operational behavior, physically and mentally, to allow for every transformation to be canceled or compensated for by its inverse. This latter characteristic he considered to be one of the main underlying mechanisms forming the system of logical classification. Specifically in this study, classification entailed the following activities:

Sorting shapes and objects: arranging shapes of varying sizes, shapes, and colors into groups or classes. In _Stage 1_ the child allows perceptual attributes to be in control as he sorts the objects. The child sorts the objects according to some basis of similarity, but the basis changes as he sorts. The child forms "graphic collections" that are not based on logical classes. In Stage II the child is able to sort or arrange by one property--color or size or shape. In Stage III the child is able to arrange the shapes into basic classes and then rearrange or sort them by another criterion. He can also subdivide classes into logical classes and set up a classification hierarchy or a matrix.

Completing a matrix: using four spaces, three of which are filled, to determine from the vertical and horizontal attributes of the three given blocks what the empty space should contain. In Stage I, the child can find the correct missing element but uses perceptual insight instead of making a conceptual transformation. He looks at the symmetrics of the patterns. In Stage II, initial attempts show confusion and trial and error. In Stage III, selection is based on the logical inclusion of multiple classes of attributes.

The dependent variables in this study that require definition are reading comprehension and intelligence quotient (IQ).

Reading comprehension is the grade-equivalent score a student is assigned, based on his responses to multiple-choice items about a reading passage. The passages are reading subtests in comprehension and vocabulary of the California Achievement Tests.

IQ is the intelligence quotient derived from an individual's responses on the Slossen Intelligence Test, using the standard CA/MA = IQ formula.

Research Questions and General Hypotheses

The purpose of this study is to explore whether a relationship exists between elementary-school children's ability to perform concrete classification tasks, intelligence quotient, and level of reading comprehension on standardized tests. The following research questions were central to this study:

1. Does the ability to classify at a higher level correlate with the ability to comprehend at a higher level?

2. Is there a stronger relationship at certain grade levels?

3. Does earlier acquisition of ability to classify at a higher level relate to a higher IQ?

4. Does the emergence of a higher level of classification performance relate to a greater-than-expected growth in level of reading comprehension over a period of one year of instruction?

5. Is the ability to classify more highly related to the level of reading comprehension than a verbally measured intelligence quotient?

6. Why do some students lack the ability to classify at a concrete level?

7. Can opportunities be provided to encourage the development of classification skills?

8. Does the development of classification skills facilitate higher intelligence quotients?

The general hypothesis of this study was that the ability to classify is learned and becomes a correlate of the ability to comprehend in reading. The ability to classify indicates enlarged mental capability to manipulate written language, resulting in better reading comprehension. Because a study of classification as a correlate of the reading process in grades 1 through 4 has not been conducted, the following hypotheses, stated in general form, were investigated:

1. The better the child's ability to classify, the higher his level of reading comprehension.

2. The better classifier also possesses a higher intelligence quotient.

3. After a child attains a higher stage of classification, his growth in reading-comprehension skills during a given school year will be greater than what would be the normal growth pattern in reading comprehension during that school year.

4. The ability to classify becomes a progressively stronger correlate of the level of reading comprehension from grade 1 through grade 4.

5. IQ is a better predictor of the level of reading than is the ability to classify.

Assumptions

The writer made three basic assumptions in conducting this study:

1. The classification tasks do assess the ability to classify concretely at three levels. The tasks and procedures are typical of those described in the literature.

2. The students are representative of a typical elementary-school population, and their responses can be expected to be replicated in other elementary schools with similar student populations.

3. The California Achievement Tests are representative of standardized reading tests, and the classification tasks used in this study are representative of those presented in the literature.

Delimitation and Limitations of the Study

Because all of the first- through fourth-grade students in a selected school population except the special education students were included in the reading tests and classification assessments, there were no controls for the population.

The classification tasks are concrete and were limited to a sorting arrangement and a matrix to establish stages. Although these tasks are similar to those described in the literature, they have not been used in their present format in another research study.

Summary

Theorists and researchers have studied the acquisition and use of language as it relates to cognitive development. Piaget and others have contended that the development of language is based on cognitive development and is a social act of communication. Other researchers such as Athey, Kirkland, Furth, and Elkind have postulated that reading comprehension is cognitively based, with linguistic flexibility required. Evidence seems to indicate some link between cognitive development and reading success. The research also seems to indicate a difference between the intelligence quotient and intelligence as represented by Piagetian tasks in cognitive development. The hypotheses and research questions of this study continue the investigation by inquiring into the relationship among concrete classification, intelligence quotients, and reading comprehension.

Overview

In Chapter I, the research problem was stated and the importance of the study was discussed. The research questions and general hypotheses were stated, and the assumptions and limitations of the study were explained. A definition of important terms was provided.

In Chapter II, a review of related literature is presented in the following areas: language and cognitive development, intelligence, and cognitive development and reading. These topics are integrated with specific research on classification.

The research methodology is presented in Chapter III. Included are the research design, variables and hypotheses, instrumentation, sampling, data-collection and data-analysis procedures, and concerns about validity and reliability. The findings of the study are analyzed and reported in Chapter IV. Chapter V contains a summary of the investigation and a discussion of the research findings.

CHAPTER II

PRECEDENTS IN THE LITERATURE

Language and Cognitive Development

A theory of the relationship between language and thought bears on the topic of reading. Reading requires language comprehension, semantic processing, and an ability to understand the meaning of the visual symbols that provide the form of language to be comprehended. Thus reading involves both a particular type of language behavior and a form of nonverbal thinking.

In the initial stages of learning to read, an individual's attempts to mobilize his developing capabilities into a working system for responding to the printed page are characterized by hesitancy, rigidity, and often a lack of fluency because he does not yet have adequately developed systems or the necessary mental structures and flexibility for changing appropriately from one working system to another (Inhelder & Piaget, 1964). Gradually his capabilities improve in variety and fluency because of maturation, learning, and experience in mobilizing information into a multitude of working systems. Consequently, he becomes more capable of shifting from one mental organization to another. Also, the individual becomes better able to mobilize conceptual systems that are appropriate for responding to various stimulus categories and for selecting and organizing word meanings applicable to the context because of his growing ability to conceptualize stimuli in his input and mediational processing systems (Singer, 1965).

Slobin (1966) regarded language acquisition as an active process in which certain abilities of the child develop. One is the cognitive ability to deal with the world; a second is the mental ability to retain items in short-term memory, to store items in long-term memory, and to process information increasingly with age. According to Slobin, general cognitive and mental development is the critical determinant of language acquisition.

A major theory of cognitive development was formulated by Piaget. He provided the basis for a general theory of both language acquisition and of the role of language as a factor of development. De Zwart (1969) summarized the two main points that recur in Piaget's writings on the relationship between language and intellectual operations:

1. The sources of intellectual operations are not to be found in language, but in the preverbal, sensorimotor period in which a system of schemes is elaborated that prefigures certain aspects of the structures of classes and relations, as well as elementary forms of conservation and operative reversibility. In fact, the acquisition of the permanency of objects constitutes a first invariant. The search for an object that has disappeared is conducted in function of its successive localizations; these localizations depend on the

constitution of an elementary "groupe de deplacements, in which detours (associativity) and returns (reversibility) are coordinated" (de Zwart, 1969, p. 267).

2. The formation of representational thought is contemporaneous with the acquisition of language; both belong to a more general process than of the constitution of the symbolic function in general. This symbolic function has several aspects, and different kinds of behaviors, all appearing at about the same time in development, indicate its beginnings. The first verbal utterances are immediately linked to, and contemporaneous with, symbolic play, deferred imitation, and mental images as interiorized imitations.

Piaget's (1969) main concepts bearing on the role of language in the development of thought may be expressed as follows. At the end of the sensorimotor period, the first decentrations appear in the child's dealings with his environment. Spatio-temporal restrictions slowly disappear with the development of thought. The activity of the baby is directed toward success in his manipulations (from the cognitive point of view) and toward personal satisfaction (from the affective point of view). Later on, his activity takes on another dimension: Cognitively, immediate success will no longer be the sole aim, but he will search for explanations and will reflect on his own actions. Affectively, he will seek not only satisfaction, but also communication; he will want to tell other people about his discoveries, which now become knowledge of objects and events rather than reactions to objects and events.

Piaget (1969) showed that language is only a symptom and not the source of this change. He demonstrated that language, despite the fact that later on it becomes most pervasive and takes on the guise of an autonomous capacity, is only part of the symbolic function. The symbolic function can be defined essentially as the capacity to represent reality through the intermediary of signifiers that are distinct from what they signify. Signals are temporally and spatially restricted; the most distinct signifiers are free from such restrictions. Piaget introduced a dichotomy in the distinct signifiers themselves:

1. Symbols, which, like a shell, have a link of resemblance with the object or event.

2. Signs (words), which are arbitrary.

Symbols are usually personal; every child invents them in his play. On the other hand, signs are social. Small children pass extremely swiftly from what looks like pure imitation to symbolic play and to acts of practical intelligence accompanied by words, but at first these different stages cannot even be distinguished. Language as viewed by Piaget is thus part of a much larger complex of processes that go on during the second year of life. It has the same roots, and in the beginning the same function as symbolic play, deferred imitation, and mental images; it does not appear simply from early, prelinguistic vocalizations but partakes of the entire cognitive development in this crucial period (de Zwart, 1969).

Piaget (1969) considered language not to be a sufficient condition for the constitution of intellectual operations. As to the question of whether language (in the sense of the normal acquisition of natural language by the young child) is a necessary, if not sufficient, condition for the constitution of operation, Piaget left the question open in terms of the operations of formal logic. With regard to concrete operations, Piaget (in de Zwart, 1969) cited experiments with deaf-mute children, which clearly seemed to point to the fact that the symbolic function is necessary for the constitution of these operations, but that the normal acquisition of a natural language is not.

The comparison of the reactions on Piagetian tests of normal children to those of deaf-mute and blind children indicated the deaf mutes had intact sensorimotor schemes but had not acquired spoken language. The blind children were in the inverse situation. Another study of deaf children was conducted by Furth (1961). The results concurred fundamentally and indicated that deaf children acquire the elementary logical operations with only a slight retardation as compared to normal children. The same stages of development were found as the ones established by Piaget on a normal population. Furth pointed out that some differences occurred in the reactions of the deaf subjects. Classification tasks possessed the same general structures and appeared at the same age as with normals, but the responses seemed slightly less mobile or flexible when classificatory criteria were changed. The investigator speculated that the cause was more a result of general lack of social exchange and stimulation than of operational retardation. The study suggested that, contrary to the accepted conclusion that deaf people are inferior in conceptual thinking, the influence of language on concept formation is extrinsic and specific. Language experience may increase the efficiency of concept formation in certain situations, but it is not a necessary prerequisite for developing the capacity to abstract and generalize.

The first concepts formed by the young child are the perceptual invariants of objects, sensational sounds, and feelings. They are internal representations of classes or categories of experience. As the child learns language, he learns socially reinforced names for these categories of experience. He can shape his behavior around internal representations of concepts; i.e., a child at a certain age can take a pencil and draw a square on demand. Not all concepts can be overtly manifested in this way, but a child who can correctly recognize instances of a particular concept and distinguish them from non-instances thereby demonstrates his acquisition of the concept. Concept can be defined as the internal representation of a certain class of experiences, these experiences being either the direct response to aspects of the external environment or responses to other experiences. In theory, an infinite number of concepts is possible because experiences may be classified in infinite ways. A concept can be arbitrarily constructed by combining other concepts, but most concepts used in daily life are based on classifications of experiences that have been found useful in some way (Carroll, 1964).

It took intelligence of a higher order to discover and formulate certain concepts like gravitation and relativity. These are classifications of experiences in the sense that there can be instances and noninstances of each of them; that they play a role in interpreting experience follows from the use of concepts in thinking. Concepts vary in their degree of novelty and complexity for the individual. For an individual without considerable training in mathematics and physics, attaining a concept like that of entropy may be difficult because he may first have to acquire an extensive series of prerequisite concepts.

For a child, attainment of the concept of oppositeness may be equally difficult. The child is unlikely to attain this concept until he has experienced oppositeness in a number of dimensions and notices a common pattern in these dimensions (Carroll, 1964).

On the other hand, many concepts may be very simple to acquire; often an individual can learn them by simply reading or hearing a verbal formulation of them. It is possible for a child to learn a language response without an underlying concept; he may simply learn to echo a word without understanding it, or he may use it in an inappropriate context. But learning to use a word in a meaningful way--that is, in such a way that it will be consistently socially reinforced--implies that the child has acquired the concept that underlies the linguistic response. One characteristic of a language that can be used in general communication is that it provides words or linguistic forms sufficient to catalogue or describe nearly all the experiences or classes of experiences that occur to the user of the language.

Elkind (1974) summarized his interpretation of Piaget's theory of language as follows:

> Operational knowing is not inherently linked to any symbol representations, and this includes language. Language and speech constitute a special symbol system, biologically evolved for social communication and consequently of vital importance for socialization. Language is required, used by the growing child in a manner similar to other symbolic instruments; it is not an indispensable medium for intelligence--the example of deaf children without language who acquire operational intelligence is evidence contrary to such an assumption. (p. 252)

Smith (1975) postulated that language is a process that must be located entirely within the individual's cognitive structure and appears to be precisely analogous to cognitive structure. Cognitive structures include a system of categories, or discrete units of experience, that are meaningfully interrelated. Smith asserted that

> words in language stand for categories in the cognitive system, and that the rules of grammar are the counterpart in language of the dynamic interrelationships among categories or "routines" of cognitive structure. Certainly the words of our language that seem to stand for objects or events in the world around us are in fact related to categories in cognitive structure. . . . However, not all words in the language can be associated with cognitive categories. Verbs often appear to refer to an interrelationship between categories rather than to the categories themselves. (p. 111)

In addition, Slobin (1966a) considered cognitive and mental development critical determinants of language acquisition. Cromer (1968) hypothesized that a single factor accounts for the observed linguistic changes; the child finds that he can free himself from the immediate situation and the actual order of events and can imagine himself at other times and view events from that perspective. His increased cognitive abilities enable him to express new meanings, and he masters the necessary syntactic apparatus to do so. Schlesinger

(1971) claimed that linguistic structures are determined by the child's innate cognitive power.

Chomsky (1972) summarized a study of children's acquisition of language. The study revealed an invariant sequence in the developmental sequence of understanding more complex linguistic constructions but variability in the precise ages of the acquisition. Chomsky attributed this to dependence on individual rates of development. From an earlier study (1969), Chomsky had concluded that linguistic development depended on the child's cognitive capacities. One of the significant variables in the 1972 study was that the children exposed to more syntactically complex literature were functionally higher in their understanding of linguistic constructions.

Singer (1965) argued that children whose experience is more limited and who have less verbal interchange with adults are less likely to attain the information, linguistic forms, and syntax needed for organizing and communicating new experiences. The author contended that the level of thought and the variety of an individual's ideas are a function of his stage of cognitive development and his interaction with his environment. "These interactions operate in oral as well as in written communication and underlie his general language development" (p. 636).

Gagne (1970) discussed concept learning as learning to respond to collections of things by distinguishing among them, or by putting things into a class and responding to the class as a whole. He considered the most fundamental meaning of the term "concept" as responding to a class of observable objects or object qualities such as those implied by the names "color," "shape," "size," or "heaviness," or by common objects that are considered concrete concepts because they can be denoted by observation. Gagne differentiated these concrete concepts from the later evolution of concepts in the abstract, or those involving relations; these he called concepts by definition. Abstract concepts include mass and temperature, language, and mathematical concepts.

Gagne contended that, to say the child is using a concept, one must be able to demonstrate that the performance is impossible on the basis of simpler forms of learning. The individual must distinguish among collections of objects that may vary widely among themselves in appearance, as well as respond to them in terms of some common abstract property, or classify them.

Gagne discussed the function of a word as that of an external stimulus to recall the structures the situation required for learning. When the student knows the word as a common connection for different examples, instruction becomes a matter of "telling him" what the concept is. Gagne pointed out that learning a concept is not necessarily a verbal matter because concepts can be learned by animals as well as by human beings, but using verbal cues makes concept learning

> a relatively easy matter for human beings who have already mastered the prerequisites. The kind of verbalization described here, however, needs to be carefully distinguished from the verbalizing that presents a definition. As an example of the latter, an edge might be defined as a region of abrupt change in intensity of the pattern of light waves reflected to the eye from a surface. It should not be supposed that this kind of verbalizing would be very

> effective in bringing out the learning of a concept. The learner must instead begin with concrete situations, to which he may bring a common verbal associate. When this condition obtains, using the word as an "instruction" is a convenient way of generating the proper conditions for concept learning. (pp. 177-78)

Conceptual changes are considered additional factors in linguistic responses. Cromer (1968) suggested that an increase in cognitive ability enables the expression of new meanings and an immediate mastery of the necessary syntactic apparatus to do so. Singer (1966) wrote that an important dimension in comprehending language consists of changing, modifying, and reorganizing previously formed concepts. Ruddell (1976) contended that concepts develop along a continuum from concrete through semiconcrete or functional to abstract levels.

Russell and Saadeh's (1962) investigation is illustrative of research supporting such a continuum. These researchers contrasted student conceptual responses at grades 3, 6, and 9 on multiple-choice questions designed to measure various levels of abstraction. They concluded that third-grade children favored "concrete" responses, whereas sixth- and ninth-grade children favored "functional" and "abstract" responses. Likewise, in her research summary of child language, Ervin-Tripp (1967) emphasized that conceptual maturation moves from concrete referents to hierarchies of superordinates, which may have rather vague features at adulthood.

Language, Cognitive Development, and Reading

Athey (1976) wrote that, unlike Piaget's theory of perception, his theory of intelligence has not been applied directly to reading, probably because the visual decoding aspects of reading have received much greater attention than the processes of comprehension. Recently, more attention has been focused on the linguistic and cognitive aspects of learning to read.

Goodman (1965) defined reading as "an interaction between thought and language." Gibson (1965) defined reading as receiving communication, making discriminative responses to graphic symbols, decoding graphic symbols to speech, and getting meaning from the printed page. Gibson assumed that once a child has reasonable competence in a native spoken language, he then progresses through three successive stages in arriving at fluent reading: "learning to differentiate graphic symbols; learning to decode letters to sounds; . . . and using progressively higher-order units of structure" (p. 1067).

Waller (1977) argued that the subskills required for reading require basic fundamental cognitive development as a prerequisite or at least a co-requisite. This condition, he maintained, holds true regardless of whether the reading level of concern is reading readiness, beginning reading, or mature fluent reading and regardless of the specific subskills of concern. Waller proposed that operational thought and perceptual decentration are necessary for successful reading acquisition and that formal operational intelligence is necessary to comprehend adult-level reading material.

Waller wrote that development of the symbolic function during the early preoperational period is profoundly important for reading because the ability to distinguish a signifier from that which is signified (to let one something stand for or represent another something) while differentiating between the two

> is absolutely essential for reading. A child who cannot let squiggles on paper represent words and meanings will not read in the sense that reading implies comprehension. In effect, the symbolic function permits the word "cat," a picture or schematic of a cat, the sound "meow," or a toy stuffed cat all to stand for or represent the real thing which might not be present in the immediate environment. (pp. 3-4)

Halpern (1970) investigated the cognitive compensating mechanisms used by children who have visual-perceptual immaturity but who do not develop reading disabilities. Halpern's study led to speculation that specific cognitive mechanisms are involved in compensating for perceptual lags, which are liberated once the child no longer relies on the developmentally misleading perceptions, thus enabling the child to rely on inferential thinking in competition with perceptual solutions.

Elkind et al. (1965) reported an experiment in which groups of good and poor readers (as defined by presence in a remedial class) in grades 3 to 6 were matched on intelligence (Otis test), age, and sex. All children were given a pretest in which their task was to find the hidden figure in each of a set of ambiguous figures. Then they were given perceptual training on a second set of figures. Finally, they received a posttest on the original set. In general, good readers performed better than poor readers on both tests and learned faster during the training session. The investigators interpreted the results to indicate that the critical factor is the ability to decenter, with the implication that poor readers have difficulty in perceptual decentration. Elkind et al. (1970) claimed to have provided strong evidence that a decentration factor exists in reading, specifically in word recognition, that the decentration factor is different from intelligence, and that decentration training improves at least the recognition aspect of reading performance.

Characteristics of high-achieving readers have also been studied. Kress (1955) concluded that achieving readers were superior to nonachievers in their versatility and flexibility, their ability to draw inferences from relevant clues, and their ability to adapt when new standards were introduced.

Piekarz (1956) identified the high-level reader as one who provides significantly more responses than the low-level reader in interpreting a reading passage, a trait indicating greater involvement and participation in the content meaning. He also found the high-level reader to be more objective and impersonal than the low-level reader in synthesizing the information.

Hodges (1976) wrote that developmental variation suggests many so-called reading difficulties may represent a mismatch between the level of a child's developing sophistication and that of the reading materials with which he is confronted. From a review of correlational research, Waller (1977) concluded that there was a positive relationship between concrete operational thought and reading success. The relationship was reduced considerably, however, when intelligence was held constant. Seriation appeared to be the highest correlate of reading performance in the research reviewed.

Classification and Reading

Studies have been completed that related classificatory skills to the reading process. Cleland (1981) considered multiple classification as a particularly important skill if learning to read is viewed as primarily code-breaking, which he believed requires mastery of multiple phoneme-grapheme correspondences. Perceptually, Cleland found this mastery lacking until the concrete-operations stage. Frayer, Frederick, and Klausmeier (1969) contended that concept mastery involves knowing its superordinate, coordinate, and subordinate concepts.

Feifel and Lorge (1950) found qualitative differences between younger and older elementary-school children's responses when defining a particular word. The younger children significantly more frequently employed use and description, illustration, demonstration, and repetition types of responses. The older children more often used synonym and explanation types of responses.

Saltz and Siegel (1967) found that six-year-old children were prone to concept overdiscrimination, thus forming very narrow concepts. With an increase in age, the children broadened their categories to include more and more instances.

Winner, Rosentsiel, and Gardner (1976) studied children ages 6 to 14 in regard to their understanding of a variety of metaphors. What were considered as genuine metaphors, which called for an association between the physical and psychological realms, were not understood until age 10. Considering metaphor comprehension a type of classification behavior, Billow (1975) studied the responses of boys ages 5 to 13 to metaphors of similarity and of proportionality and several Piaget-type verbal cognitive tasks. According to Billow, results indicated that metaphor comprehension is a type of classificatory behavior and is strongly related to maturing cognitive operations as well as to age. Significant increases in similarity metaphor comprehensions between ages 7 and 13 were explained in terms of increasing access to concrete operational mechanisms. Proportional metaphor comprehension was significantly related to advancement in formal operational development.

Heatherly (1972) used sets of fruits, wooden blocks, and metal cars in an attempt to assess knowledge of relationships between class and subclass. Observed correlations were .31 with vocabulary and .35 with comprehension for the total sample of 120 first- and second-grade boys and girls. Although it was not significantly different, the correlation appeared, for boys, to be higher in second grade and, for girls, to be higher in first grade. The correlation was higher for girls than for boys in both grades.

Simpson (1972) used White's Free-Sorting Classification Task and some items from Rigney's Pictorial Test of Cognitive Development as measures of skills in multiple classification and class inclusion of second- and fourth-grade middle-class children. In general, the results indicated that there was a positive relationship between performance in reading and classification and that poor readers appeared to be functioning at a preoperational level. The author drew a parallel between (a) difficulty in dealing with multiple and varying criteria in group pictures and in dealing with part-whole relationships and (b) difficulty in dealing with the letter-sound generalizations necessary for reading. Smith (1971) reported a weak positive relationship between performance on class inclusion and letter identification. DeVries (1974) reported positive correlations between reading and class inclusion (.24) and between reading and sorting (.09).

Lovell and others (1964) cited the performance of the most disturbed subgroup of poor readers, as compared to the less disturbed of the poor readers, as being particularly inferior on the classification test, more so than on the conservation or seriation task. These results were in accord with Halpern's (1970) suggestion that, among children who are perceptually handicapped, some can read because they compensate for perception with cognitive operations.

Intelligence Quotient Versus Cognitive Development

The differences in opinion regarding psychometric measures as intelligence quotients and intelligence defined as the development of cognitive stages are diverse. Studies have indicated that cognitive development, as well as intelligence quotient, influences school achievement.

DeVries (1974) believed that psychometric intelligence tests obscure a broad understanding of child development and the long-range development of the individual cognitively, emotionally, socially, and morally in the educational process. He studied to what extent IQ tests and Piagetian tasks measure the same intelligence, and to what extent school achievement tests and Piagetian tasks measure the same knowledge. The results of the study indicated that Piagetian tasks do appear to measure a different intelligence and a different achievement than do psychometric tests.

Likewise, McClelland (1973) challenged the validity of IQ tests as measures of intelligence and argued that the high correlations between IQ scores and various measures of occupational success or life adjustment are likely due to social class rather than intelligence. Kohlberg and Mayer (1973) reviewed the literature regarding school achievement tests and concluded that school achievement only predicts further school achievement while failing to predict anything else. The authors further suggested that Piagetian cognitive-stage measures provide a rational standard for educational intervention, whereas psychometric intelligence tests do not.

In a study of first graders' performance on a battery of tasks, including Piagetian tasks and the Lorge-Thorndike as predictors of success on the Stanford Achievement Test at the end of first grade, Kaufman and Kaufman (1972) found the Piagetian battery of tasks had a higher correlation with the Stanford than did the Lorge-Thorndike IQ measure.

Elkind (1965) found that the decentering ability of subjects with lower IQs did not spontaneously increase with age. He also found

(1970) that slow readers were deficient in perceptual activity, both initially and after training, in comparison with average readers. Elkind concluded it is reasonable to assume that perceptual activity is an important factor in reading achievement.

Stephens (1972) studied mental ages for achievement of Piagetian reasoning tasks and noted that normals and retardates of equivalent mental ages do not necessarily possess equivalent flexibility in thought processes. He concluded that Piagetian reasoning tasks involve abilities separate from those measured by standard tests of intelligence and achievement. Chomsky (1972) found IQ to be positively related to linguistic development across all stages.

Ribovich (1972) examined the relationship between beginning reading and cognitive development. He concluded that it appears some comprehension tasks are affected by cognitive factors and some are not. An extension of this conclusion explained that the research was scarce, that many times no assessment of cognitive stages had actually been made, and that research attempting to show a differentiation in ability on the basis of cognitive stage did not directly involve reading. According to Ribovich, the implications for instruction are that the teaching-learning situation is best approached by teachers who recognize individual differences in children's cognitive development, who inquire how children understand something, and who help them develop new cognitive strategies.

Summary

Theorists and researchers have studied the development of the acquisition and use of language as it relates to cognitive development. Piaget and others have contended that the development of language is based on cognitive development and is a social act of communication. Other researchers such as Athey, Kirkland, Furth, and Elkind postulated that reading comprehension is cognitively based and requires linguistic flexibility. Evidence seems to indicate some link between cognitive development and reading success. The research also seemed to indicate a difference between the intelligence quotient and intelligence as represented by Piagetian tasks of cognitive development.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

The research methodology is presented in this chapter. The research design, including variables and hypotheses, is described. Instrumentation, population, data-collection procedures, and data analysis are discussed, along with validity and reliability concerns.

The major purpose of this study was to explore whether there is a relationship between the ability to classify and the level of reading comprehension. A second purpose was to explore the correlation among the ability to classify, level of reading comprehension, and measured intelligence quotient.

Population

The population for this study comprised 212 students in grades 1 through 4 of one elementary school over a four-year period: the 1980-81 through 1983-84 school years. The students in the population attended a rural school that is part of a semi-rural school district of approximately 3,500 students in grades K-12. The students were white and came from a variety of socioeconomic backgrounds.

Description of Methodology

The methodology used in this study was correlational and developmental, designed to explore the effects of the ability to classify on the level of reading comprehension and the predictive effect of intelligence quotient and ability to classify on the attained level of reading comprehension. Since the independent variable, ability to classify, has not been manipulated except through longitudinal sampling, the study was not experimental in nature.

Design Over Time

The classification tasks were administered to the subjects in fall and spring of the 1980-81 school year and each spring thereafter through 1984. In addition, the first graders were assessed each fall. The California Achievement Test reading comprehension and vocabulary subtests were administered to students in grades 1 through 4 in spring 1981, to students in grades 2 and 4 only in 1982, and to students in grades 2 through 4 in 1983 and 1984. The Slossen Intelligence Test was administered to all students in the study in fall of the 1980-81 school year.

Design Over Variables

The independent variable was the ability to classify using concrete objects. Classification was measured as the ability to sort objects by attributes and to complete a matrix by combining attributes.

The dependent variables were level of reading comprehension, intelligence quotient, sex, and grade level over four years. Level of reading comprehension was measured by standardized reading tests using grade-equivalent scores on the California Achievement Test. The intelligence quotient was derived using the Slossen Intelligence Test.

Hypotheses

Previous studies (Inhelder & Piaget, 1964; Piaget, 1955) have shown that cognitive development occurs sequentially in invariant stages. Theoretical implications are that language development is a cognitively based phenomenon (Chomsky, 1972; Elkind, 1976; Piaget, 1955; Slobin, 1966) and that reading is a process that requires these capabilities (Elkind, 1965; Hodges, 1976; Kirkland, 1978; Ruddell, 1976). Kohlberg and Mayer (1975) suggested that cognitive-stage measures provide a rational standard for educational intervention. De Vries (1974) believed that the sole use of psychometric intelligence tests obscures a broader understanding of child development and of the long-range cognitive development of the individual.

In the present study, hypotheses of relationships were formulated, based on the theoretical foundation of previous research. The hypotheses, stated in the null form, are as follows:

1. There is no correlation between the ability to classify and reading comprehension at any grade level.
2. There is no significant correlation between the ability to classify and reading comprehension across all grade levels.
3. There is no significant difference in the grade level mean score for the ability to classify between grades 1 and 2, 2 and 3, or 3 and 4.

4. There is no significant difference between the correlation of mean reading comprehension scores and the ability to classify in any grade.

5. There is no significant difference in the mean reading comprehension scores in subsequent grades for students who achieve a Stage III classification in the ability to classify.

6. There is no significant difference in reading gain scores and classification stage gains.

7. There is no significant difference between male and female students across all grades on their ability to classify.

8. There is no significant correlation among classification ability, grade level, reading comprehension, IQ, and sex.

9. There is no significant correlation between IQ and the grade when a Stage III in classification occurred.

10. There is no significant prediction of the level of reading comprehension by the ability to classify.

11. There is no significant prediction of the level of reading comprehension by IQ.

Instrumentation and Scoring Procedures

Three instruments were used in the study: Piagetian classification tasks, the California Achievement Test, Form C (1976) reading comprehension and vocabulary subtests, and the Slossen Intelligence Test (1970). The classification tasks were in two parts and were replications of classification tasks described in the literature (Inhelder & Piaget, 1969). Each student was assigned a Stage I, Stage II, or Stage III to indicate his level of cognitive development in the classification tasks. The student was given a set of shapes of varying sizes, shapes, and colors and was asked to sort them by attributes. The Stage I student was not able to form logical classes, the Stage II child was able to sort by only one attribute, and the Stage III child was able to arrange the shapes into basic classes and then to rearrange by other criteria, as well as to subdivide into logical classes setting up a classification hierarchy.

On the second task, the student was given a matrix of four squares and a set of shapes. The examiner arranged three shapes on the matrix. Stage I children used perceptual symmetrics of the patterns to complete the matrix; Stage II children showed confusion and error as they moved from using graphic collections to solve two- and three-attribute matrices to using operational solutions; Stage III children were able to complete the matrix by using multiplicative interactions of logical classes. (See Appendix A.)

Reliability and Validity of Test Instruments

The classification tasks were administered following the procedures described in the literature, using concrete sorting to determine stage level (Inhelder & Piaget, 1964). The procedure (see Appendix A) was uniform for all students.

The California Achievement Test subtests included vocabulary and reading comprehension. Reliability and validity data for these subtests are reported in Appendix B. The concurrent validity of the Slossen Intelligence Test is indicated by its high correlation with the Stanford-Binet, as shown in Appendix C.

Administration Procedures

Assessments of the ability to classify on the formulated tasks were administered individually by the Chapter 1 teacher to all students in grades 1 through 4 in one elementary school. The assessments were done initially in fall 1980 and subsequently in spring 1981, 1982, 1983, and 1984 to all students who had not reached the Stage 3 level of classification, indicating the attainment of concrete operations. Each fall, students in grade 1 were assessed as performing at Stage I, Stage II, or Stage III.

California Achievement Test subtests in reading comprehension and vocabulary were administered to all students in grades 1 through 4 in spring 1981; only to students in grades 2 and 4 in spring 1982; and to students in grades 2, 3, and 4 in spring 1983 and 1984. All scores were recorded in grade-equivalent figures for the reading subtests.

The Slossen Intelligence Test was administered individually to all students in grades 1 through 4 in fall 1980 by the Chapter 1 teacher. An intelligence quotient was recorded for each student, using the standard formula.

The data collected on the classification tasks and the Slossen Intelligence Test were used for prescriptive purposes for the Chapter 1 instructional program. The data from the California Achievement Tests were collected as part of the district-wide achievement testing that is conducted each spring.

Data-Analysis Procedures

The data were analyzed using the Pearson product-moment correlation coefficient (Hypotheses 1, 3, 5, 8, and 9), group comparisons with t-tests (Hypotheses 2 and 10), multiple linear regression (Hypotheses 3, 6, and 7), and Z-scores (Hypothesis 11).

The Pearson product-moment correlation method was used to analyze the correlations between the ability to classify and reading-comprehension scores, IQ, grade level, and sex. This technique was also used to analyze the correlation between IQ and grade when Stage III of the ability to classify was attained.

Group means were analyzed using t-tests for differences between males and females in terms of classification skills. The t-test was also used to analyze the difference in grade level mean scores for ability to classify. An analysis of the differences in mean reading-comprehension scores in subsequent grades for students who attained Stage III in the ability to classify also used the t-test.

Multiple linear regression was used to analyze the correlation between the ability to classify and reading comprehension across all grade levels. This technique was also used to analyze the use of IQ or ability to classify to predict reading comprehension.

Z-scores were used to analyze the difference in reading gain scores between classification-stage gains.

Summary

The research methodology of the study was correlative. Theoretical relationships were postulated using the ability to classify as the independent variable and level of reading comprehension, IQ, sex, and grade as the dependent variables. The data collected in the study were generated by students' scores on Piagetian classification tasks, the California Achievement Test reading comprehension and vocabulary subtests, and the Slossen Intelligence Test. Data were analyzed using the Pearson product-moment correlation technique, t-tests, multiple linear regression, and Z-scores. The findings of the data analysis are reported in Chapter IV.

CHAPTER IV

FINDINGS

Introduction

The data collected through the research instruments are reported and analyzed in this chapter. The results of the hypothesis testing are also reported. Other findings that enhance the exploratory nature of the study are discussed. Finally, the findings are summarized.

The purpose of this study was to explore whether children who classify at a higher level are also able to comprehend reading passages at higher levels than their peers who have higher intelligence quotients. The investigator examined the relationship between the independent variable of ability to classify and the dependent variables of reading comprehension, IQ, grade, sex, and grade of attainment of a Stage III in classification. Piagetian tasks of concrete classification, the Slossen Intelligence Test, and the California Achievement Test reading comprehension and vocabulary subtests were administered to 212 students in grades 1 through 4 in one elementary school.

Reading comprehension was defined as the level of performance in grade-equivalent units on reading passages in the California Achievement Test reading comprehension and vocabulary subtests.

Ability to classify was defined as the ability to form classes by attributes into more and more complex class-inclusion structures. IQ was defined as the intelligence quotient derived from an individual's responses on the Slossen Intelligence Test, using the standard CA/MA = IQ formula.

Results of Hypothesis Testing

Eleven research hypotheses, cited in Chapter III, guided the collection of data in the study. To test the hypotheses, the Pearson product-moment correlation, t-test, F-test, multiple linear regression, and analyses of variance and significance were used. The analyses used in testing each hypothesis are specified in the narrative for each hypothesis. The dependent variables included reading comprehension, IQ, sex, grade, and grade of attainment of a Stage III in classification. The independent variable was the ability to classify.

Hypothesis 1

> There is no significant correlation between the ability to classify and reading comprehension at any grade level.

The results of the two-tailed test of correlation of the variables were significant for grades 1 ($p < .02$), 2 ($p < .01$ in comprehension and $p < .05$ in vocabulary), and 3 ($p < .001$ in comprehension and $p < .05$ in vocabulary) but were not significant for grade 4, lending support to rejection of the null hypothesis for grades 1, 2, and 3 and to retention of the null hypothesis for grade 5. The results are shown in Table 1.

Table 1.--Correlation of ability to classify and reading comprehension.

	Comp.	Vocab.	p	N
Grade 1	.324	.381	.05	48
Grade 2	.419		.01	50
		.314	.05	
Grade 3	.483		.001	54
		.330	.05	
Grade 4	.260	.237		54

Analysis of the data showed the highest correlation (.483) in grade 3 between those who could classify at a higher level and those who scored higher on the reading comprehension subtest. In grade 1, the reading comprehension and vocabulary subtests yielded equal correlations of .337. Neither the comprehension nor the vocabulary subtest correlated significantly in grade 4. It was concluded that the ability to classify was significantly correlated with the level of reading comprehension in grades 1, 2, and 3, but was not significantly correlated in grade 4.

Hypothesis 2

> There is no significant correlation between the ability to classify and the level of reading comprehension across all grade levels.

The correlation of regression coefficients indicated a correlation of .4988 ($p < .01$) between the ability to classify and the level of performance on the reading comprehension subtest and a correlation of .5006 ($p < .01$) between the ability to classify and performance on the vocabulary subtest. The mean scores for the ability to classify and reading comprehension and vocabulary are shown in Table 2. The null hypothesis was rejected because there was a statistically significant correlation between the ability to classify and the level of reading comprehension at the $p < .01$ level.

Table 2.--Mean scores for ability to classify and reading comprehension and vocabulary subtests.

Subtest	Mean	N
Reading comprehension	38.66	212
Vocabulary	38.92	212

<u>Hypothesis 3</u>

> There are no significant differences in grade level mean scores for the ability to classify between grades 1 and 2, 2 and 3, or 3 and 4.

The analysis of variance on two-tailed tests between grade level mean scores for significant differences yielded a t-value of -4.0849 ($p < .01$) between grades 1 and 2, a t-value of -2.2102 ($p < .02$) between grades 2 and 3, and a t-value of .5453 ($p > .05$) between grades 3 and 4. The assumption of homogeneity of variance was upheld on all analyses by the usual pooled-variance t-test. The differences between grades 1 and 2 and between grades 2 and 3 were statistically significant. The differences between grades 3 and 4 were not statistically significant. The means and F-test statistics are shown in Table 3.

Table 3.--Means and F-test statistics for Hypothesis 3.

Grade	Mean	Difference	t	Variance	F	p	N
1	1.4167			.4184			48
2	1.9808	.5641	-4.0849	.5290	1.2643	.4180	52
3	2.2857	.3049	-2.2102	.4987	-1.0608	.8281	56
4	2.2143	.0714	.5453	.4623	1.0786	.7798	56

There was a statistically significant difference between grades 1 and 2 and between grades 2 and 3, which led to rejection of the null hypothesis for these grades. The null hypothesis was retained for grades 3 and 4 as no statistically significant difference between those grades was found from the data analysis.

Hypothesis 4

> There is no significant difference between the correlation of mean reading comprehension scores and the ability to classify in any grade.

In comparing the correlation of the grades, only one significant difference ($p < .01$), for grades 3 and 4 ($Z = 1.678$), was found. Table 4 shows the means for grades 1 through 4. Table 5 shows the Z-scores for grade comparisons. The null hypothesis was retained for grade differences in grades 1 and 2, 1 and 3, 1 and 4, 2 and 3, and 2 and 4; it was rejected for grades 3 and 4, where there was a statistically significant difference between the correlation of reading comprehension and the ability to classify.

Table 4.--Means for reading comprehension differences by grade.

Grade	Mean	N
1	.337	48
2	.326	50
3	.474	54
4	.187	54

Table 5.--Grade differences in reading comprehension means.

Grades	Z-Score
1 & 2	.059
1 & 3	-.811
1 & 4	.796
2 & 3	-.892
2 & 4	.752
3 & 4	1.678*

*p < .01.

<u>Hypothesis 5</u>

> There is no significant difference in the mean reading comprehension scores in subsequent grades for students who achieve a Stage III classification in the ability to classify.

The analysis of students' reading scores one year and two years after achieving a Stage III classification in ability to classify yielded a t-score of -2.73 ($p < .01$). Table 6 shows the mean scores for reading comprehension. There was a statistically significant difference between mean reading scores one year and two years after attaining a Stage III classification, which led to rejection of the null hypothesis.

Table 6.--Stage III and reading comprehension: one and two years.

	Stage III & 1 yr.	Stage III & 2 yrs.	t	p	N
Reading comprehension	38.22	49.27	-2.73	.01	22

The analysis of students' reading scores two years and three years after achieving a Stage III in ability to classify yielded a t-score of -1.28, which was not statistically significant. Table 7 shows the mean scores for reading comprehension. There was no statistically significant difference in reading scores two years and three years after attaining a Stage III; therefore, the null hypothesis was retained for those years.

Table 7.--Stage III and reading comprehension: two and three years.

	Stage III & 2 yrs.	Stage III & 3 yrs.	t	p	N
Reading comprehension	49.27	56.93	-1.28	.213	14

Hypothesis 6

> There is no significant difference in reading gain scores and classification stage gains.

Analysis of Z-scores showed no significant difference in reading comprehension gain scores for stage gains from Stage I-II, Stage II-III, and Stage I-III. The Z-score for stage gains from Stage I-III was -.1656 (p = .869), for stage gains from II-III the Z-score was .8842 (p = .377), and for Stage I-II the Z-score was -.7497 (p = .454). Table 8 shows means for the classification stage gains.

Table 8.--Means for classification stage gains and reading comprehension gains.

Stage Gains	Mean	N
I-II	16.69	13
II-III	17.10	19
I-III	18.44	7

Hypothesis 7

> There is no significant difference between male and female students across all grades on their ability to classify.

The result of the analysis of variance yielded a t-score of -1.36, which was not statistically significant at the .05 level (p = .175). The null hypothesis was retained because there was no statistically significant differences between males and females in terms of their ability to classify across all grade levels. The means for male and female students are shown in Table 9. Analysis of the means showed no trends. Therefore, it was concluded that sex had no effect on the ability to classify.

Table 9.--Means for male and female students.

Sex	Mean	N
Male	1.9729	111
Female	2.0693	101

Hypothesis 8

> There is no significant correlation among classification ability, grade level, reading comprehension, IQ, and sex.

The analysis of the regression coefficient matrix showed statistically significant correlations ($p < .01$) among classification ability, comprehension level, and grade level. No significant correlations were found among classification ability, IQ, and sex nor among grade, IQ, and sex. The matrix means are shown in Table 10. The correlation coefficients are shown in Table 11.

The null hypothesis was retained by the data analysis for the correlations among the variables of ability to classify, IQ, and sex; among grade, IQ, and sex; and among sex, reading comprehension, and IQ. The null hypothesis was rejected for the variables of ability to classify, level of reading comprehension, and grade level, which were statistically significantly correlated at the $p < .01$ level.

Table 10.--Means for classification ability, IQ, reading comprehension subtest, vocabulary subtest, sex, and grade.

	Mean	N
Classification ability	1.99524	212
IQ	110.60306	212
Comprehension subtest	38.66000	212
Vocabulary subtest	38.92000	212
Sex	1.47637	212
Grade	2.56598	212

Table 11.--Relationships among ability to classify, IQ, sex, and grade.

	Ability to Classify	IQ	Sex
IQ	.1195		
Comprehension subtest	.5013	.1627	.0890
Vocabulary subtest	.4728	.1383	.0198
Sex	.0927	-.0013	
Grade	.3834	-.1653	-.0014

<u>Hypothesis 9</u>

There is no significant correlation between IQ and the grade when a Stage III in classification occurred.

The two-tailed test resulted in a correlation of -.088 and was not statistically significant at the $p < .05$ level. The means for the grade when a Stage III in classification occurred and IQ are shown in Table 12. The null hypothesis was retained because no statistically significant correlation between IQ and grade when a Stage III in classification occurred was found from the data analysis.

Table 12.--Means for grade when a Stage III in classification occurred and IQ.

	Mean	N
IQ	117.200	86
Grade	1.394	86

<u>Hypothesis 10</u>

There is no significant prediction of the level of reading comprehension by the ability to classify.

The multiple linear regression analysis yielded an F-ratio of 69.570, which was statistically significant at the $p < .01$ level. About 25% (24.88%) of the variance in level of reading comprehension was explained by the ability to classify. (See Table 13.) The null hypothesis of no significant prediction of level of reading comprehension by ability to classify was therefore rejected by the data analysis.

Table 13.--Prediction of reading comprehension by ability to classify.

	Multiple R	Multiple R^2	F-Ratio	p
Classification	.4988	.2488	69.570	.0000

Hypothesis 11

There is no significant prediction of the level of reading comprehension by IQ.

The multiple linear regression analysis yielded an F-ratio of 5.710, which was statistically significant at the $p < .02$ level. About 3% (2.65%) of the variance in the level of reading comprehension was explained by the IQ. (See Table 14.) Hence the null hypothesis of no significant prediction of the level of reading comprehension by IQ was rejected.

Table 14.--Prediction of reading comprehension by IQ.

	Multiple R	Multiple R^2	F-Ratio	p
IQ	.1627	.0265	5.710	.01775

Summary

The results of the data analysis were reported in this chapter. The 11 null hypotheses were analyzed, and conclusions regarding whether the hypotheses were retained or rejected were presented. A summary of the results concerning each hypothesis follows.

Hypothesis 1: There was a statistically significant correlation between the ability to classify and reading comprehension in grades 1, 2, and 3. There was not a statistically significant correlation in grade 4.

Hypothesis 2: There was a statistically significant correlation between classification ability and level of reading comprehension across all grade levels.

Hypothesis 3: Differences in mean scores for the ability to classify between students in grades 1 and 2, and between students in grades 2 and 3, were statistically significant. Differences in mean scores between students in grades 3 and 4 were not statistically significant.

Hypothesis 4: There were no statistically significant differences between reading comprehension and the ability to classify for students in grades 1 and 2, 1 and 3, 1 and 4, 2 and 3, or 2 and 4. There was a statistically significant difference for students in grades 3 and 4.

Hypothesis 5: There was a statistically significant difference in students' reading scores one year and two years after attaining a Stage III in classification. There was not a statistically significant difference in reading scores two and three years after attaining a Stage III in classification.

Hypothesis 6: There were no statistically significant differences in reading gain scores and classification stage gains.

Hypothesis 7: There was no statistically significant difference between male and female students in terms of their ability to classify.

Hypothesis 8: There was no statistically significant correlation among the variables of ability to classify, IQ, and sex;

among grade, IQ, and sex; or among sex, IQ, and reading comprehension. There was a statistically significant correlation among the variables of ability to classify, level of reading comprehension, and grade level.

Hypothesis 9: There was no correlation between IQ and the grade in which a Stage III in classification occurred.

Hypothesis 10: There was a statistically significant prediction of the level of reading comprehension by the ability to classify.

Hypothesis 11: There was a statistically significant prediction of the level of reading comprehension by IQ.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter contains a summary of the investigation and a discussion of the research findings. Conclusions are drawn from the data analysis and relevant research. Implications for further research and curriculum development are suggested.

Summary

The writer investigated whether elementary-school children who can classify at a higher level are also able to comprehend reading passages at a higher level. Also explored was the predictive value of ability to classify and IQ for level of reading comprehension.

It would seem that many children who should be able to read proficiently are unable to do so, and the answer to the question of why they cannot is still not altogether understood. The process by which elementary-school children are able to comprehend meaning from symbols, specifically written language as in reading, is an aspect of cognitive development that needs further study.

This investigation provided data on elementary-school children in grades 1 through 4 over a four-year period. The data are needed for continuing development of a reading model based on theoretical precepts applicable to instruction in the elementary school.

Numerous studies that investigated relationships between cognitive development and reading comprehension were reviewed. Some researchers concluded that there was a relationship between cognitive abilities and reading abilities. IQ was sometimes seen as being of less predictive value for school success than Piagetian cognitive abilities. Research in language development was reviewed as both dependent on and causative of cognitive development. Stages of language development, however, were found to be irreversibly sequential in complexity.

Some authors asserted that conceptual maturation moves from concrete to abstract linguistic responses. Reading could be viewed as an interactive process of thought and language.

The independent variable in this study was the ability to classify. Dependent variables included reading comprehension, IQ, grade, and sex. Results showed that (1) the ability to classify and reading comprehension were correlated, (2) the ability to classify was a better predictor of the level of reading comprehension than was IQ, (3) there was no difference between the classification abilities of males and females, (4) IQ did not relate to the grade of acquisition of Stage III classification skills, and (5) classification skills increased with grade level.

Discussion of Findings

Results of the data analysis were reported in Chapter IV. The hypotheses were designed to answer the research questions as comprehensively and yet as starkly as possible. In this section, interpretations of the findings for each hypothesis are presented.

> Hypothesis 1: There is no correlation between the ability to classify and reading comprehension at any grade level.

The null hypothesis was rejected for grades 1, 2, and 3. No correlation was substantiated for the fourth grade. The highest correlation was for the third grade. Because language development is related to cognitive development, and because reading comprehension is related to facility in language, the correlation between ability to classify and reading comprehension should be higher as the complexity of the reading material increases.

> Hypothesis 2: There is no significant correlation between the ability to classify and reading comprehension across all grade levels.

The results indicated a correlation between the ability to classify and reading comprehension for the population as a whole. Comprehension and vocabulary subtest means varied only slightly. Were it not for the first hypothesis investigating the specific grade-level correlations, the interpretation of the results for this hypothesis could be misleading. However, it is possible that the lack of a correlation at the fourth-grade level was the result of a design limitation. The classification tasks included were purposely limited to concrete sorting and matrix completion using concrete objects. This was done to minimize language responses, which might have interfered with the child's response. When the child had finished manipulating the objects, he was asked how the sorted groups were alike and why he had formed the groups as he had. The initial observed response, however, was the actual manipulation of the objects.

Upon examining the data after all of the information had been collected, it was observed that at the end of third grade, only 15 students out of a population of 56 were not at the highest level the tasks measured (3.0) or in transition from a 2.5 to a 3.0. In fourth grade, 38 of 56 students were already at the 3.0 level or in transition at the 2.5 level. It is possible that there was not a statistically significant correlation in the fourth grade because of the limitations of the score potential for classification tasks. More advanced classification tasks included in a design with allowance for a wider range of scores on classification tasks may yield different results. Although the reading comprehension mean scores continued to be higher from grades 1 through 4, the classification means were nearly identical for grades 3 and 4.

> Hypothesis 3: There is no significant difference in the grade level mean score for the ability to classify between grades 1 and 2, 2 and 3, or 3 and 4.

There was a statistically significant difference in grade level mean scores for the ability to classify between grades 1 and 2 and grades 2 and 3. The classification mean scores increased from grade 1 to grade 3. Between grades 3 and 4 there was no statistically significant difference. This could be attributed to the design limitation already discussed--that the mean classification scores for grades 3 and 4 were nearly the same.

> _Hypothesis 4_: There is no significant difference between the correlation of mean reading comprehension scores and the ability to classify in any grade.

The mean correlation scores for classification and reading comprehension were not significantly different except for grades 3 to 4. This would indicate a correlative increase in classification skills and reading comprehension skills until fourth grade. This could also be attributed to the design limitation discussed above, i.e., that the mean classification scores for grades 3 and 4 were nearly the same. As reading comprehension skills increased and classification scores remained the same, the correlation became insignificant. Thus the mean score difference became significant because of the lack of correlation between classification and reading comprehension in fourth grade.

> _Hypothesis 5_: There is no significant difference in the mean reading comprehension scores in subsequent grades for students who achieve a Stage III classification in the ability to classify.

A statistically significant difference was found between the first-year means and the second-year means in reading comprehension following attainment of Stage III, or a score of 3.0, in classification. No statistically significant difference was found in mean reading scores between the second and third years following attainment of a Stage III in classification. The population for the data collected and analyzed for this hypothesis comprised 14 students, using scores from grades 1 or 2, and 3 and 4. Again, the design limitation for classification being limited to a score of 3.0, which did not allow for differentiation in mean scores for grades 3 and 4, may have contributed to the result of no significant difference being found between the second-and third-year mean scores for a Stage III (score of 3.0) classifier. This finding is consistent with the lack of correlation found in portions of Hypotheses 1, 3, 4, and 9.

> <u>Hypothesis 6</u>: There is no significant difference in reading gain scores and classification stage gains.

The results showed no statistically significant differences between reading gain scores and classification gain scores when a change from Stage I-II, Stage II-III, or Stage I-III occurred within a period of one year. The sample population of this study did not support the anticipation that students who show a change in cognitive stages will also have greater gains in reading comprehension than those who do not change stages within a year.

> <u>Hypothesis 7</u>: There is no significant difference between male and female students across all grades on their ability to classify.

The results showed no statistically significant differences between males and females across all grade levels in terms of their ability to classify. This would indicate that the results for the population of this study are typical of results of previous studies comparing males and females.

> <u>Hypothesis 8</u>: There is no significant correlation among classification ability, grade level, reading comprehension, IQ, and sex.

No statistically significant correlation was found among classification ability, IQ, and sex. None of thee variables showed any relationship to the others. Likewise, no statistically significant correlation was found among grade, IQ, and sex. As there are no research precedents to support a relationship among these variables, the population can be presumed to be typical.

Statistically significant correlations were found among classification ability, level of reading comprehension, and grade level. As these variables had been found to correlate in earlier hypotheses' findings, it would be expected that such a relationship would be observed in this hypothesis, as well.

> Hypothesis 9: There is no significant correlation between IQ and the grade when a Stage III in classification occurred.

No correlation was found between IQ and grade level of attainment of a Stage III (score of 3.0) in classification. Although it might be anticipated that students with higher IQ's would be earlier Stage III classifiers than their counterparts with lower IQ's, there was no evidence in the data to support this assumption.

> Hypothesis 10: There is no significant prediction of the level of reading comprehension by the ability to classify.

Ability to classify was found to have significant predictive value for the level of reading comprehension. Almost 25% of the variance in the level of reading comprehension was explained by the ability to classify. This would indicate that elementary-school students' ability to classify is related to their reading comprehension.

> Hypothesis 11: There is no significant prediction of the level of reading comprehension by IQ.

IQ was found to have significant predictive value for the level of reading comprehension. About 3% of the variance in level of reading comprehension was explained by IQ.

The percentage of explanation of variance in the prediction of level of reading comprehension was greater for the ability to classify than for IQ. One might speculate that the ability to classify, regardless of IQ, may be a cognitive ability of greater importance for reading than IQ. Is the ability to classify one of the cognitive schemes on which some researchers believe language depends, which in turn facilitates the process of reading comprehension? This study was not experimental and therefore cannot answer the question, but the results of testing these hypotheses indicate a need for further investigation in this area.

Conclusions

Based on the findings of the study and in answer to the research questions, the following conclusions were drawn.

1. There was a correlation between students who were better classifiers and those who read at a higher level in grades 1, 2, and 3. Scores in grade 4 did not correlate significantly. Possibly the design limited a differentiation for fourth graders' classification skills.

2. Across the entire study population, better classifying skills were correlated with higher reading comprehension scores.

3. Grade level mean scores for classification skills were higher in grade 2 than in grade 1, and were higher in grade 3 than in grades 2 or 1. The grade 4 mean score for classifying skills was almost the same as that of grade 3. Again, the study design may have been inadequate to measure fourth graders' classification skills.

4. In grades 1, 2, and 3, the relationship between classification skills and level of reading comprehension was similar. In grade 4 the relationship between classification skills and level of reading comprehension was dissimilar to that for grades 1, 2, and 3.

5. Two years after students' attaining a Stage III in classification skills, reading scores were significantly higher than one year after students' attaining a Stage III. Three years after attaining a Stage III in classification skills, the mean score for reading comprehension was not significantly higher. Apparently there was greater growth in reading skills during the first two years than during the third year. However, since the population for the third year after attaining a Stage III was students in fourth grade, the design limitation for classification should be considered as possibly having contributed to the results.

6. Students who grew from a Stage 1-II, Stage II-III, or Stage I-III in classification skills within a year did not make greater gains in reading comprehension that year than did other students.

7. Boys and girls had similar classification abilities across all grade levels.

8. Better classifying skills were related to higher reading levels but were not correlated with higher or lower IQ's. There was no relationship between IQ and ability to classify or level of reading comprehension.

9. The grade when students attained a Stage III in classification was not related to their IQ's.

10. Twenty-five percent of the variance in the level of reading comprehension was explained by classification skills. Three percent of the variance in the level of reading comprehension was explained by IQ. Therefore, the ability to classify was a better predictor of the variance in reading level than was IQ.

Implications of the Findings

The purpose of this study was to inquire into the relationship between the ability to perform concrete classification tasks, intelligence quotient, and the level of reading comprehension. The ability to classify at a higher level did correlate with the ability to read at a higher level. The correlations were not high enough to indicate the need for an experimental study to determine cause and effect. The results did indicate, however, that the ability to classify was present to some extent for good readers and lacking to some extent for poorer readers. The correlation did become stronger for students in third grade. As the fourth-grade mean for classification ability was so similar to the third-grade mean, the possibility of a design limitation emerged. What would the relationship be in grade 4, given classification tasks that differentiate from the skills that appear already to be prevalent in third grade, using the concrete sorting tasks of this study? A study investigating classification tasks that are not limited to concrete sorting would provide more information regarding the relationship between the ability to classify and level of reading comprehension for older elementary-school students.

The mean scores for the year following the acquisition of a Stage III in classification, indicating entrance into the concrete-operation stage, were significantly lower than those for the second year after acquiring concrete operations, indicating the students did continue to advance their level of reading comprehension. The third year after attaining concrete operations, or Stage III, the mean was not significantly higher. A design limitation due to the mean similarity of the ability to classify in grades 3 and 4 is again suggested. The data analysis did not include comparison of actual grade equivalent scores for the groups. A follow-up study analyzing the actual score variance could provide additional information with regard to the levels of performance relative to the groups found to correlate, or not to correlate, in this study.

Among the variables investigated, IQ did not show a correlation with either ability to classify or level of reading comprehension. This finding conflicts with some previous research findings but supports the theory that measures of cognitive development and IQ are not one and the same. Since IQ is frequently considered the predictor of reading expectations for students, the findings of this study suggest that the ability to classify should also be considered in making such predictions. Although IQ was a significant predictor for 3% of the variance, the ability to classify predicted 25% of the variance in the level of reading comprehension. Is the ability to classify a developmental correlate of learning to read more comprehensively? The findings of this study indicate that in some instances it is, and that IQ was not a significant correlate. Classification was selected for this investigation to isolate only one of the capabilities Piaget included in his stages of cognitive development. Given the lesser value of IQ as a predictor, the role of classification needs to be investigated further as it relates to reading and language.

Linguistic awareness is considered to be more fully developed than linguistic manipulation for meaning. Chomsky (1972) found IQ to be positively related to linguistic development across all stages of language development. If reading is presumed to be a language-based skill that depends on cognitive development, the findings of this study both support and cast some doubt on the assumption. An investigation of the relationship among classification ability, IQ, and language development could provide additional data concerning both the theory behind the development of a reading model and implications for curriculum and instruction.

Concerning curriculum and instruction, this study indicated that opportunities for developing classification abilities may enable some students to become better readers, regardless of IQ. IQ did not, in this study, correlate with either the ability to classify or the level of reading. There was, however, a relationship between better classifiers and better readers.

There is a need for further research into the relationship between language, cognitive development, IQ, and reading that would provide more precise answers for theory development, curriculum design, and instructional planning at the elementary-school level.

APPENDICES

APPENDIX A

CLASSIFICATION TASKS

Reliability and Validity

The tasks and procedures used in this study are described in _The Early Growth of Logic in the Child_ by Barbel Inhelder and Jean Piaget. The specific task cards used are included in materials copyrighted by Alpha II, Inc.

The following table shows the grades the students were tested and the number of students scoring in each stage for the years 1981, 1982, 1983, and 1984.

Grade Level	Stage Scores I	II	III	N
		Spring 1981		
1	27	18	2	47
2	22	28	12	51
3	6	27	23	56
4	9	28	20	57
		Spring 1982		
1	19	27	3	49
2	8	20	16	44
3	1	17	26	44
4	0	16	36	52
		Spring 1983		
1	12	47	9	68
2	1	26	22	49
3	2	17	22	41
4	0	9	32	41
		Spring 1984		
1	27	27	6	60
2	6	20	15	41
3	5	6	29	40
4	0	12	35	47

PRE/POST ASSESSMENT 5: CLASSIFICATION--SHAPES AND OBJECTS

Objective: Given a set of 3 small triangles, 3 large triangles, 3 small circles, 3 large circles, 3 small squares, and 3 large squares, the student will be able to classify the shapes according to color and shape.

Vocabulary

triangle(s)	blue
square(s)	yellow
circle(s)	large
size	small
shape	alike
color	same
red	different

Manipulatives

From the Logical Blocks:
3 small triangles*
3 large triangles*
3 small squares*
3 large squares*
3 large circles*
3 large circles*
*1 red, 1 blue, 1 yellow

ACTIVITY

Place the shapes on a flat surface in front of a small group of children. Say, "Put the objects together that are alike." (Possible groupings: circles together, triangles together, small squares in one group, all red shapes together, etc.)

1. "Why did you put these together?"
2. "Is there another way you might put them together?"

SCORE

STAGE I	STAGE II	STAGE III
Child will allow perceptual attributes to be in control as he sorts the objects. The objects are sorted on some basis of similarity, but the basis will change as he sorts. Will form "graphic collections" not based on logical classes.	Child will be able to sort or arrange by one property (color, or size, or shape).	Child will be able to arrange into basic classes, and then re-arrange (sort) by another criterion. Can also subdivide classes into logical classes. Can set up a classification hierarchy.

PRE/POST ASSESSMENT 7: CLASSIFICATION--MATRIX

Objective: Given a board divided into four equal spaces, three spaces which contain blocks, the student will be able to determine from the vertical and horizontal attributes of the three given blocks what the empty space should contain.

Vocabulary

block(s)	one
shape	two
color	three
down	four
across	missing
size	alike
use	large
matrix	small
next	

Manipulatives

Board divided into four squares.

Logical Blocks

ACTIVITY

Place the board with four empty spaces in front of the child. From the Logical Blocks use:

- 1 large blue circle
- 1 large red circle
- 1 small blue triangle
- 1 small red triangle
- 1 small yellow rectangle
- 1 large yellow circle

Place three blocks on the board as shown below.

Give the remaining blocks to the child. Say:

1. "How are the blocks in Box 1 and Box 3 alike?" Response: same color.
2. "How are blocks in Box 3 and Box 4 alike?" Response: same shape.
3. "We are going to put these blocks together to form what is called a matrix. This means that boxes across the top and the bottom (point to these) will be alike in the same way."
4. "The boxes up and down will be alike in the same way." Point to the up and down boxes.
5. "Can you find the missing shape?""

SCORE

STAGE I	STAGE II	STAGE III
Youngest children (4 & 5) can find the correct missing element but are using perceptual insight or spatial form instead of making conceptual transformations. They simply look at the symmetrics of the patterns.	Less success for these children (6 & 7) for they are moving from graphic collections for solving two and three attribute matrices to operational solutions. Their initial attempts may show confusion and trial and error.	Older children (8 & 9) reach the concrete operations stage and understand the importance of multiplicative interactions. The logical multiplication of classes is more evident.)

APPENDIX B

STATISTICAL DATA RELATED TO VALIDITY OF THE CALIFORNIA ACHIEVEMENT TEST

Statistical Data Related to Validity of the California Achievement Test

According to the California Test Bureau,

> The validity of CAT C and D was established during the process of test development. . . . Tables 9-19 present intercorrelation coefficients and related summary data for the normed section of Levels 1-19 of CAT/C in combination with appropriate levels of SFTAA for Grades 2-12. The related data (means and standard deviations) are expressed in scale score units and were produced from the total standardization sample.

Table 10

Level 13, CAT/C—Level 2, SFTAA
Grade 3 N = 1,357

	[illegible]	4	5	6	7	8	9	10	11	12	13	14	15	16	VARIABLE	MEAN	SD
[illegible]	[illegible]	69	87	60	57	69	70	52	67	65	80	67	53	69	1 Phonic Analysis	394	51.4
	[illegible]	[illegible]	78	51	54	61	64	52	63	63	74	58	48	61	2 Structural Analysis	380	51.9
		75	86	57	61	73	74	53	72	69	82	73	54	73	3 Reading Vocabulary	396	47.1
			90	60	63	76	77	54	74	71	85	76	56	76	4 Reading Comprehension	410	52.4
				67	68	80	83	60	80	77	93	80	61	81	5 TOTAL READING	387	51.2
					54	59	63	48	58	.58	.72	.57	42	57	6 Spelling	426	67.1
						61	89	56	65	66	77	.58	52	62	7 Language Mechanics	445	48.5
							89	53	72	69	84	.73	.56	.74	8 Language Expression	438	55.4
								60	75	75	89	73	.59	.75	9 TOTAL LANGUAGE	426	54.3
									69	89	78	50	50	.56	10 Mathematics Computation	339	35.2
										93	90	72	64	77	11 Mathematics Concepts and Applications	397	41.8
											93	.67	63	73	12 TOTAL MATHEMATICS	371	32.2
												79	66	.82	13 TOTAL BATTERY	378	37.1
															SFTAA		
													57	.91	14 Language IQ	102	14.0
														.85	15 Nonlanguage IQ	104	13.7
															16 TOTAL IQ	103	13.5

Table 11

Level 14, CAT/C—Level 2, SFTAA
Grade 4 N = 1,493

	[illegible]	4	5	6	7	8	9	10	11	12	13	14	15	VARIABLE	MEAN	SD
[illegible]	[illegible]	57	63	.73	.75	.56	71	.69	.86	.70	.79	.57	76	1 Reading Vocabulary	443	48.7
	[illegible]	[illegible]	63	76	.77	.59	.73	71	.87	.72	.75	.57	.74	2 Reading Comprehension	452	57.0
		[illegible]	66	78	80	60	75	73	91	74	.80	.59	.79	3 TOTAL READING	438	54.0
			54	54	59	.46	.53	53	.67	.48	.52	.41	.53	4 Spelling	477	70.6
				67	.88	.58	.68	.67	.79	.65	.61	.57	.66	5 Language Mechanics	488	50.4
					.93	.60	.72	.71	.86	.72	.71	.58	.72	6 Language Expression	481	54.4
						65	.76	.75	.91	.75	.73	.63	.76	7 TOTAL LANGUAGE	474	53.2
							76	.92	.80	.61	54	61	64	8 Mathematics Computation	402	41.0
								.95	90	75	.69	.67	.76	9 Mathematics Concepts and Applications	437	42.8
									91	73	66	69	.75	10 TOTAL MATHEMATICS	419	38.0
										80	79	69	83	11 TOTAL BATTERY	429	42.4
											.68	.60	71	12 Reference Skills	467	54.5
														SFTAA		
												.62	91	13 Language IQ	102	14.2
													.88	14 Nonlanguage IQ	104	14.6
														15 TOTAL IQ	103	14.2

TEST—RETEST RELIABILITY COEFFICIENTS AND RELATED DATA (IN SCALE SCORE UNITS) FOR CAT/C FROM TWO ADMINISTRATIONS AT AN INTERVAL OF TWO-TO-THREE WEEKS

Table 92

Level 12, Grade 2

NORMED SECTION	N	TEST		r	RETEST	
		Mean	SD		Mean	SD
Phonic Analysis	292	338	43.7	.80	340	46.0
Structural Analysis	289	329	44.2	.50	328	50.1
Reading Vocabulary	288	343	42.9	.78	347	43.6
Reading Comprehension	284	349	48.3	73	360	46.3
TOTAL READING	276	322	45.5	.89	329	46.7
Spelling	288	367	55.3	.67	366	52.9
Language Mechanics	286	403	38.5	.79	409	43.0
Language Expression	283	379	51.7	.77	385	53.6
TOTAL LANGUAGE	283	364	48.4	.84	372	51.2
Mathematics Computation	286	289	29.7	.69	293	28.7
Mathematics Concepts and Applications	291	344	33.0	80	351	32.2
TOTAL MATHEMATICS	285	327	24.5	.85	332	23.8
TOTAL BATTERY	259	327	30.3	.93	332	30.4

ALTERNATE FORM RELIABILITY COEFFICIENTS AND RELATED DATA (IN SCALE SCORE UNITS) FOR CAT C AND D FROM TWO ADMINISTRATIONS AT AN INTERVAL OF TWO-TO-THREE WEEKS

Table 93

Level 13, Grade 3

NORMED SECTION	N	FORM C		r	FORM D	
		Mean	SD		Mean	SD
Phonic Analysis	316	386	51.5	.78	392	52.2
Structural Analysis	315	382	48.8	.59	388	47.2
Reading Vocabulary	315	393	46.3	.71	401	44.8
Reading Comprehension	310	405	47.5	.78	404	50.9
TOTAL READING	303	382	47.4	.89	387	49.3
Spelling	314	433	68.7	.71	427	67.7
Language Mechanics	313	451	50.1	.76	451	50.6
Language Expression	318	437	50.1	.74	435	51.7
TOTAL LANGUAGE	310	429	51.3	.83	428	51.1
Mathematics Computation	312	337	30.8	.76	341	33.2
Mathematics Concepts and Applications	307	392	33.8	.83	393	35.5
TOTAL MATHEMATICS	304	369	26.1	86	372	27.9
TOTAL BATTERY	284	377	30.2	92	380	32.9

ALTERNATE FORM RELIABILITY COEFFICIENTS AND RELATED DATA (IN SCALE SCORE UNITS) FOR CAT C AND D FROM TWO ADMINISTRATIONS AT AN INTERVAL OF TWO-TO-THREE WEEKS

Table 94

Level 14, Grade 4

NORMED SECTION	N	FORM C Mean	FORM C SD	r	FORM D Mean	FORM D SD
Reading Vocabulary	278	425	52.8	.77	428	56.2
Reading Comprehension	280	431	59.2	.80	428	54.8
TOTAL READING	278	417	57.0	.84	416	56.9
Spelling	283	461	71.7	59	452	63.6
Language Mechanics	281	471	56.4	.76	467	51.5
Language Expression	283	461	61.5	.79	457	58.2
TOTAL LANGUAGE	277	454	58.3	.85	450	55.6
Mathematics Computation	280	382	39.6	.70	377	38.6
Mathematics Concepts and Applications	278	416	45.0	.83	417	43.9
TOTAL MATHEMATICS	272	400	38.9	.83	399	37.4
TOTAL BATTERY	256	410	44.8	.90	407	43.6
Reference Skills	281	442	58.7	.76	442	56.9

Table 95

Level 15, Grade 5

NORMED SECTION	N	FORM C Mean	FORM C SD	r	FORM D Mean	FORM D SD
Reading Vocabulary	310	455	53.5	.77	455	53.3
Reading Comprehension	310	463	61.1	.81	465	66.2
TOTAL READING	309	451	56.9	.87	452	59.4
Spelling	313	487	68.5	.73	486	72.5
Language Mechanics	305	506	52.3	.78	509	57.5
Language Expression	304	486	57.9	.79	483	56.4
TOTAL LANGUAGE	301	485	55.0	.85	486	57.9
Mathematics Computation	311	432	46.1	.75	430	47.5
Mathematics Concepts and Applications	305	452	39.6	.83	453	45.9
TOTAL MATHEMATICS	301	442	37.7	.87	442	42.0
TOTAL BATTERY	279	446	43.1	.94	447	46.1
Reference Skills	303	478	58.2	.74	477	59.3

TEST—RETEST RELIABILITY COEFFICIENTS AND RELATED DATA FOR CAT/C CATEGORY OBJECTIVES (IN RAW SCORE UNITS) AND DERIVED OBJECTIVES MASTERY SCORES FROM TWO ADMINISTRATIONS AT AN INTERVAL OF TWO-TO-THREE WEEKS

Table 2

Level 10, Grade K

	RAW SCORES						DERIVED OBJECTIVES MASTERY SCORES				
	Test			Retest			Test			Retest	
TEST/CATEGORY OBJECTIVE	Mean	SD	r	Mean	SD	N	Mean	SD	r	Mean	SD
TEST 1 LISTENING FOR INFORMATION											
1 School Vocabulary	4.98	1.66	.58	5.50	1.57	286	.68	.21	.69	.75	.20
2 Space/Direction/Location	3.31	1.22	.57	3.60	1.11	286	.68	.21	.69	.75	.20
3 Relationships—Facts/Concepts	2.66	1.17	.54	2.86	1.12	285	.68	.21	.70	.74	.20
TEST 2 LETTER FORMS											
4 Match Uppercase/Lowercase	10.44	4.88	.84	11.06	4.85	271	.58	.27	.84	.61	.27
TEST 3 LETTER NAMES											
5 Recognize Uppercase/Lowercase	14.04	4.92	.83	14.50	4.70	281	.74	.26	.83	.76	.25
TEST 4 LETTER SOUNDS											
6 Long Vowels	2.54	1.22	.62	2.71	1.23	272	.54	.23	.74	.57	.23
7 Short Vowels	1.98	1.25	.51	2.10	1.28	261	.46	.22	.78	.49	.21
8 Single Consonants	5.41	3.11	.78	5.72	2.98	278	.47	.22	.80	.50	.22
TEST 5 VISUAL DISCRIMINATION											
9 Match Shapes	4.91	2.20	.77	5.51	2.06	275	.61	.26	.81	.68	.27
10 Match 3-Letter Words	3.73	2.08	.72	4.20	2.08	272	.58	.27	.80	.65	.28
11 Match 5/6-Letter Words	1.50	1.26	.62	1.91	1.39	256	.42	.23	.73	.50	.25
TEST 6 SOUND MATCHING											
12 Identical Words	7.11	2.22	.47	7.48	2.10	280	.78	.24	.50	.83	.23
13 Medial Short Vowels	2.62	1.33	.50	3.02	1.20	278	.70	.25	69	.77	.24
14 Initial Consonants	2.54	1.48	.50	2.92	1.39	278	.69	.26	.67	.77	.25
15 Final Consonants	3.27	1.72	.54	3.73	1.57	279	.70	.25	.69	.77	.24
16 Consonant Clusters/Digraphs	4.07	1.93	.61	4.56	1.74	278	.70	.25	.70	.78	.24
TEST 7 MATHEMATICS CONCEPTS AND APPLICATIONS											
73 Numeration	3.76	1.39	.49	4.04	1.41	277	.51	.17	68	.56	.16
75 Number and Set Theory	2.11	1.23	.54	2.32	1.17	277	.51	.17	.69	.55	.17
76 Number Sentences	1.70	.94	.17	1.68	.98	262	.51	.16	.69	.55	.16
80 Common Scales	3.02	1.18	.52	3.08	1.11	277	.50	16	.63	.53	.15
88 Story Problems	2.55	1.50	.59	3.12	1.51	278	.48	.18	.69	.54	.17

Table 4

Level 12, Grade 2

TEST CATEGORY OBJECTIVE	RAW SCORES						DERIVED OBJECTIVES MASTERY SCORES				
	Test			Retest			Test			Retest	
	Mean	SD	r	Mean	SD	N	Mean	SD	r	Mean	SD
TEST 1 PHONIC ANALYSIS											
20 Variant Single Consonants	3.46	1.31	.69	3.51	1.36	290	.59	.21	.83	.61	.22
21 Consonant Clusters/Digraphs	4.32	1.06	.56	4.29	1.08	290	.71	.19	.76	.72	.19
23 Long Vowels/Vowel Combinations	3.78	2.55	.69	3.87	2.66	287	.53	.22	.81	.55	.23
24 Short Vowels/Vowel Combinations	2.35	1.76	.69	2.49	1.84	286	.54	.22	.82	.55	.23
TEST 2 STRUCTURAL ANALYSIS											
28 Compound Words/Syllables/Contractions	3.72	1.39	.51	3.74	1.48	289	.59	.21	.54	.59	.22
29 Base Words/Affixes	1.98	1.25	.43	2.01	1.31	281	.44	.22	.46	.44	.23
TEST 3 READING VOCABULARY											
32 Same Meaning	4.18	2.45	.74	4.36	2.53	288	.55	.29	.84	.58	.29
33 Opposite Meaning	4.10	2.19	.80	4.37	2.14	287	.56	.29	.86	.59	.28
TEST 4 READING COMPREHENSION											
36 Recall of Facts	2.85	1.75	.67	3.11	1.85	284	.46	.27	.82	.51	.26
38 Inferred Meaning	3.28	2.28	.69	3.83	2.16	284	.46	.27	.82	.51	.26
39 Character Analysis	3.01	1.90	.76	3.33	1.83	284	.46	.27	.82	.51	.26
TEST 5 SPELLING											
44 Consonant Phonemes/Graphemes	3.46	1.33	.58	3.44	1.25	288	.69	.17	.69	.68	.16
45 Vowel Phonemes/Graphemes	2.65	1.15	.55	2.70	1.11	288	.69	.17	.69	.68	.16
46 Morphemic Units	1.93	1.16	.41	1.77	1.14	288	.51	27	.41	.47	.26
TEST 6 LANGUAGE MECHANICS											
47 I/Proper Nouns	2.17	1.20	.56	2.26	1.16	284	.56	.23	.68	.58	.23
49 Beginning Words	3.06	1.30	.62	3.02	1.29	284	.68	.25	.72	.69	.25
51 End Marks	3.14	1.06	.57	3.21	1.09	282	.69	.21	.70	.71	.22
53 Comma	1.40	1.35	.50	1.70	1.50	281	.33	.24	.52	.38	.27
TEST 7 LANGUAGE EXPRESSION											
56 Irregular Nouns/Verbs	3.42	1.26	.44	3.48	1.27	283	.67	.20	.78	.69	.21
57 Pronouns	3.80	1.22	.58	3.91	1.17	283	.68	.20	.78	.70	.21
58 Verbs	3.01	1.36	.55	3.14	1.39	282	.67	.20	.79	.69	.21
59 Adjectives	3.19	1.33	.59	3.36	1.29	283	.67	.20	.78	.69	.21
TEST 8 MATHEMATICS COMPUTATION											
69 Addition	5.83	2.34	.59	6.22	2.32	285	.52	.21	.70	.56	.21
70 Subtraction	4.36	2.60	.61	4.80	2.54	284	.45	.22	.70	.49	.22
71 Multiplication	1.90	1.97	.60	1.91	1.97	271	.36	.27	65	.38	.28
TEST 9 MATHEMATICS CONCEPTS AND APPLICATIONS											
73 Numeration	4.90	1.87	.60	5.13	1.67	291	.57	.17	81	.60	.17
75 Number and Set Theory	5.53	1.74	.63	5.94	1.57	291	.57	.17	81	61	.16
79 Number Sentences/Properties	3.01	1.70	.49	3.23	1.77	288	.52	.18	.71	55	.18
80 Common Scales	4.39	1.71	.68	4.58	1.61	291	.57	.17	81	.61	17
85 Measurement/Graphs	4.86	2.10	75	5.24	2.00	291	.57	18	82	.61	.17

ALTERNATE FORM RELIABILITY COEFFICIENTS AND RELATED DATA FOR CAT C AND D CATEGORY OBJECTIVES (IN RAW SCORE UNITS) AND DERIVED OBJECTIVES MASTERY SCORES FROM TWO ADMINISTRATIONS AT AN INTERVAL OF TWO-TO-THREE WEEKS

Table 5

Level 13, Grade 3

	RAW SCORES						DERIVED OBJECTIVES MASTERY SCORES				
	Form C			Form D			Form C			Form D	
TEST/CATEGORY OBJECTIVE	Mean	SD	r	Mean	SD	N	Mean	SD	r	Mean	SD
TEST 1 PHONIC ANALYSIS											
21 Consonant Clusters/Digraphs	4.30	0.92	.40	4.54	0.85	315	.76	.18	.63	.84	.17
25 Short, Long Vowels/Vowel Combinations	3.47	1.62	.71	3.03	1.70	314	.66	.24	.83	.65	.25
26 Diphthongs	2.83	1.60	.66	2.68	1.76	313	.65	.23	.83	.65	.25
27 Variant Vowels/Vowel Combinations	2.43	1.60	.66	2.92	1.60	312	.63	.23	.83	.65	.25
TEST 2 STRUCTURAL ANALYSIS											
28 Compound Words/Syllables/Contractions	4.88	1.30	.50	4.85	1.29	314	.76	.20	.56	.74	.19
29 Base Words/Affixes	2.77	1.49	.46	2.37	1.37	311	.62	.25	.51	.55	.23
TEST 3 READING VOCABULARY											
32 Same Meaning	3.15	1.59	.64	3.19	1.41	314	.67	.24	.74	.66	.22
33 Opposite Meaning	3.74	1.39	.54	3.28	1.40	313	.69	.24	.72	.66	.22
34 Multimeaning	3.30	1.36	.37	3.50	1.29	314	.67	.23	.67	.67	.22
TEST 4 READING COMPREHENSION											
36 Recall of Facts	3.56	1.32	.52	3.07	1.49	309	.71	.21	.78	.66	.22
38 Inferred Meaning	4.32	1.92	.61	3.75	2.05	309	.70	.21	.78	.65	.22
39 Character Analysis	2.78	1.39	.57	2.85	1.47	309	.70	.21	.79	.66	.22
40 Figurative Language	4.08	1.15	.59	4.15	1.08	308	.72	.20	.80	.69	.21
41 Real/Unreal Elements	4.35	1.28	.30	4.09	1.49	307	.77	.20	.56	.75	.24
TEST 5 SPELLING											
44 Consonant Phonemes/Graphemes	2.78	1.07	.40	3.15	0.93	313	.71	.17	.67	.69	.15
45 Vowel Phonemes/Graphemes	4.99	1.21	.51	3.97	1.18	313	.72	.15	.69	.69	.15
46 Morphemic Units	1.43	1.18	.44	1.49	1.11	313	.36	.29	.44	.38	.27

(continued)

Table 5 (continued)

TEST/CATEGORY OBJECTIVE	RAW SCORES						DERIVED OBJECTIVES MASTERY SCORES				
	Form C			Form D			Form C			Form D	
	Mean	SD	r	Mean	SD	N	Mean	SD	r	Mean	SD
TEST 6 LANGUAGE MECHANICS											
47 I/Proper Nouns	2.97	1.54	.60	3.42	1.41	311	.60	.23	75	.64	.22
50 Beginning Words Titles	2.95	1.14	.58	3.17	1.11	312	.65	.22	.72	.70	.22
51 End Marks	2.86	1.11	.47	2.83	1.16	312	.66	.22	.66	.65	.22
53 Comma	1.81	1.84	.61	1.52	1.69	310	.41	.33	.64	.37	.30
TEST 7 LANGUAGE EXPRESSION											
57 Pronouns	4.08	1.06	.41	4.26	0.97	317	.74	.18	.75	.75	.17
58 Verbs	3.32	1.31	.53	3.38	1.29	317	.73	.18	.75	.74	.18
59 Adjectives	3.70	1.40	.68	3.88	1.40	317	.73	.18	.76	.74	.18
60 Subjects/Verbs	3.77	1.43	.38	3.97	1.54	316	.68	.19	.58	.70	.20
61 Modifying Words	4.12	1.02	.36	3.78	1.11	317	.73	.18	.73	.74	18
TEST 8 MATHEMATICS COMPUTATION											
69 Addition	5.69	2.40	.67	5.26	2.27	311	.47	.19	.77	.41	.17
70 Subtraction	4.28	1.85	.47	4.39	1.79	311	.41	.16	.75	.39	.16
71 Multiplication	3.99	2.59	.67	3.60	2.32	289	.40	.19	.77	.38	.17
72 Division	2.38	2.14	.56	2.36	2.06	264	.29	.19	.65	.35	.16
TEST 9 MATHEMATICS CONCEPTS AND APPLICATIONS											
73 Numeration	3.51	1.15	.39	3.15	1.26	305	.56	.18	.83	.51	.19
74 Number Theory	3.06	1.23	.46	2.54	1.23	306	.55	.18	.84	.50	.19
79 Number Sentences/Properties	2.75	1.50	.53	2.05	1.53	303	.54	18	.82	.50	.19
80 Common Scales	3.09	1.35	.46	2.86	1.34	305	.56	.18	.84	.50	.19
81 Geometry	2.28	1.24	.43	3.14	1.11	306	.54	.18	.82	.52	.18
82 Measurement	3.52	1.75	.58	3.03	1.74	305	.55	.18	.84	.50	.19
84 Graphs	4.20	1.81	.55	4.42	2.29	306	.55	.18	.83	.51	.19
88 Story Problems	2.55	1.33	.43	1.49	1.08	304	.56	.19	.83	.50	.19

Table 6

Level 14 Grade 4

TEST/CATEGORY OBJECTIVE	RAW SCORES					N	DERIVED OBJECTIVES MASTERY SCORES				
	Form C			Form D			Form C			Form D	
	Mean	SD	.	Mean	SD	N	Mean	SD	r	Mean	SD
TEST 1 READING VOCABULARY											
32 Same Meaning	11 87	5 40	60	8 09	4 52	277	57	27	81	.47	23
33 Opposite Meaning	2 71	1 84	61	2 58	1 62	243	57	28	82	53	26
34 Multimeaning	2 77	1 53	47	2 95	1.44	217	57	27	75	.56	.25
TEST 2 READING COMPREHENSION											
36 Recall of Facts	4 15	2 48	65	3 46	2 16	279	48	23	.82	.42	.20
38 Inferred Meaning	3 83	2 21	68	4 52	2 62	279	48	23	.82	.42	20
39 Character Analysis	5 62	2 74	62	3 74	2 05	279	49	24	82	42	.20
40 Figurative Language	3 56	2 14	58	3 13	1.94	276	48	23	.80	42	.20
42 Author Attitude Position	2 17	1 44	47	2 09	1.17	277	.47	.23	.81	.42	.20
TEST 3 SPELLING											
44 Consonant Phonemes Graphemes	3 76	1 40	35	3 03	1 49	282	56	18	59	52	17
45 Vowel Phonemes Graphemes	4.50	1 88	46	4 55	1 65	282	56	18	.60	.53	.17
46 Morphemic Units	1 49	1 04	23	1 70	1.11	278	.44	.21	.36	.46	.16
TEST 4 LANGUAGE MECHANICS											
48 I Proper Nouns Adjectives	3.39	1.55	62	2 93	1 47	280	.55	.23	.77	.49	.20
50 Beginning Words Titles	2 00	1.13	.38	1.69	1.00	280	50	21	75	.45	.18
51 End Marks	2 34	1.32	51	2.37	1.19	277	.53	24	.72	.49	.20
53 Comma	1.72	1.41	56	1.36	1.24	272	40	23	.69	.37	.19
54 Quotation Marks	1.73	1.49	56	1.75	1 53	271	39	25	.64	.41	.22
TEST 5 LANGUAGE EXPRESSION											
57 Pronouns	3 95	1.11	.47	3.67	1.02	282	67	.19	.79	.61	.18
58 Verbs	2.75	1.41	.45	3 16	1.41	282	.59	.22	.81	.59	.20
59 Adjectives	3 40	1.50	.59	3.28	1.27	280	.62	.22	.81	.59	19
60 Subjects Verbs	2.84	1.61	.42	2.75	1.59	274	.54	.22	.68	.54	.20
62 Modifying Transitional Words	3.83	1.73	.60	4.38	1.57	278	.61	.21	.81	.61	.20
63 Complete Incomplete Run-on	2.81	1.41	.46	2.59	1.45	271	.59	.21	.76	.57	.20
66 Sequence	3.39	1.97	.58	2.75	1.81	269	.59	.24	.78	.55	.21
TEST 6 MATHEMATICS COMPUTATION											
69 Addition	5.63	2.18	.50	5.51	2 19	279	47	18	.69	42	17
70 Subtraction	4.62	2 66	.57	4.01	2.33	278	.42	19	.72	.38	17
71 Multiplication	3.56	2.06	.53	3.23	1.96	272	.39	17	.72	.38	16
72 Division	2.66	1.98	.48	2.69	1.75	257	.34	.17	.67	.36	.15
TEST 7 MATHEMATICS CONCEPTS AND APPLICATIONS											
73 Numeration	2 58	1.27	51	2.51	1.41	277	46	.21	.86	.47	.21
74 Number Theory	2.11	1.36	.52	2.07	1.22	277	46	21	.86	.47	.21
76 Number Sentences	1.80	1.20	48	1 82	1.26	271	.45	.20	.85	.46	.21
78 Number Properties	2 48	1.22	58	2 10	1.31	276	50	.22	.83	48	22
80 Common Scales	3 00	1.69	58	2 61	1 71	277	46	.21	.85	.47	21
81 Geometry	2.29	1.42	47	1 95	1.26	275	46	.21	.83	.45	20
82 Measurement	2 31	1 46	56	3.32	1 73	276	46	21	86	47	21
84 Graphs	2 08	1 44	56	2 37	1 33	276	47	22	.85	48	22
88 Story Problems	2 23	1.48	.54	2 40	1.40	275	.46	21	85	47	21
TEST 8 REFERENCE SKILLS											
89 Title Page Copyright Page	3 61	1 77	67	4 21	2 11	279	55	25	85	59	26
90 Table of Contents	3 11	1.68	68	2.95	1 61	278	57	25	86	.59	26
91 Index	3.38	1.72	68	3 21	1 55	275	60	27	85	60	25
92 Dictionary Page	2 04	1.28	46	2 03	1.29	272	56	25	82	57	26
93 Map	1 96	1 19	.45	2 36	1 31	271	55	24	78	59	26

APPENDIX C

SLOSSEN INTELLIGENCE TEST

Initial Validity Studies

The concurrent validity of this short intelligence test is indicated by the high correlations with the Stanford-Binet (L-M) as shown in Table 1.

TABLE 1

IQ correlations between the Stanford-Binet (L-M) and Slosson (SIT)

Age	Number*	r	Mean SB-LM	Mean SIT	Standard Deviation SB-LM	Standard Deviation SIT	Average Difference
4	27	.90	116.6	114.6	19.7	18.7	6.7
5	23	.93	102.1	101.5	20.7	18.0	5.6
6	61	.98	100.7	101.3	20.7	20.2	4.4
7	71	.98	98.9	98.4	23.5	20.9	5.9
8	44	.94	95.5	95.5	17.6	17.0	5.3
9	45	.97	100.7	100.6	25.1	23.7	5.1
10	40	.94	96.1	97.2	23.9	24.6	6.1
11	51	.96	93.1	92.6	21.4	22.0	4.9
12	36	.97	94.0	94.1	22.4	24.6	4.6
13	57	.96	96.3	97.0	23.4	24.9	5.0
14	66	.97	92.7	92.4	20.4	21.5	4.4
15	56	.94	92.7	91.7	18.8	18.2	5.1
16	39	.96	97.6	97.5	23.7	24.0	4.7
17	23	.94	106.0	106.6	16.9	16.7	5.0
18 and up	62	.97	101.7	102.5	31.8	31.2	5.9
	701						

*Includes cases from Table 2.

Most of the subjects shown in Table 1 were originally tested by the author with both SB and SIT. In order to avoid any bias, independent testing of 141 subjects was therefore conducted. For this independent testing, the author administered the SB and the SIT was administered by a teacher, principal, guidance counselor, social worker or nurse. The results are shown in Table 2a.

TABLE 2a

IQ correlations obtained independently between the Stanford-Binet (L-M) and Slosson (SIT)

Age	Number	r	Mean SB-LM	Mean SIT	Standard Deviation SB-LM	Standard Deviation SIT	Average Difference
4-19	141	.92	107.7	107.2	20.2	19.9	6.1

TABLE 7

Statistical Comparison of the Slosson (SIT) with Other Standardized Tests

	Range of Correlations High	Range of Correlations Low	Median	Number of Correlation Coefficients Reported	Total Number of Subjects	Average Number of Subjects per Study
Slosson (SIT) correlated with Stanford-Binet (L-M)	.96	.60	.90	18	3253	181
Slosson (SIT) correlated with Wechsler (WISC)-FS*	.96	.52	.75	20	1765	88
-V	.96	.44	.82	19		
-P	.84	.10	.62	19		
Slosson (SIT) correlated with Variety of Achievement and IQ Tests	.83	.24	.55	18	1536	81

*FS = Full Scale; V = Verbal; P = Performance.

Reliability

A high reliability coefficient of .97 (test-retest interval within a period of two months) was obtained for this short test on 139 individuals from age 4 to 50 years. The mean IQ's of the initial tests and of the retests were respectively 99.0 and 101.3. The standard deviations were 24.7 and 24.1, respectively.

The standard error of measurement (SEM) was found to be 4.3. This is interpreted to mean that about two-thirds of the time the IQ's will not change more than plus or minus 4.3 IQ points.

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