77-21,402

ROBERTS, Kathleen Piegdon, 1947-
THE EFFECTS OF CONSERVATION TRAINING ON READING READINESS IN KINDERGARTEN PUPILS.

The University of Oklahoma, Ph.D., 1977
Education, general

Xerox University Microfilms, Ann Arbor, Michigan 48106

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECTS OF CONSERVATION TRAINING
ON READING READINESS IN
KINDERGARTEN PUPILS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

by

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Norman, Oklahoma

Spring, 1977

THE EFFECTS OF CONSERVATION TRAINING
ON READING READINESS IN
KINDERGARTEN PUPILS

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ACKNOWLEDGEMENTS

The writer would like to express appreciation to all those who helped make this work possible. Although their names are too numerous to list, the combined encouragement of all my friends and associates is appreciated.

Dr. Richard Williams, Chairman of my doctoral committee, deserves a very special thank you. His patience, guidance, criticisms, and encouragement were invaluable to me throughout this study. Without his true interest and genuine concern this study might not have reached its culmination. I shall always remember and appreciate my friend and "teacher."

Thankful appreciation is expressed to the other members of the writer's graduate committee. Dr. Michael Langenbach, Dr. Robert Bibens, and Dr. William Graves. All offered helpful suggestions and encouragement.

The administrative staff, faculty, and students of the Edmond School System, Edmond, Oklahoma, who helped arrange for and participated in the study deserve a special thanks.

The writer also wishes to acknowledge and thank my parents, Mr. and Mrs. Casimer Piegdon for bestowing upon me those special gifts only they could give: love, support, and a desire and ability to learn, and a desire and ability to teach what I have learned to others.

I am especially grateful to my husband Jim. Thank you for the love, support, understanding, and encouragement. Without you I never would have made it.

May my future career justify the faith so many have had in me.

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CHAPTER I

INTRODUCTION

A great deal of writing has been devoted to the concept of reading readiness, and numerous readiness programs are on the market and in the classroom. Yet frequently children are pushed into reading activities for which they are not intellectually ready. Asking children to learn letters of the alphabet, or whole words may be beyond their intellectual level of functioning. Renner, Bibens, and Shepherd address themselves to this point when the state:

> Reading, for example, involves basically a set of abstract sounds represented by a series of abstract signs. The alphabet is an abstraction, a defined series, and to to really understand it the child must be able to take the point of view of those who defined it. This may be asking too much of a child in the preoperational stage whose egocentricism is strong. . . according to the empirical data upon which the Piagetian model is based, a preoperational learner is not able to perform intellectual operations.[1]

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[1]John W. Renner, Robert F. Bibens, and Gene D. Shepherd Guiding Learning in the Secondary School (New York: Harper & Row, 1972), pp. 80-90.

Theoretically, according to Durkin, the purpose of the reading readiness program is to help children get ready to learn to read. Educators who see readiness as dependent on maturation tend to view readiness programs as a way to use the time until the child matures. Educators who believe that the environment plays some role in affecting readiness tend to view readiness programs as plans of instruction to help prepare children for reading.[1]

When should children read? This has been a question in education for many years. Morphett and Washburne did a study on this question which had tremendous impact on school programs for many years. They found that groups of first grade pupils with average mental ages of 6.6 and 7.0 were more successful in first grade reading than were groups whose M A's were below 6.6.[2] Thus many schools adopted the 6.6 M A as the magic moment and would delay reading instruction until the M A of 6.6 was achieved by the child.

This concept of delaying reading instruction which was developed in the 1920's has been re-examined many times in the light of new research. The National Committee on Reading in

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[1]Dolores Durkin, Teaching Them to Read (Boston: Allyn and Bacon, Inc., 1970), p. 38.

[2]Mabel Morphett and Carleton Washburne, "When Should Children Begin to Read?" Elementary School Journal. 31 (March, 1931), pp. 496-503.

1925 took the position that preschool and probably first grade children should engage in activities that would help prepare them for reading.[1]

Others in education interpreted the concept to mean readiness could not be nurtured but had to develop in its own good time. Extensive crossectional and longitudinal studies which tended to support the view that reading ability develops in an harmonious way with other aspects of growth--physical and intellectual, were conducted by Olson[2] and Gesell.[3] They concluded that there was not much anyone could do to hurry up the process. Gesell found that children at given age levels could be expected to perform certain tasks and that each child passed through successive stages of growth as a result of natural processes. Most children seemed to be ready for a given activity at about the same stage of development. Trying to speed up performance levels with training was considered to be a waste of time, and possibly damaging to future performances.

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[1] Report of the National Committee on Reading, Twenty-fourth Yearbook of the National Society for the Study of Education, Part I. Chicago: University of Chicago Press, 1925, pp. 9-10.

[2] Willard C. Olson, Child Development (Boston: D. C. Heath & Co., 1959), pp. 17-21.

[3] Arnold Gesell and Frances L. Ilg, The Child From Five to Ten (New York: Harper and Row, 1946), p. 389.

Olson[1] and Gesell[2] believed that environmental factors were of lesser importance than constitutional ones in the development of children, and that children should be allowed to mature in their own way without outside interferences.

Proponents of the view that children need time to mature not only point to developmental stages in physical growth but in cognition as well. They refer to Piaget's period of "conservation", ages 4-7, when children begin to grasp the idea that a substance contains the same amount even though its shape changes.

Smith summarized the results of over 130 reading readiness studies completed before 1950. She concluded that earlier studies tried to determine relationships between physical, intellectual, social, emotional, and experiential readiness and success in beginning reading. The results of these studies were not consistent, but Smith reported that a measure of agreement was achieved among those who interpreted the findings. Some of the conclusions are:

1. There appeared to be significant relationships between physical development and success in beginning reading.
2. Girls developed earlier and thus had lower failure rates in the first grade than boys.

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[1]Olson, Child Development, pp. 17-21.

[2]Gesell and Ilg, The Child From Five to Ten, p. 389.

3. Hearing and visual impairments might interfere with the progress in learning to read. Poor health and general physical condition could be detrimental factors in beginning reading achievement.
4. Intelligence is a major factor in learning to read. However, it is no guarantee of success.
5. Socially and emotionally immature children have more difficulty responding satisfactorily to learning tasks.
6. Children with rich language and experiential backgrounds seem to do much better than children with poor backgrounds.

Hunt, reviewed and reinterpreted the research on readiness for learning. Earlier interpretations held that readiness was a product of maturation. In Hunt's view, a great variety of practices and experiences are said to affect readiness for any particular skill.[2]

Perhaps the most significant outcome of this research and interpretation of the research was the idea that readiness is a complex concept and that there is no single method for helping children get ready to read.

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[1]Nila B. Smith, "Readiness for Reading", Readiness For Reading and Related Language Arts, A Research Bulletin of the National Conference on Research in English (Urbana: The National Council of Teachers of English, 1950), pp. 3-33.

[2]J. McVicker Hunt, Intelligence and Experience (New York: The Ronald Press Co., 1961), pp. 344-363.

Traditionally, readiness to read has been considered to be the product of maturation. While this is a defensible view, according to Durkin, she believes that current knowledge indicates that a child's readiness to learn is the production of the interaction of both maturational and environmental factors. The added dimension of this view is the relationship between children's ability and the learning experiences made available to them.[1]

Jerome Bruner introduced his chapter "Readiness for Learning" by writing: "We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development."[2] Bruner was urging the schools to examine the organization and presentation of instruction. Since 1960, Bruner has reassessed his thoughts in this area. He now questions whether curriculum reform is the sole answer to problems in education. Bruner wonders whether the curriculum revisions of the 1960s were enough, or if a more fundamental restructuring of the entire educational system is in order.[3]

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[1]Durkin, Teaching Them to Read, p. 38.

[2]Jerome Bruner, The Process of Education (Cambridge: Harvard University Press, 1960), p. 33.

[3]Jerome Bruner, "The Process of Education Revisited," Phi Delta Kappan Vol. 53, No. 2, (September, 1971), pp. 18-21.

Durkin pointed out that the long debate over getting ready to read and beginning to read can be misleading in its subtle inference that the two occur at separate points in time. She suggested that it would be more realistic to identify the different ways in which beginning reading could be taught.[1]

More recent research on reading readiness, since 1950, has been less concerned with intelligence and personality and more concerned with specific abilities associated with reading.

What visual skills do children need to learn to recognize words? Durrell, concluded that "familiarity with letter form seems essential to the accurate perception needed to discriminate between words."[2] From the first grade studies, Bond and Dykstra concluded that knowledge of letter names was the best predictor of beginning reading success.[3]

Karlin reported that auditory discrimination which involves acuity, understanding, discrimination and retention, is important to beginning reading.[4]

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[1]Durkin, Teaching Them to Read, p. 42.

[2]Donald D. Durrell, and Helen A. Murphy, "Reading Readiness," Journal of Education Vol. 146 (December, 1963), p. 5.

[3]Guy L. Bond, and Robert Dykstra, Coordinating Center, First Grade Reading Instruction Programs, Final Report. U. S. Department of Health, Education, and Welfare, Project No. X001 (Minneapolis, University of Minnesota, 1967).

[4]Robert Karlin, Teaching Elementary Reading: Principles and Strategies (New York: Harcourt, Brace, and Jovanovich, Inc., 1971), p. 81.

Most of the investigations of auditory discrimination sought to determine if any relationships existed between ability to distinguish between spoken sounds and learning to read. Harrington administered a series of tests involving recognition of initial and final consonants in words and rhyming words. She reported superior performances by children who were significantly superior in word recognition.[1] Durrell and Murphy concluded on the basis of obtained correlation coefficients that success in beginning to read was tied closely to the ability to recognize separate sounds in spoken words.[2] Dykstra administered a series of auditory discrimination tests to first grade children and found that performance on each was significantly related to reading achievement.[3]

In the area of language development the research findings are far from clear. Oral language development ability by itself does not seem to be a good discriminator of potential and actual

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[1]Sister Mary James Harrington, "The Relationship of Certain Word Analysis Abilities to the Reading Achievement of Second Grade Children", (Unpublished Doctoral Dissertation, Boston University, 1953).

[2]Donald Durrell and Helen Murphy, "The Auditory Discrimination Factor in Reading Readiness and Reading Disability", <u>Education</u> Vol. 73 (May, 1953), pp. 556-560.

[3]Robert Dykstra, "Auditory Discrimination Abilities and Beginning Reading Achievement," <u>Reading Research Quarterly</u>, Vol. 1 (Spring, 1966), pp. 5-34.

reading achievement. This was the conclusion of Martin[1] and Bougere[2]. Yet two other investigators, Strickland[3] and Loban[4], who conducted longitudinal studies found that superior language development and reading achievement were positively related. Deutsch reported that socially disadvantaged children lack the language facility necessary for school success.[5]

Almy indicated that similar abilities may be involved in performance of conservation tasks and programs in learning to read.[6] Almy's writings suggest that an awareness of the abilities needed for conservation and beginning reading can enable the classroom teacher to plan instruction according to the child's level of intellectual development.

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[1]C. Martin, "Development Interrelationships Among Language Variables in Children of the First Grade", Elementary English, Vol. 32 (March, 1955), pp. 167-171.

[2]Marguerite B. Bougere, "Selected Factors in Oral Language Related to Achievement in First Grade Reading", (Unpublished Doctoral Dissertation, University of Chicago, 1969).

[3]Ruth G. Strickland, The Language of Elementary School Children: Its Relation to the Language of Reading Textbooks and the Quality of Reading of Selected Children, Bulletin of the School of Education, No. 38, (Indiana University, 1962).

[4]Walter D. Loban, The Language of Elementary School Children (Champaign, Illinois: The National Council of Teachers of English, 1963).

[5]Martin Deutsch, et. al., The Disadvantaged Child: Studies of the School Environment and the Learning Process (New York: Basic Books, Inc. 1967).

[6]Millie Almy, Young Children's Thinking (New York: Columbia University, Teachers College Press, 1966), pp. 130-140.

Another factor in reading readiness which is frequently studied is gender differences. According to Kagan, gender differences are apparent for language and reading skills. He stated that the special effect of maternal ability and personality on girls cognitive development is clearest in the verbal domain.[1]

Kagan reported that middle class mothers spend more time talking to their daughters, and correct them more frequently for task incompetence, than they do their sons.[2]

Two major dimensions on which mothers can be divided are a desire to accelerate the cognitive development of their children, and positive feelings about them. Kagan stated that mothers have different conceptions of the ideal boy and the ideal girl, and that they engage in different practices in order to attain these idealized goals. Many mothers value verbal proficiency and language skills in girls, and in contrast, many mothers believe boys should be strong and proficient at gross motor talents, and thus rough and tumble play facilitates attainment of this goal. Kagan suggested that mothers treat their infants in ways that are consonant with their idealized goals and their theories of appropriate procedures. Thus, they engage in reciprocal vocal and verbal simulation more frequently with their daughters than with their sons, and more motor play with their sons.[3]

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[1]Jerome Kagan, Change and Continuity in Infancy (New York: John Wiley & Sons, Inc., 1971). pp. 184.

[2]*Ibid.*, p. 186.

[3]*Ibid.*, p. 181.

Evidence continues to accumulate that a child's readiness to read does not depend upon any single factor. Smith pointed out that there is an intellectual readiness, an emotional readiness, and a social readiness, as well as a physiological readiness.[1]

A critical issue in reading instruction is to help children reach a stage where they can read words, phrases, sentences, and paragraphs that they have never seen before.

A beginning task for children in learning to read is the development of the concept that there are units of sound in spoken language and that these units have a written representation, i.e., the letters of the alphabet. Children must then perceive that these sounds and letters are arranged as words and thus provide spoken and written cues for meaning.

The comparison of reading readiness with progress in mental development involves identifying characteristics associated with mental development. To begin the exploration of the nature of the learner one can look to the developmental theory of Piaget. Ideally from birth to death, the human being's encounters with the environment result in adaptation to that environment.

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[1]Nila B. Smith, "Readiness for Reading", Elementary English, Vol. 27 (January, 1950), pp. 31-39, and Vol. 27 (February, 1950), pp. 91-106.

Intelligence begins to develop the moment the baby is born and originates in reflexes which are hereditary structures. Intelligence governs the interaction between the organism and its environment.[1]

This adaptation of an organism motivated to explore its environment has two components. One is assimilation, the process of internalizing data, the other is accommodation, the process of internal change in the organism brought about by assimilation. In development, assimilation leads to accommodation, which in turn leads to further assimilation with the process repeating itself.

In adaptation, intelligence organizes the assimilated input; and as intelligence develops, an increasing number of organizations--structures--are formed; new organizations coordinate with one another, and organizations combine with one another.[2]

In this chapter the research provides implications of the various concepts regarding reading readiness and mental development in children. There is one general implication that requires emphasis: educators may be expecting too much

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[1]Justin Fishbein and Robert Emans, A Question of Competence: Language, Intelligence, and Learning to Read (Chicago: Science Research Associates, 1972), pp. 99.

[2]Ibid.

from young children. Children in the primary grades need many opportunities to act out problems and to arrive at solutions by manipulating actual objects. The teacher of reading, recognizing the nature of children and their learning, prepares the reading environment to support children's maximum use of their functional capacities for learning to read. The reading situation must be one of active, manipulating children, building in relation to their background of direct relevant experience.[1]

Statement of the Problem

The problem was to determine if there are significant differences between the reading readiness scores of kindergarten children who were given reading readiness training, and those who were given reading readiness training and conservation training. Further study was made to determine if the gender of the student influenced the effectiveness of these two approaches. The primary questions investigated in the present study are:

1. Does a conservation training program combined with a reading readiness program improve reading readiness?
2. Are there differences in reading readiness taught by the two techniques for the male and female students?

Purpose of the Study

The purpose of the study was to determine the effects of two programs of training on reading readiness. By comparing gains

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[1]*Ibid.*, p. 110.

in reading readiness skills it was determined which of the techniques for readiness training had been more effective during the time period involved, and with the kindergarten students included in the study. The effectiveness of conservation training on reading readiness was examined by these results.

Hypotheses

$Ho_{1:0}$ There is no difference between group mean gain scores in reading readiness of those groups taught by readiness techniques and those groups taught by a combination of conservation and readiness techniques.

$Ho_{2:0}$ There is no difference between group mean gain scores for those girls taught by readiness techniques and those boys taught by readiness techniques.

$Ho_{3:0}$ There is no difference between group mean gain scores in reading readiness for those girls taught by conservation and readiness techniques and those boys taught by conservation and readiness techniques.

Definition of Terms

There are several terms used in this study which should be operationally defined in order to clarify any misconceptions and to avoid multiple interpretations in the text of the study. The terms to be defined and their definitions as they are being used in this study are as follows:

1. Conservation: The cognition that certain properties (quantity, number, length, etc.) remain invariant (are conserved) in the face of certain transformations (displacing objects into pieces, changing shape). In this study five Piagetian conservation tasks were used to train for conservation. The five tasks are conservation of number, weight, volume, area, and mass. A conserver is considered to be one who conserves in all five areas.
2. Readiness: The child is in the best position to learn without waste of time and energy. In this study readiness is the understanding of material as measured by the *Metropolitan Reading Test* (Forms A and B).
3. Reading Readiness Program: In this study the reading readiness program is *Distar I* published by Science Research Associates.

Assumptions

1. The test scores obtained on the *Metropolitan Readiness Test* are valid for each of the subjects.
2. The subjects are representative of kindergarten pupils attending a southwestern, suburban community.
3. The number of correctly marked answers on the *Metropolitan Readiness Test* was assumed to represent each subjects average performance.

4. The final evaluation and the generalizations derived from this study were assumed to be valid only when applied to the school district included in the study or to school districts with comparable populations and conditions.

Limitations of the Study

1. The data collected were obtained from kindergarten pupils in a suburban area attending the Edmond Public Schools.
2. Criteria for selection of subjects was limited to kindergarten pupils who were not repeaters, and who were present during the entire eighteen weeks.
3. Subjects who missed the designated testing dates because of absence or other conflict were given one alternate testing date, then dropped from the study if a second absence occured.
4. The study was restricted to two schools assigned by the Edmond School System's administrative personnel. The decision was based on the fact that all kindergarten pupils in Edmond attend one of these two schools.
5. In some instances the testing environment was not ideal and not without limited distractions.

Overview of Subsequent Chapters

The theoretical foundations for a study dealing with conservation and reading readiness are established in Chapter II, the concepts of readiness and conservation are both examined, then a closer examination is made of the literature related to conservation training and to readiness training and conservation.

Chapter III will present the design and the procedures of the study.

Chapter IV will present the findings of the study.

Chapter V will be concerned with the summary, conclusions, and recommendations of the study.

CHAPTER II

REVIEW OF THE LITERATURE

Theoretical Framework

This chapter presents a review of the professional literature related to questions of the relationship of theories of reading readiness, and theories of conservation training. The studies chosen for review were chosen on the basis of two criteria. They were fundamental references in the category. They conformed to the design of this study in that they dealt with relationships between reading and conservation, or they dealt with the training of conservation skills.

Reading Readiness

A persual of the writings of such authorities in the reading field as Durkin,[1] DeHirsch,[2] Karlin,[3] and Robeck and Wilson,[4] and others, indicated that current theories and methods of teaching beginning reading center on the sequential development

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[1]Durkin, Teaching Them to Read.

[2]Katrina DeHirsch, Predicting Reading Failure (New York: Harper and Row, 1966).

[3]Robert Karlin, Teaching Elementary Reading.

[4]Mildren Coen Robeck and John A. R. Wilson, Psychology of Reading (New York: John Wiley & Sons, Inc., 1974).

of reading skills and habits extending from primary levels through the highest levels. Within this concept of continuous growth and development is the idea that children learn a kind of reading at each successive stage.

In 1961, David Russell offered five generalizations about reading and child development. (1) Children's devèlopment of reading ability is continuous and gradual. (2) Most children go through the same patterns of development with an orderly sequence of reading abilities. (3) Although development is orderly, it proceeds at different rates at different times. (4) There is a great variation in the ages at which different children reach the various developmental stages. (5) There seems to be a positive correlation between patterns of physical, mental, social, and emotional devèlopment and their relation to children's reading abilities.[1]

Robeck and Wilson view beginning reading as primarily decoding. Subjects must make sense out of the cognitive messages they receive from the environment. This forming of an inherent structure from related bits of experience is conceptualization. In reading, the first conceptualization is that words are made up of specific letters in a specific order. The second conceptualization in reading is that groups of words tell a story.[2]

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[1]David Russell, Children Learn to Read (New York: Ginn & Co., 1961), p. 90.

[2]Robeck and Wilson, Psychology of Reading, p. 12.

Russell emphasized the concept formation that preceded the reading as basic to the interpretation the reader would make. To him, the sequence went from conceptualization, to linguistic form, to printed words. Concept formation involved generalization of the elements common to an object or situation that the learner derived from related precepts, images, memories, information, and feelings. Reading was defined as a conceptualized response to a printed word stimulus, suggesting the importance of association and conceptualization within the reader.[1]

During the past decade Durkin has studied beginning reading by observing teachers and students in the classroom She reported that very little has changed over the past ten years. She suggested that there is too little individualization of instruction. Teachers do not seem to have the ability to overcome the idea that they should teach grade level content. Failure to overcome that idea is based on two factors; habit, and lack of preparation during college.[2]

Schools in the 1970s have continued to use grouping practices to achieve small measures of individualized instruction. In the beginning years there are almost always three groups, with the children lockstepped into a group never to leave it.

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[1]David Russell, <u>Children's Thinking</u> (Boston: Ginn & Co., 1956), p. 234-236.

[2]Dolores Durkin, "After Ten Years: Where Are We Now In Reading?" <u>The Reading Teacher</u>, Vol. 28, No. 3 (December, 1974), pp. 262-267.

Durkin further reported that what is taught is generally determined by what comes next in the basal manual, not on what the child may need next. Few tests are given which are of any diagnostic value, and when diagnostic tests are given the scores are generally recorded and filed, and forgotten.[1]

The controversy and confusion over beginning reading instruction has placed the kindergarten teachers in a dilemma write O'Donnell and Raymond.[2] Those concerned with the social and emotional adjustment of the children are disturbed by the recent emphasis on structured programs. Others have welcomed formal teaching of reading in kindergarten. One solution to this dilemma, offered by Robison and Spodek, is that concepts identified by scholars of the subject matter field become the intellectual goals. They say:

> The content would be developed through instructional materials and experiences from which young children could be expected to gather information, ideas, skills, and attitudes. While the teacher would not be explicitly teaching the basic concepts which she hopes the children are learning, she would be exerting her skill in making available to them selected areas of information and experiences, and helping children to make sense out of their assorted collections of data. Without teaching

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[1] Ibid.

[2] C. Michael O'Donnell and Dorothy Raymond, "Developing Reading Readiness in the Kindergarten." Elementary English, Vol. 49 (May, 1972), pp. 768-771.

> reading, and without formal instruction the teacher would encourage and stimulate children's interests and efforts, thus helping them perceive and conceptualize more clearly.[1]

O'Donnell and Raymond tested the hypothesis of Robison and Spodek. They took a group of Maine kindergarten children and randomly assigned them to two groups; (a) a conceptual-language program, (b) a basal-reader program. All of the kindergarten classes followed similar daily schedules. Children in the basal-reader program received reading readiness instruction centered around workbooks and seatwork. The conceptual-language approach consisted of many informal experiences designed to simultaneously foster concept attainment and development. The content of the program consisted of reducing major concepts into experiences that would be readily understood by five year olds. The results of this study indicated that the conceptual-language group scored significantly higher on the Metropolitan Readiness Test than did the basal-reader group. The conceptual-language group also scored significantly higher on the Sheldon Visual Subtests.[2]

Reading readiness has been a topic of controversy and concern to educators for many years. In general, the research

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[1]Helen F. Robison and Bernard Spodek, New Directions in the Kindergarten (New York: Teachers College Press, 1965), p. 8.

[2]O'Donnell and Raymond, "Developing Reading Readiness in the Kindergarten." pp. 768-771.

presents evidence to the effect that children who do not learn to read easily when they enter school should not be thought of as defective but merely unready for reading in some respects. Although time is required for certain aspects of readiness to develop, teachers in kindergarten and first grade may do much to stimulate the development of other aspects of readiness before systematic training in reading is begun.

Over the past fifty years there have been voluminous amounts of research on reading readiness. While none of this research has led to a definitive statement concerning readiness, there has been a consistent thread of opinion over the years. This thread has revealed that many researchers in reading readiness believe that readiness training, to be beneficial to the development of later reading achievement, needs to be based on individual needs, and diagnostic testing should be done to determine areas of skill deficiencies.

In 1932, Teegarten conducted a study of kindergarten trained children and non-kindergarten trained children. She found that the children who received kindergarten training showed less tendency to reverse and confuse letters and figures. At the end of the first grade the kindergarten trained children's reading achievement was higher than the non-kindergarten trained children. She reported that the actual progress of the non-kindergarten trained children seemed to be dependent on the reversal tendency shown in the pretest. The correlation between reversal test scores and reading achievement scores was .75 for the non-kindergarten trained groups, and .54 for the kindergarten trained groups.[1]

Teegarten gave the following rationale for her conclusion that kindergarten training is beneficial to reading achievement: "The value of kindergarten training lies in the fact that it gives continuous stimulation to observation and appropriate reaction or activity. It offers children opportunities for manipulation of materials, demands discrimination of size, form, color, and encourages children to see similarities and contrasts and to form judgments."[2]

Walters, in 1934, found that children who received pre-reading experiences in kindergarten made more rapid progress in first grade reading than those without such experiences.[3] Walter's study divided experiences into types, for example: animals, transportation, farm, house, etc. She then showed all the children pictures of the different categories of experiences and asked the children questions about the pictures to determine if they lacked experience with that category. Then

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[1]Lorene Teegarten, "The Kindergarten and Reading Reversals," Childhood Education, Vol. 9, No. 2 (1932), pp. 82-83.

[2]Ibid.,

[3]Doris Walters, "Pre-Reading Experiences," Education Vol. 54 (1934), pp. 308-312.

she planned experiences for the children in the categories where they showed lack of experience.

In a study of the factors determining success and failure in beginning reading, Gates and Bond obtained the following results: (1) the correlation of mental age with reading achievement was about .25. The range of mental ages in relation to reading achievement was wide. (2) Paper and pencil tests yielded fairly good correlations with reading achievement, but were not consistent in predicting reading success and failure. (3) Tests of naming the letters of the alphabet, reading letters, and matching words gave fairly good correlations but they were not significant. (4) Examination of hearing showed a clear difference, that is, the pupils in the near-failing group showed a marked hearing loss as compared to the group as a whole. (5) Tests of eye-hand dominance, motor coordination, and speech defects showed nothing to differentiate the failing group from the whole group. (6) Data gathered about the home backgrounds showed only slight differences between the successful readers and the nonsuccessful readers.[1]

Gates and Bond concluded that their results suggested the likelihood that deficiencies in teaching, such as those that result from an insufficiency of materials, failure to understand directions, and missing material due to absences, cause reading

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[1]Arthur I. Gates and Guy L. Bond, "Reading Readiness: A Study of Factors Determining Success and Failure in Beginning Reading", Teachers College Record, Vol. 37 (1936), pp. 679-685.

failure. The study emphasized the importance of recognizing and adjusting to individual limitations and needs. "Readiness is something to develop, not to wait for", they concluded.[1]

Scott found in 1947, that readiness training during the second semester of first grade was more effective in preparing for reading success than kindergarten training, or no readiness training.[2] She measured one year's growth of pupils who had readiness training and pupils who did not have readiness training. The results indicated the following: (1) the experimental group received higher average scholastic marks for the first semester of first grade. (2) The experimental group rated higher in desireable attributes, habits and skills. (3) The experimental group covered more material in reading. (4) The experimental group read at a higher level at the end of the study.[3]

In their study of auditory discrimination factors in reading readiness, Durrell and Murphy concluded that the children who learn to read easily are the ones who notice the separate sounds in spoken words. They tested children on the ability to discriminate initial, medial, and final sounds, as compared to reading achivement.[4]

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[1] Ibid.

[2] Carrie M. Scott, "An Evaluation of Training in Readiness Classes." Elementary School Journal, Vol. 48 (1947), pp. 26-32.

[3] Ibid.

[4] Donald D. Durrell and Helen A. Murphy, "The Auditory Discrimination Factor in Reading Readiness and Reading Disability", Education, Vol. 73 (1953), pp. 556-560.

Robinson asserts that learning to read cannot be considered apart from the total learner, the learning situation, and the interaction of the two. She reported on factors which influence reading. First she referred to the characteristics of the learners. The intelligence of the children, the development of their language skills, visual perception, auditory discrimination, emotional maturity, social maturity, sex, and health were all seen as factors within the learners which influence learning to read. She discussed factors outside the learners, such as educational levels of the families, and the socioeconomic levels of the families as they influence learning to read.[1]

The purpose of a study by Prescott was to determine the extent of sex differences in the performance of beginning first grade pupils on the Metropolitan Readiness Test. The data obtained from the administration of the Metropolitan to 7821 boys and 7138 girls were analyzed. On the basis of the analysis the following conclusions were drawn: (1) when the beginning first grade boys and girls are matched according to chronological age, the Metropolitan performance of the girls is slightly higher than the boys performance, but not significantly. (2) The mean Metropolitan score of the average boys was slightly higher than that of the underage boys, but it was not significant. Prescott's overall

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[1]Helen M. Robinson, "Factors Which Affect Success In Reading". Elementary School Journal, Vol. 55 (1955), pp. 263-269.

conclusion was that separate norms for boys and girls are not needed with the Metropolitan Readiness Test.[1]

The primary question of Bradley's study of reading readiness was, "Will the child lose or gain if formal systematic instruction in reading is not provided until the child is ready?"[2] The experimental group participated in a program which was built on the concept of readiness and was designed to stimulate growth in all areas of development. The control group received formal systematic instruction in all academic areas immediately upon entering first grade.

Bradley concluded that the soundness of the readiness approach to all school learning was reaffirmed. Her major conclusions were: (1) Test results indicate that the experimental groups were equal to the control groups in achievement by the end of the second grade, and by the end of the third grade the experimental group was up to grade level. (2) The early intensive start in reading did not result in greater gains by the control group. Thus Bradley suggested that the time would be better spent developing the social and emotional growth of the children.[3]

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[1]George A. Prescott, "Sex Differences in Metropolitan Readiness Test Results," Journal of Educational Research, Vol. 48 (1955), p. 605-610.

[2]Beatrice E. Bradley, "An Experimental Study of the Readiness Approach to Reading," Elementary School Journal, (1956), pp. 262-267.

[3]Ibid.

Anderson, Hughes, and Dixon studied the age of learning to read and its relation to sex, intelligence, and reading achievement. Their primary questions were: (1) What individual differences exist in age of learning to read? (2) What sex differences exist in age of learning to read? (3) What is the relationship between age of learning to read and intelligence? (4) What is the relationship between age of learning to read and reading achievement by the end of sixth grade?[1]

The results of this study showed that: (1) The average age of learning to read was 86 months. This is the average age of children in the second grade. (2) They found that 52 percent of the girls learned to read in first grade, and 33 percent of the boys learned to read in first grade. This was a significant difference between boys and girls. The average age of girls learning to read was 83.1 months, and for boys the average age of learning to read was 89.6 months, again this was a significant difference. (3) The correlation between intelligence in first grade and age of learning to read was .57 for girls and .54 for boys. The conclusion drawn was that high intelligence is associated with an earlier age of learning to read. (4) Finally, the earlier the age of learning to read, the higher the achievement level by sixth grade[2]

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[1]Irving H. Anderson, Byron O. Hughes, and W. Robert Dixon, "Age of Learning to Read and Its Relation to Sex, Intelligence, and Reading Achievement in the Sixth Grade," Journal of Educational Research, Vol. 49 (February, 1956), pp. 447-453.

[2]Ibid.

Fast took 134 children with kindergarten training and 46 without kindergarten training, using age as the only criterion of difference between the two groups, and analyzed the results of reading achievement scores. She hypothesized that initial reading scores of children with kindergarten training would be higher than scores of children without such training, and that this advantage would be maintained over the school year. The results supported the hypothesis.[1]

Each year teachers of beginning reading face the problem of defining the starting point of instruction. Paradis and Peterson supported Durkin's observation that teachers tend to use structured basal programs, and unfortunately few teachers possess the skills to diagnosis the children's readiness skills, thus all pupils progress as a group through the readiness programs regardless of the background they bring to school.[2]

Knowledge of individual differences leads one to expect that a few pupils will already have developed the skills which constitute the readiness program and therefore will not need the readiness training. Two studies cited below support this notion.

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[1]Irene Fast, "Kindergarten Training and Grade I Reading", Journal of Educational Psychology, Vol. 48 (1957), pp. 52-57.

[2]Edward Paradis and Joseph Peterson, "Readiness Training: Implications from Research," The Reading Teacher, Vol. 28, No. 5 (February, 1975), pp. 445-448.

Mitchell studied the visual discrimination skills of lower socioeconomic kindergarten pupils who had received no formal reading readiness training. He found that the majority of these kindergarten pupils, who had been assumed not to have basic readiness skills, did possess most of the basic readiness skills. Mitchell suggested that teachers should be more selective in determining which visual discrimination training materials they use.[1]

In a similar study Paradis examined the visual discrimination skills of preschool and kindergarten pupils of middle socioeconomic status, who had not received formal readiness training. The results indicated that 97 percent of the kindergarten pupils were successful on 80 percent of the items. Most children had developed the skill to discriminate pictures and letters, but had moderate difficulty with discrimination of words.[2] Research done by Rosen,[3] and Wingert[4] indicated that visual discrimination training with nonverbal stimuli such as pictures, has little effect upon reading achievement.

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[1]Ronald W. Mitchell,"Kindergarten Children's Responses to Selected Visual Discrimination Exercises in Reading Readiness Materials", (Unpublished Collequium Paper, University of Minnesota, 1965).

[2]Edward E. Paradis, "The Appropriateness of Visual Discrimination Exercises in Reading Readiness Materials," Journal of Educational Research, Vol. 67 (1974), pp. 267-278.

[3]C. L. Rosen, "An Experimental Study of Visual Perception Training and Reading Achievement in First Grade," Perceptual and Motor Skills, Vol. 22 (1966), pp. 979-986.

[4]Robert C. Wingert, "Evaluation of a Readiness Training Program," The Reading Teacher, Vol. 22, No. 4 (January, 1969), pp. 325-328.

In 1968, Paradis studied the auditory discrimination skills of lower socioeconomic kindergarten pupils. His results indicated that none of the tasks was easy for the pupils, but they had the greatest success with rhyming sounds. Paradis concluded that children from lower socioeconomic backgrounds are likely to need instruction in auditory discrimination tasks.[1]

Sequenced experiences relating to the integration of perceptual-motor functioning are believed to contribute to children's beginning school success; for example: the complex form discrimination task encountered in reading may be one of the skills that is affected as a result of the visual discrimination tasks required in readiness exercises.

Some concern has been voiced in the literature regarding the value of perceptual-motor training which is based on the transfer effect with reading skills of skills gained from practice with material consisting not of letters but of objects or geometric shapes. Such concern has contributed to the intuitive conclusion that practice on the academic material to be affected by training would appear to have a more significant educational influence.

The research literature suggests that training on fine-motor exercises which use geometric figures contribute little to the development of skills initially required in reading. This

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[1] Edward E. Paradis, "Kindergarten Children's Responses to Selected Auditory Discrimination Exercises in Reading Readiness Materials", (Unpublished Colloquium Paper, University of Minnesota, Minneapolis, Minnesota, 1968).

conclusion was drawn after study of the work of Cohen,[1] Linn,[2] and Rosen.[3] Bosworth reported that it may be argued that improvements in specific perceptual-motor skills, which are fundamental to learning of school skills, is the main purpose of the training. Only when factors such as the concept of form and learning set are involved in the training will any transfer effect be demonstrated.[4]

Barrett stated that it would appear that not only is "verbal-visual" discrimination a better predictor of first grade reading achievement, but that early knowledge of letters and sounds is causally related to reading achievement.[5] This view was supported by Chall in her studies.[6] Durrell's findings that

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[1]R. I. Cohen, "Remedial Training of First Grade Children with Visual-Perception Retardation," Educational Horizons, Vo. 45 (1966-1967), pp. 60-63.

[2]S. H. Linn, "Achievement Report of First Grade Students after Visual-Perceptual Training in Kindergarten," Academic Therapy, Vol. 3 (1968), pp. 979-986.

[3]C. L. Rosen "An Experimental Study of Visual Perception Training and Reading Achievement," pp. 979-986.

[4]M. H. Bosworth, Pre-Reading: Improvement of Visual-Motor Skills (Winter Haven, Florida: Winter Haven Lions Research Foundation, 1967).

[5]T. C. Barrett, "Review: Visual Discrimination and First Grade Reading," Reading Research Quarterly, Vol. 1 (1965), pp. 51-76.

[6]Jeanne S. Chall, Learning to Read: The Great Debate (New York: McGraw-Hill, 1967), pp. 140-149.

beginning first graders match letters with ease,[1] and the work of Gibson, Pick, and Osser,[2] designed to study the development of the ability to discriminate visually, lend support to the argument that training directed to the significant attributes of the forms to be learned holds greater potential transfer value than the typical matching exercises found in reading readiness materials.

Pryzwansky's study of six schools in a metropolitan city in Pennsylvania showed no significant gains in experimental groups for three methods of perceptual-motor training on reading readiness. His data revealed the lack of confirmation of the benefits to readiness which were hypothesized. He suggested that other facets of the training may be more important in the studies which do show significant gains.[3] One notion he presented is that the behavior of attending to important attributes to form represents the crucial element in successful learning. Equally important could be the cognitive demands involved in requiring the pupils to explain the reasoning behind their choices in a matching task.[4]

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[1]Donald D. Durrell, Success in First Grade Reading: A Summary", Journal of Education, Vol. 140 (1958), pp. 2-6.

[2]E. J. Gibson, J. J. Gibson, A. D. Pick, and H. Osser, "A Developmental Study of the Discrimination of Letter-like Forms," Journal of Comparative and Physiological Psychology, Vol. 55 (1962), pp. 897-906.

[3]Walter B. Pryzwansky, "Effects of Perceptual-Motor Training and Manuscript Writing on Reading Readiness Skills in Kindergarten," Journal of Educational Psychology, Vol. 63, No. 2 (April, 1972), pp. 110-115.

[4]Ibid.

Silberberg, Silberberg, and Iverson contended that the literature suggests that kindergarten training in general, and reading readiness activities in particular have no lasting effects, but that this may be a matter of diluting the training of reading with other activities subsumed under the rubric of "reading readiness."[1] The purpose of their study was to determine whether training in letter and number recognition in kindergarten would provide more lasting effects.

They took four classes of kindergarten pupils in two schools. They had a total of 109 students. The experimental group received fifteen minutes of formal lessons daily. The lessons were concerned with teaching letter and number names. The results showed that the experimental group made significant gains learning the names of letters and numbers, while the control group made only the usual modest gains. However, follow-up testing at the end of first grade showed that the special kindergarten training in letters and number recognition has no discernible effect upon end-of-first grade reading.

The theory of Piaget stresses the importance of perceptual-motor development as it is related to cognitive abilities. Piaget's theory localizes perceptual-motor development during the first two years of life. He emphasizes the growth during this period

[1] Norman E. Silberberg, Margaret C. Silberberg, and Iver A. Iverson, "The Effects of Kindergarten Instruction in Alphabet and Numbers in First Grade Reading," Journal of Learning Disabilities Vol. 5, No. 5 (May, 1972), pp. 254-261.

of various types of schemata that are associated with coordination between motor behavior and the response of different sensory modalities. Hence, according to Piaget's theory infants develop their cognitive abilities through repetitious sensory-motor activities such as observing a block drop, etc. These sensory-motor activities give rise to growth in the understanding of means-ends relationships, spatial and object constancy concepts. Piaget's theory de-emphasizes the role of sensory-motor activities in intellectual development during the periods that occur between two and seven years, and seven and eleven years of age. The sub-period of preoperational thought and the concrete operations period are more concerned with the growth of conceptual skills than with sensory-motor growth.

Fisher and Turner suggested that the key features of mental development in the sub-period of preoperational thought and the concrete operational period is the emerging facility with which children maintain constancies in their environment.[1] Therefore children's major developmental tasks are concerned with achieving the conservation of physical matter such as solid and liquid substances, and conceptual information such as space, time, and distance relationships.

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[1]Maurice D. Fisher and Robert Turner, "The Effects of Perceptual-Motor Training Program Upon the Academic Readiness of Culturally Disadvantaged Kindergarten Children." Journal of Negro Education, Vol. 41, No. 2 (Spring, 1972), pp. 142.

Piaget does not place much emphasis upon the role of perceptual-motor skills in facilitating conceptual development because his theory is based upon the idea that thinking abilities result from the internalization of motor behaviors. Following this internalization children no longer use sensory-motor means as the primary means of solving conceptual problems. Instead they resort to mental operations such as "reversibility."[1]

Piaget's de-emphasis of sensory-motor growth during these later stages of development does not indicate that this type of growth is unimportant; on the contrary, children's ability to solve conservation problems seems to depend on whether they have developed skills in manipulating concrete objects and observing the results of their actions.

Hoffman believes the attitude prevails in the minds of instructors from kindergarten through college, that the more varied experiences students have in a broad range of areas the more they will be able to relate their reading into a meaningful and integrated understanding.[2] Karlin has reported that "rich background" children score higher on reading readiness tests than do "meager background" children.[3] Carter compared age to

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[1]Ibid.

[2]Earl Hoffman, "Pre-Kindergarten Experiences and Their Relationships to Reading Achievement," Illinois School Research, Vol. 8, No. 1 (Fall, 1971), pp. 6-12.

[3]Robert Karlin, "Research in Reading," Elementary English, Vol. XXXVII (March, 1960), pp. 177-183.

reading readiness with controls for sex, and IQ, and found that 87 percent of the younger children had not equalled the achievement of older groups by the sixth grade.[1] Balow found that girls scored higher than boys in readiness.[2] Balow concluded that greater social, physical, emotional, attitudinal maturity, and an environment rich in varied experiences are the building blocks upon which the primary teacher builds successful reading achievement.

In summary, the literature reviewed suggested that the standard exercises offered in most readiness programs seem to be both necessary for many children, and appropriate enough to allow the learning of skills. The literature further suggested that testing should reveal the readiness training necessary for individual pupils. Following the diagnostic testing the programs should be tailored to meet the needs of each child's skill deficiencies, and level of cognitive growth.

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[1] L. B. Carter, "The Effect of Early School Entrance on the Scholastic Achievement of Elementary School Children in the Austin Public Schools," Journal of Educational Research, Vol. 50, (1956), pp. 91-113.

[2] I. Balow, "Sex Differences in First Grade Reading", Elementary English, Vol. 49 (1963), pp. 303-312.

Conservation and the Development of Knowledge

Piaget's theory of conservation has received much attention recently by such authorities as Elkind,[1] Sigel and Hooper,[2] and Flavell.[3] Most of the research has been in such areas as math and science. Within the past five years some researchers such as Elkind,[4] Almy,[5] Brekke,[6] and Crutchfield,[7] have begun to look into the relationships between reading and conservation.

In order to understand the research in reading and conservation it is important to understand the concept of conservation. Flavell defines conservation as:

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[1]David Elkind, "Conservation and Concept Formation," Studies in Cognitive Development, ed. by David Elkind and John Flavell (New York: Oxford University Press, 1969),

[2]Irving E. Sigel and Frank H. Hooper, ed., Logical Thinking in Children (New York: Holt, Rinehart and Winston, Inc., 1968).

[3]John Flavell, The Developmental Psychology of Jean Piaget (New York: D. Van Nostrand Co. Inc., 1963).

[4]David Elkind, "Cognitive Development and Reading," Claremont Reading Conference (Claremont, California: Claremont Reading Conference, 1974).

[5]Millie Almy, Young Children's Thinking.

[6]Beverly W. Brekke, "An Investigation of What Relationships Exist Between A Child's Performance of Selected Tasks of Conservation and Selected Factors in Reading Readiness," (Unpublished Doctoral Dissertation, University of North Dakota, 1972).

[7]Majorice Alice Crutchfield, "Conservation Training: Posited Effects on Reading Readiness," (Unpublished Doctoral Dissertation, University of California at Los Angeles, 1970).

> The cognition that certain properties (quantity, number, length, etc.) remain invariant (are conserved) in the face of certain transformations (displacing objects or object parts in space, sectioning an object into pieces, changing shape etc.).[1]

Belin discussed conservation and its importance to the understanding of cognitive processes and even its importance to the development of technology.

Belin stated:

> The young child's conservation capacities stand in such contrast to those of the older child's and adult's that research investigations throughout the world have been stimulated into an attempt to elucidate their nature. Aside from its novelty and incongruity, is that it appears to offer some important possibilities for understanding the general character of cognition and cognitive development.
>
> As a starting point, conservation may be said to involve the ability to retain one of a series of physical concepts in the face of the transformation of elements related to that concept. . . . in direct response to reality, particularly where reality is a highly industrialized world with almost constant activity and change, the development of invariant concepts may have considerable adaptive significance . . . .[2]

Piaget used his extensive studies to identify four stages of cognitive development. The first period of development is called the "sensorimotor" period. This corresponds in time to about the first two years of life. The important feature of

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[1]John Flavell, The Developmental Psychology of Jean Piaget, p. 245.

[2]Harry Belin, "Stimulus and Cognitive Transformation in Conservation," in Studies in Cognitive Development, ed. by David Elkind and John Flavell (New York: Oxford University Press, 1969), p. 410.

this period is that children are acquiring skills and adaptations of a behavioral nature. The schemata of this period are sensorimotor schemata; they organize sensory information and result in adaptive behavior, but are not accompanied by any cognitive or conceptual representations of the behavior or the external environment. It must be pointed out that these sensorimotor schemata are the historical roots out of which later conceptual schemata develop.

During this period of infancy, children become able to coordinate information gained through auditory, visual or tactual means. They become able to look at what they are listening to; their walking can be guided by various cues, they can hold their hands still so that they can look at an object they hold, and they can integrate the two hands so that they function cooperatively.

A second major acquisition of the sensorimotor period is the infant's ability to operate as if the external world were a permanent place. They begin the construction of the schemata of the permanent object. This means the children are able to assume the permanent identity of objects.[1]

Finally, they are able to exhibit goal-directed behavior that is governed from its beginning by some intention. They can put together two or three actions, all under the motivation to reach the end point of the sequence. Children are seriously

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[1]Jean Piaget, "Development and Learning", Piaget Rediscovered ed. Richard E. Ripple and Verne N. Rockcastle, (Ithaca, New York: Cornell University, March, 1974), pp. 9.

limited however, as to how far ahead they can plan their actions.

The end of the sensorimotor period is characterized by children's ability to make some type of mental representations, or actually the beginning of cognitive representations. In summary, during infancy or the sensorimotor period children progress through stages of development. At first their behavior is limited to those reflexes with which they are born. These are modified and expanded through experience, then they begin to acquire new schemata that are "extensions" of the reflex patterns. By the middle of the sensorimotor period they can acquire completely new behavior patterns which occur accidentally and they can immitate or prolong external events. Next, they can put together sets of schemata to achieve some end. Finally they can intentionally vary their behavior to produce new behaviors and therefore start to conceptualize mental representations.

Following the period of infancy there is a period of several years during which children's internal cognitive structures of the external world are growing and developing. This period is called the "preoperational" period and lasts from about age two to seven. It is one of the most puzzling periods to understand. The children's mental work consists principally in establishing relationships between experience and action; they are concerned with manipulating the world through action. This stage corresponds to the point at which children learn to manipulate symbols; but the children's symbolic world does not make a clear separation between internal motives and feelings on the one hand, and external reality on the other. The children are not quite able to separate their own goals from the means for achieving them, and when they have to make corrections in their activity after unsuccessful attempts at reality, they do so by trial-and-error rather than the result of logical thinking.

The preoperational stage is primarily a transitional one, not marked by any degree of stable equilibrium. The end of the sensorimotor stage represented a kind of equilibrium at the behavioral level. The stage of concrete operations represents a new, higher-order equilibrium, and the preoperational stage is the transition between the two.

In summary, the preoperational period in the development of children marks the interval from the earliest beginnings of cognitive representations in the form of concrete imagery and rudimentary symbolism, to the time in which the children's conception of their environment and its operation is coherently organized. This conceptualization permits a more decentered adaptation to the environment than either sensorimotor schemata or perception. During this period the inconsistencies and lack of organization in children's thinking stand out. At times, preschool children seem to behave in a perfectly logical manner, and then, quite mysteriously, they fail to follow through an apparently simple logical pattern. The end of this period is characterized by children's attempts to stabilize and organize their thinking.

The third developmental period is what Piaget calls the stage of concrete operations.[1] This stage lasts from about age seven to age eleven. By now children are operational in contrast to the preceding stages, which were merely active. An operation is a type of action; it can be carried out rather directly by the manipulation of objects, or internally, as when one manipulates the symbols that represent things and relations in one's mind. An operation is a means of getting data about the real world into the mind, and there transforming them so that they can be organized and used selectively in the solution of problems. At the start of this period, children's formal thought processes become more stable and reasonable. The very important characteristic of reversibility is present in this period.[2] This means that the grouping of schemata becomes a part of the children's mode of behavior, and complete compensations (any operation is compensated by an inverse operation) is used in their attempts at problem solving. For example, if marbles are divided into subgroups, the children can grasp intuitively that the original collection of marbles can be restored by being added back together again. With the start of the concrete opera-

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[1]Piaget, "Development and Learning," p. 9.

[2]Ibid.

tional period children develop an internalized structure with which to operate. At this point, Piaget stressed the importance of translating ideas into the language of these structures if children are to grasp them.[1]

Concrete operations, though they are guided by logic of classes and relations, are means for structuring only immediate or present reality; children are not yet readily able to deal with possibilities not directly before them or not already experienced. This is not to say that children in this period cannot anticipate the things that are not present, they just do not command the operations required for the full range of alternative possibilities that could exist at any given time.

The final stage of Piaget's theory of intellectual development is what he called the stage of "formal operations."[2] It begins at about age twelve and is consolidated during adolescence. Children's intellectual activity seems to be based upon the ability to operate on "hypothetical propositions" rather than being restricted to what they have experienced, or what is immediately before them. At this point, children can understand the basic principles of causal thinking and scientific experimentation. They can think of possible variables and even deduce solutions that can later be verified by experimentation or observation. Probably the most important achievement of this stage of develop-

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[1]Hans G. Furth and Harry Wacks, Thinking Goes to School (New York: Oxford Press, 1974), pp. 19-21.

[2]Piaget, "Development and Learning," p. 9.

ment is that the adolescent's system of mental operations has reached a high degree of equilibrium; thought is flexible and effective. This stage of development marks the growth in intellectual development which gives the individual the capacity for creativity.

"To understand the development of knowledge," says Piaget, "we must start with an idea. . . the idea of an operation."[1] Knowledge is not a copy of reality. To know an object, to know an event, is not simply to look at it and make a mental copy or image of it. To know an object is to act on it. To know is to modify, to transform the object, and to understand the process of this transformation, and as a consequence to understand the way the object is constructed. An operation is thus the essence of knowledge; it is an interiorized action which modifies the object of knowledge. For instance, an operation would consist of joining objects in a class to construct a classification. Or an operation would consist of ordering, or putting things in a series. Or an operation would consist of counting, or of measuring. It is a set of actions modifying the object, and enabling the knower to get at the structures of the transformation.[2]

An operation is an interiorized action, but in addition it is a reversible action; that is it can take place in both directions. For instance, adding or subtracting, joining or separating, are reversible operations.

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[1]Piaget, "Development and Learning," p. 8.

[2]*Ibid.*

"Above all," asserts Piaget, "an operation is never isolated."[1] It is always linked to other operations, and as a result it is always a part of a total structure. For example, a logical class does not exist in isolation; what exists is the total structure of classification. An asymmetrical relation does not exist in isolation. Seriation is the natural, basic operational structure. A number does not exist in isolation. What exists is the series of numbers which constitute a structure.

Piaget reported that these operational structures are what constitute the basis of knowledge, the natural psychological reality, in terms of which we must understand the development of knowledge.[2]

Pulaski interpreted Piaget's use of the word operation as referring to actions in thought or mental operations as opposed to physical actions. She reported that children who cannot escape from the compelling aspects of the immediate stimulus and think about what it looked like before the transformation, are in the preoperational stage.[3]

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[1]Ibid.

[2]Ibid., p. 9.

[3]Mary Ann Pulaski, Understanding Piaget (New York: Harper & Row, 1971), p. 30.

Piaget has offered four factors which can be called upon to explain the development from one set of structures to another. Each of the factors is important, yet alone, none of the four can fully explain the development of cognitive structure. First there is maturation, in the sense of Gesell this development is a continuation of the embryogenesis; second, the role of experience, the effects of the physical environment on the structures of intelligence; third, social transmission in the broad sense (linguistic transmission, education, etc.); and fourth, a factor which is too often neglected, but one which seems to be fundamental and even the principal factor, that of equilibrium or self-regulation.[1]

Hunt pointed out that maturation certainly does play an indispensable role in learning, it does not fully explain everything because the average age at which these stages appear varies a great deal from one society to another.[2] The ordering of these stages is constant and has been found in all the societies studied. Although the order of succession is constant, the chronological ages of these stages varies a great deal.

Experience of objects, of physical reality, is obviously a basic factor in the development of cognitive structures.

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[1]Gil Guadia, "The Piagetian Dilemma: What Does Piaget Really Have to Say to Teachers." The Elementary School Journal Vol. 74, No. 8 (May, 1974), p. 481.

[2]Hunt, Intelligence and Experience, pp. 344-363.

Piaget's objection to the sufficiency of experience as an explanatory factor is that the notion of experience is a very equivocal one. He contends there are two kinds of experience which are psychologically very different, and this difference is very important from the pedalogical point of view. It is because of the pedalogical importance that he emphasizes this distinction. First there is physical experience, and second, logical-mathematical experience.[1]

Physical experience consists of acting upon objects and drawing some knowledge about the objects by abstraction from the objects. For example; to discover that a pipe is heavier than a watch, the child will weigh both of them and find the difference in the objects themselves. This is experience in the usual sense of the term--in the sense used by empiricists. There is however, a second type of experience which Piaget calls logical-mathematical experience where the knowledge is not drawn from the objects, but is drawn by the actions effected upon the objects.[2]

It is not the physical property of the object which the experience uncovers; it is the properties of the actions carried out on the objects, and that is quite another form of experience. It is the point of departure of mathematical deduction. The subsequent deduction will consist of interiorizing these actions and then of combining them without needing the object. Children

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[1]Piaget, "Development and Learning," p. 11

[2]*Ibid.*

can combine operations simply with symbols, and the point of departure of this mathematical deduction is logical-mathematical experience, and this is not at all experience in the sense of the empiricists.

The third factor is social transmission-linguistic transmission, or educational transmission. This factor is fundamental to learning, but not inclusive. It is also related to the two previous factors. Bloom stated that research has shown that the language deficiencies of many children are related to the way the language is used in the home, and to the type of experiences the children had prior to coming to school. According to Bloom, weaknesses in language, limited range of experiences, and restricted stimulation of an intellectual nature, all operate to produce cognitive deficiencies.[1] Children can receive valuable information via language from an adult, only if they are in a state where they can understand it. To receive the information they must have a structure which enables them to assimilate it.[2]

The fourth factor is that of equilibration. Piaget contends this is the fundamental factor. Since there are already three factors, they must somehow be equilibrated among themselves. This is one reason for the factor of equilibration.

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[1]Benjamin Bloom, Allison Davis, and Robert Hess, <u>Compensatory Education for Cultural Deprivation</u> (New York: Holt, Rinehart and Winston, 1965), pp. 70-71.

[2]Piaget, "Development and Learning", p. 13.

The second reason is that in the act of knowing, the subjects are active, and consequently, faced with an external disturbance, they will react in order to compensate and consequently they will tend towards equilibrium. Equilibrium, defined by active compensation, leads to reversibility. Operational reversibility is a model of an equilibrated system where a transformation in one direction is compensated by a transformation in the other direction. Equilibration is thus an active process. It is a process of self-regulation.[1]

The concept of equilibration is central to Piaget's theorizing concerning the development of intelligence. Silverman and Geiringer ascribed a very broad role to equilibration in development, identifying it with self-regulatory growth factors which integrate the classical factors of development (maturation, social transmission, and experience).[2]

Equilibration was defined as that state of balance between assimilation and accommodation toward which all cognitive functions tend.[3] Assimilation was conceptually defined as attempts

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[1] Ibid.

[2] I. W. Silverman and E. Geiringer, "Dyadic Interaction and Conservation Induction: A Test of Piaget's Equilibration Model," Child Development, Vol. 44, No. 4 (December, 1973), pp. 815-820.

[3] Linda Preston Scott, "A Learning Model Based on Piaget, Nietzsche, and Mead," Reading Improvement, Vol. 12, No. 4 (Winter, 1975), pp. 233-235.

to relate the new phenomenon to the existing cognitive framework. This process of assimilation takes place in the stage of manipulation, where the perceiving organism attempts to place the phenomenon perceived within the context of what prior experience has shown to be in its place.[1]

Having found themselves unable to fit the new stimuli into the conceptual framwork as it exists, individuals try on heretofore unrecognized modes of dealing with the problem facing them. They dialectically entertain, dispose of and/or remodel ideas as a means of resolving their situation; a process Piaget called accommodation.[2]

The process of accommodation, as defined by Piaget, involves the individual's alteration of existing cognitive structures in order to assimilate environmental stimuli.[3]

Equilibration is also used by Piaget as a concept to explain the sequential character of development, or the opinion that intelligence evolves through a series of stages in constant order. Piaget reported that there is achieved at each stage of development, a more or less stable equilibration of the subject's mental structures.[4] However, at any given moment a structure can be disequilibrated by the transformations that arise in

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[1]Ibid.

[2]Ibid.

[3]Ibid.

[4]Jean Piaget, Six Psychological Studies, (New York: Random House, 1967), p. 6-8.

reality or thought. Piaget postulated that the inherent tendency of mental structures "consists not only in reestablishing equilibrium, but also in moving toward a more stable equilibrium than that which preceded the distrubance."[1]

Central to the concepts of assimilation, and accommodation is the understanding that individuals attempt to keep their mental organization abreast of their information, achieved through interaction, as to the organization of the outside world. They are constantly reorganizing to be in a state of equilibrium or adaptation.[2] They are seekers through their sense. They gather or assimilate information from the environment that does not easily fit into what they know, so they must therefore reconstruct their conceptual framework. This process of reconstruction is called accommodation.[3] How they accommodate depends on the kind of equilibrium or adaptation they have so far achieved. At first infants can assimilate only through the senses. Later their mental and physical development enable them to manipulate objects physically. When they are seven or eight, they are able to manipulate objects mentally (to conserve), but they are still conceptualized with reference to their imagined direct action on them. By the age of eleven or twelve, they can perform these mental operations abstractly.

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[1]Ibid. p. 7

[2]Justin Fishbein and Robert Emans, A Question of Competence (Chicago: Science Research Associates, 1972), pp. 109.

[3]Ibid.

Elkind discussed conservation and concept formation in detail. He wrote that psychologically speaking, concepts are mechanisms by which individuals attempt to cope with the multiplicity of nature. Via concepts individuals are able to deal with new events in terms of past experiences and thus effect a psychic efficiency.[1]

Elkind further stated, the most general function of concepts is that of adaptation. Concepts can serve the goals of adaptation in multiple ways. By eliminating the need for fresh adaptations each time a new situation is encountered, classificatory responses help with psychic efficiency. Conservation serves as an adaptive function by preserving the object in experience. Conservation principles enable individuals to conserve objects in reality by enabling them to distinguish between the real and the apparent in both thought and in reality.[2]

It is during the stage of transition from preoperational to concrete operational functioning that children undertake the highly complex task of learning to read. In learning to read children are faced with several problems: (1) the children must develop the idea that the written word or symbol stands for the spoken word that they have come to know, (2) the children must master the written

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[1]David Elkind, "Conservation and Concept Formation," Studies in Cognitive Development, ed. by David Elkind and John Flavell (New York: Oxford University Press, 1969), pp. 172.

[2]Ibid., pp. 176-177.

symbol in the task referred to as word recognition. The children's newly gained operational knowledge permits them to gain the skill more rapidly than if the task were introduced in the previous stage of development. It should be noted that word recognition at this time represents only the beginning of a continuum which ranges from the recognition of concrete object words through the highly abstruse words associated with many disciplines. Thus, the appearance of word recognition represents the beginning of a sequence as well as the culmination of one.[1]

The ability to recognize written symbols does not assure reading with comprehension. Before comprehension evolves, children are faced with yet another complex operation, that of transferring to the symbol all that they have come to know about the object, and previously transferred to the spoken word. For example: when children hear the word candy all past experiences with candy are associated with the spoken word. Now when children read the word candy all knowledge of the word must be transferred to a written symbol.

Reading comprehension is a highly abstract task which involves the development of meaning followed by a duel shift of the meaning: first from the object to the spoken word, and subsequently from the spoken word to the written word.

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[1]Lois P. Macomber, "The Developmental Aspects of Reading Comprehension," ERIC, ED. 066 727 (Arlington, Virginia, 1972), pp. 23-24.

Thus, reading comprehension represents the reciprocal relationship between knowing and learning. The absence of "knowing" prohibits the reciprocal exchange, relegating reading completely to the area of learning, consequently to a less stable and more tenuous position.[1]

Children can "learn" a word, or respond correctly to conservation task items, however, if the children do not associate meaning with the word, or understand what happened during the transformation of an object or event in conservation tasks, the learning is more rapidly subject to extinction than a word or principle of conservation that is understood. Children learn by action, the teacher prepares the focus of action and interaction within the reading instruction by ensuring opportunity for action specific to learning to read. Reading instruction proceeds on many fronts, each tied to its particular manipulative correlate--letter-letter, letter-sound, written word spoken word, and so on.

The major purpose of reading instruction is to improve comprehension. To comprehend means to understand. The limiting factors in learning to read are the maturity of the readers and the experiences of the readers, how old are the readers, and what developmental experiences have the readers had to prepare them for reading? Reading is a mental process, as is concept development. To a large degree the processes are similar.

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[1]*Ibid.*, p. 24.

Actions constitute the key aspect of all cognitive functioning. Overt actions (slow and concrete) and covert actions (internalized, abstract) involve action as the common demoninator of cognitive behavior. It is no accident that as children mature they develop a heirarchy of values and systems, but rather it is the result of the cognitive organization so far developed.

The route to symbolic functioning is characterized by a cognitive form that is far more encompassing than perceptual or sensory-motor representations. Representational thought can recall the past, represent the present, and anticipate the future in one brief act.

Piaget and many other philosophical epistomologists believe that if learning is to be functional it must lead to understanding and knowledge.

Training for Conservation

If the ability to learn to read is influenced by the ability to conserve, practitioners are left with a dilemma. Should they wait for children to naturally acquire the ability to conserve, or can they take positive action to train children to conserve?

Much recent research has shown that some training procedures can teach children to conserve. Comprehensive reviews of the literature on conservation training may be found in several sources: Flavell,[1] Almy,[2] Bruner,[3] and Sigel and Hooper.[4]

There is some skepticism and criticism of the training of conservation. Robert Gagné is skeptical of the effectiveness of conservation training.[5] He referred to studies conducted by Wohlwill and Lowe, Sigel and Roeper, and Smedslund. Gagné referred to Wohlwill and Lowe's statement that the results of their study were such that no effects could be shown for any of the training procedures.[6] Gagné continued by

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[1]John Flavell, The Developmental Psychology of Jean Piaget.

[2]Millie Almy, Young Children's Thinking.

[3]Jerome Bruner, Oliver R. Rose, and Patricia Greenfield, et al., Studies in Cognitive Growth (New York: John Wiley & Sons, 1966).

[4]Irving E. Sigel and Frank H. Hooper, ed. Logical Thinking in Children (New York: Holt, Rinehart and Winston, Inc., 1968).

[5]Robert M. Gagné, "Contributions of Learning to Human Development", Psychological Review, Vol. 75, No. 3, (May, 1968), pp. 177-191.

[6]Joachim F. Wohlwill and Roland C. Lowe, "An Experimental Analysis of the Development of the Conservation of Number", Child Development, Vol. 33 (1962), pp. 153-167.

reporting that the studies by Smedslund,[1] Sigel and Roeper,[2] and others, led to the same conclusions.

Gagné proposed an alternative theory of intellectual development. He stated that: "Learning contributes to the intellectual development of the human being because it is cummulative in its effects."[3] Children progress from one level to another, because they learn an ordered set of capabilities which build upon one another in a progressive fashion not because they acquire new associations.

Jan Smedslund has done many studies on the training of conservation skills, just as Gagné reported. His work of the late fifties and early sixties established the framework for later researchers who have achieved significant results with training procedures. In a study done in 1959, Smedslund set up an experiment to learn which worked best, a system of external reinforcement, or a system using equilibration theory, to induce conservation. His results while not significant at the expected level, indicated that a concept of conservation may be

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[1]Jan Smedslund, "The Acquisition of Conservation of Substance and Weight in Children," I-V, Scandinavian Journal of Psychology, Vol. 2 (1961), pp. 11-160.

[2]Irving E. Sigel and Anne Marie Roeper, "Finding the Clue to Children's Thought Processes," Young Children, Vol. 21 (1966), pp. 335-349.

[3]Robert M. Gagné, "Contributions of Learning to Human Development," Psychological Review, p. 181.

acquired as a function of external reinforcement.[1]

Sigel, Hooper and Roeper reported on a study they did to train conservation of quantity.[2] They took ten non-conserving children and randomly assigned them to two groups. The experimental group went to an office for training. The training focused on multiple labeling, multiple classifications, multiple relations and reversibility. The training procedures did not focus directly on the tasks to be tested. The sessions were twenty to thirty minutes a day for five weeks. The control group also went into an office, but they discussed social studies.

In the control group one child showed an ability to do one conservation task after the five week period. The children in the experimental group did show an increase in conservation skills. Gagné indicated that the results showed the training to be less than effective, it was not general. However, the results were significant at the .025 level on the Fisher Probability Test.

Wohlwill and Lowe have done several studies which involved exposing children, presumed to be slightly below the age of onset of conservation, to systematically manipulated learning experiences

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[1]Jan Smedslund, "The Acquisition of Conservation of Substance and Weight in Children," in Logical Thinking in Children pp. 265-281.

[2]Irving E. Sigel, Anne Marie Roeper, and Frank H. Hooper, "A Training Procedure for Acquisition of Piaget's Conservation of Quantity: A Pilot Study and Its Replication," in Logical Thinking in Children, pp. 295-308.

designed to call into play different factors believed to be important in the development of number conservation.[1] One experiment by Wohlwill and Lowe, involved a verbal pretest, pretraining in number matching, a non-verbal pretest, and the actual teaching. The training involved four conditions: (1) reinforced practice; the subjects determined the number of objects immediately before and after their spatial arrangement (in terms of their spread in a horizontal line) had been changed, (2) addition and subtraction; subjects were trained in observing the effects of addition and subtraction of one object from a larger aggregate on the determination of the number of such objects after their spatial arrangement had been changed, (3) dissociation; subjects received practice in counting an aggregate of objects under varying spatial arrangements, and (4) control no treatment applied. The three experimental conditions were designed to relate respectively to reinforcement, inference, and differentiation hypotheses.

The subjects were seventy-two kindergarten pupils with a mean chronological age of 5.10. There were eighteen subjects in each training condition group. The major finding of this study was that none of the procedures proved in any way effective in

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[1]Joachim F. Wohlwill and Roland C. Lowe, "Experimental Analysis of the Development of the Conservation of Number," in <u>Logical Thinking in Children</u>, pp. 324-339.

leading to an understanding of the principles of conservation. Wohlwill and Lowe explained this failure of the nonverbal conservation learning to transfer to a verbal posttest by suggesting that the nonverbal situation favored the development of an essentially empirical rule. If this were the case, little if any transfer to the very different situation confronting the children in the verbal conservation questions could be expected.

In 1968 Feigenbaum conducted a study to see if training procedures could induce conservation of discontinuous quantity in children, and also to see if conservation ability increased children's ability to take different social roles.[1] He used eight heterogeneous groups. Seven of the groups received six weeks of small group training on different combinations of three basic conditions. The three conditions of training were reversibility-reciprocity, physical perspective taking, and social role playing. One group received no training, this was the control group.

Feigenbaum's findings, which were significant at the .05, .02, and .01 levels, indicated that reversibility-reciprocity training does increase conservation of discontinuous quantity, and the conservation of discontinuous quantity does increase children's ability to take different social roles.

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[1]Kenneth D. Feigenbaum, "A Pilot Investigation of the Effects of Training Techniques Designed to Accelerate Children's Acquisition of Conservation of Discontinuous Quantity," <u>ERIC</u> ED 044 178 (Arlington, Virginia, 1968), pp. 1-29.

Wallach and Sprott conducted a study using sixty-six first graders from a middle class university town. The pupils ages ranged from 6.5 to 7.8. On the pretest there was no significant difference in conservation ability between the control and the experimental groups. The results on the post-test, which was administered after the training was given the experimental group, showed a difference which was significant at the $p < .01$ level. Wallach and Sprott concluded that training was very effective. Conservation can be acquired by experience with reversibility.[1]

The purpose of Nelson's study was to assess the development of certain logical operations in young children and to ascertain whether these cognitive processes might be developed at an earlier age than Piaget has indicated.[2] Her study was designed to test children on three cognitive tasks involving conservation of number, mass, and quantity. Each task entailed manipulating specific materials and responding to questions. The questions sought to determine whether the children understood equilivalency and reversibility as involved in number, mass, and quantity tasks.

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[1]Lise Wallach and Richard L. Sprott, "Inducing Number Conservation in Children." Child Development, Vol. 35 (December, 1964), pp. 1057-1072.

[2]Lois N. Nelson, "The Development of Cognitive Operations in Young Children," Journal of Educational Research Vol. 68, No. 3 (November, 1974), pp. 116-123.

The data suggested that cognitive development does follow an age related developmental sequence. Nelson concluded that her research reaffirmed the age-related developmental sequence that cognitive growth follows; therefore, efforts to stimulate cognition must consider the stage-related prerequisite operations which may be incorporated into the daily curricular offerings of the school.

Murray,[1] and Silverman and Geiringer[2] have demonstrated that conservation can be acquired in a social conflict situation in which the conservers and non-conservers confront each other and are required to agree and give a single group conservation judgment on a series of problems.

A number of other researchers such as Kuhn,[3] and Rosenthal and Zimmerman,[4] have shown that some nonconserving children could acquire conservation by merely observing conserving

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[1]Frank B. Murray, "Acquisition of Conservation Through Social Interaction," Developmental Psychology, Vol. 6, No. 1 (1972), pp. 1-6.

[2]I. W. Silverman and E. Geiringer, "Dyadic Interaction and Conservation Inducement: A Test of Piaget's Equilibration Model." Child Development, Vol. 44, No. 4 (December, 1973), pp. 815-820.

[3]D. Kuhn, "Mechanisms of Change in the Development of Cognitive Structures," Child Development Vol. 43, No. 3 (September, 1972), pp. 833-844.

[4]T. L. Rosenthal and B. J. Zimmerman, "Modeling By Exemplification and Instruction in Training Conservation," Developmental Psychology, Vol. 6 (1972), pp. 392-401.

adult models. Thus, the acquisition of conservation in the social conflict situation may have been the result of imitation of conservers rather than the effect of conflict with conservers.

Murray and Botvin[1] studied fifty-three nonconserving first graders and twenty-five conserving second graders. The children were randomly assigned to one of three treatment groups. (1) A social interaction group in which two nonconservers were confronted with three conservers. (2) A modeling group in which nonconservers observed conservers, and then the nonconservers responded to conservation problems. (3) A control group to which no treatment was applied.

The results indicated that both groups made significant gains when compared with the control group. There was no significant difference in the improvement of the nonconservers performance between the interaction group and the modeling group.

Murray and Botvin reported that the results suggest that initial conservation is based upon quite a different system of justification than is found later in seasoned conservers. They stated that initial conservers favor identity reasons and only later come to support their judgments with reversibility and compensation reasons.

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[1]Gilbert J. Botvin and Frank B. Murray, "The Efficacy of Peer Modeling and Social Conflict in the Acquisition of Conservation," Child Development, Vol. 46, No. 3 (September, 1975), pp. 796-799.

Piaget's theory requires children to ignore several misleading perceptual cues and provide a logical explanation before he diagnoses children as conservers. His test of conservation of liquid quantity presents many cues; different heights, widths of various containers, movement of the water, the color. The children must decide which of these many cues, if any, are relevant to quantity. The information processing requirements are great.

Miller and Heldmeyer expressed concern that the standard tests of conservation may make performance unnecessarily difficult and even mask children's true competence.[1] They felt systematically removing these cues would reveal a clearer picture of exactly how perceptual information influences conservation performance in young children.

Miller and Heldmeyer used Piaget and Inhelder's "screening technique;" that is blocking part or all of the stimuli from the children's view. They used kindergarten and first grade pupils. Their results indicated that kindergarten children, but not first graders were affected by the amount of perceptual information.[2]

Frank devised a study using forty pupils between the ages of four and seven. She showed that training procedures increased

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[1]Patricia H. Miller and Karen H. Heldmeyer, "Perceptual Information in Conservation: Effects of Screening," Child Development, Vol. 46, No. 2 (June, 1975), pp. 588-592

[2]Ibid.

children's ability to conserve liquid by up to seventy percent. She also showed that nearly all the children were able to conserve when screening procedures were used, but that when the screen was removed, the younger children reverted back to nonconserving answers.[1]

Sonstroem hypothesized that (1) children who do experiments will conserve better than children who just observe, (2) children who get verbal labels will conserve better than children who do not get verbal labels, (3) screening procedures will help children learn to conserve.[2] She took eighty-one first graders with a median age of seven, and gave them one of three types of conservation training. The results indicated the following: (1) screening procedures were effective in inducing conservation, (2) children who manipulated objects learned to conserve better (22 of 41 conserved on the posttest), (3) verbal labeling is most effective in inducing conservation (24 of 41 conserved on the posttest).

Piaget and Inhelder indicated that nonconservers may appear to be conservers in the screening situation only because they expect the water level to remain the same. Thus they are "pseudoconservers."[3] They suggested that conservation of

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[1]Jerome Bruner, "On Conservation of Liquid," in _Studies in Cognitive Growth_, pp. 183-207.

[2]Anne McKinnon Sonstroem, "On Conservation of Solids," in _Studies in Cognitive Growth_, pp. 208-224.

[3]Jean Piaget and Barbel Inhelder, _Mental Imagery in the Child_, (New York: Basic Books, 1971).

liquid quantity is not an all-or-none ability, but instead consists of several levels. That is, many children considered to be nonconservers may have a rudimentary understanding of the variance of liquids. This rudimentary understanding is fragile and easily shattered by the overwhelming perceptual cues of the irrelevant features. Eventually the concept generalizes to all perceptual conditions.

Recent experiments by Siegler and Liebert indicated that five or six year olds can acquire the conservation of liquid concept rapidly through a combination of verbally presented rules and immediate feedback.[1] The children were required to provide both answers and reasons for their judgments after each trial.

Each rule included a direct statement of the relationship between the particular pouring operation and its consequence (e.g., "the rule is that when we pour all the water from one glass into an empty glass there is the same amount of water to drink as before.")[2], and an explanation of why this was the case (e.g., "this is because we haven't added any water or taken any away. It doesn't matter if it looks taller, or

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[1]R. S. Siegler and R. M. Liebert, "Effects of Presenting Relevant Rules and Complete Feedback on the Conservation of Liquid Quantity Tasks," Developmental Psychology, Vol. 7, (1972), pp. 133-138.

[2]Robert S. Siegler, "Inducing a General Conservation of Liquid Quantity Concept in Young Children: Use of a Basic Rule and Feedback," Perceptual and Motor Skills, Vol. 37 (1973), pp. 443-452.

shorter, or whether the glass is thinner or wider, or how high the water is. It is the same water so the amount is the same. We can pour the water back into the first glass and have the same amount because it is the same water.")[1]

Other investigations employing verbal rules have relied on similar descriptions and justifications. Belin,[2] and Smith,[3] and Peters[4] would first describe the consequences of number, length, weight, and liquid quantity conservation transformations respectively, and then refer to absence of addition/subtraction, irrelevance of perceptual attributes, and operational reversibility as justification for their initial statements. The success of these training procedures provided evidence for the general effectiveness of rule statements.

In 1969, Stafford conducted a study to determine if an inquiry science program which provided beginning first grade

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[1] Ibid.

[2] Harry Belin, "Learning and Operational Convergence in Logical Thought Development," Journal of Experimental Child Psychology, Vol. 2 (1965), pp. 317-339.

[3] I. Smith, "The Effects of Training Procedures Upon the Acquisition of Conservation of Weight," Child Development, Vol. 39 (1968), pp. 515-526.

[4] D. L. Peters, "Verbal Mediators and Cue Discrimination in the Transitions from Nonconservation to Conservation of Number," Child Development, Vol. 41 (1970), pp. 707-722.

children with a variety of experiences with objects from their environment would significantly enhance the rate of attainment of conservation skills.[1]

Sixty children were chosen to make the experimental and control groups. They were pretested on conservation of number, length, weight, liquid amount, solid amount, and area, using Piagetian tasks and techniques. Both groups were then given a treatment which was the same except that the control group received a regular textbook program of science, and the experimental group received the Science Curriculum Improvement Study program.

Posttest differences in behavior relative to conservation ability were attributed to the different treatments given the groups. Analysis showed the experimental group had greater growth in conservation skills in all six areas. Number and length were significant at the .01 level. Comparisons on the increase in conservation were also made on the basis of I. Q., readiness scores, kindergarten attendance, and gender. In all comparisons the experimental group scored higher.

Young and Austin conducted a study designed to induce conservation of number, weight, volume, area and mass in disadvantaged children. They used a three week training period for their study. They found that the lesson plans were effective

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[1]Donald G. Stafford, "The Influence of the First Grade Porgram of the Science Curriculum Improvement Study on the Rate of Attainment of Conservation," (Unpublished Doctoral Dissertation, University of Oklahoma, 1969) .

for children with a M A over three years, and in the I. Q. range of 60-167. They concluded that the lessons were effective in improving conservation. They further concluded that the lessons were simple enough to be taught by inexperienced teachers using only the printed lesson plans.[1] It is due to the conclusion that the lessons were effective and easy to use that Young and Austin's lesson plans were chosen for use in this study.

Conservation and Reading Readiness

From children's points of view, the concept of the letter poses many of the same problems as concepts of number, space, and time.

Before the age of six or seven most children lack a true unit or number concept because they cannot coordinate two dimensions or relationsips simultaneously. Such coordinations are basic to the construction of a unit concept because a unit is, by definition, both like every other unit and different from it in its order of enumeration.[2]

In many ways children's problems understanding the concept of a letter are more difficult than understanding the concept of a number. Letters, like numbers have an ordinal (position) property, and a cardinal (name) property. In addition letters

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[1]Beverly S. Young and Stephen F. Austin, "Inducing Conservation of Number, Weight, Volume, Area, and Mass in Disadvantaged Preschool Children--A Math Readiness Final Report," ERIC, ED 060 154 (Arlington, Virginia, 1970), pp. 1-79.

[2]David Elkind, "We Can Teach Reading Better," Today's Education, Vol. 64, No. 4 (November/December, 1975), pp. 34-38.

are more complicated than numbers because they also have phonic and contextual properties. One letter can stand for one or more sounds, and one sound can be represented by different letters. Hence, to understand phonics, children must be able to perform logical operations on letters and sounds to understand all their possible combinations.

Elkind reported that his research has shown that reading achievement and logical ability are highly correlated; that average readers are superior in logical ability to slow readers of comparable intelligence, and that training children in logical skills has a significant positive effect upon some aspects of reading achievement.[1]

According to Fowler, there are at least three major issues inherent in the question, "How early can a child learn to read?"[2] Aside from whether early reading results in long term advantages in cognitive development, perhaps the most essential issue concerns the matching between the cognitive operations required in reading, and those ordinarily developed in early childhood. A third issue centers on whether certain strategies of developmental stimulation can systematically develop in young children the cognitive skills of reading; skills apparently too complex to appear normally.[3]

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[1] Ibid.

[2] William Fowler, "A Developmental Learning Strategy For Early Reading in a Laboratory Nursery School," Interchange Vol. 2, No.2 (1971), pp. 106-23.

[3] Ibid.

Piaget and Inhelder reported that the mental processes of young children well into the elementary school years, are largely infralogical in form. That is, children's reasoning is heavily rooted in perceptions and manipulations of contiguious groupings as compared to their later logical structuring of phenomena on the basis of multidimensional, abstract criteria, which may often run counter to perceptually salient patterns.[1]

In recent years considerable theoretical and experimental effort has been expended on the problem of developmental shifts in children from associative to representational forms of cognitive functioning capable of transcending perceptual patterns. There is a substantial body of evidence summarized by White[2] on language, Luria[3] on transposition, and Sigel and Hooper[4] on conservation and other processes that tend to support Piaget's theory of a major developmental transition toward integrative, generalized forms of mental functioning from early to middle childhood.

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[1] Jean Piaget and Barbel Inhelder, The Early Growth of Logic in the Child, (New York: Harper & Row, (1964).

[2] S. H. White, "Evidence for a Hierarchial Arrangement of Learning Processes," in Advances in Child Development and Behavior, Vol. 2 ed. by L. Lipsitt and C. C. Spiker (New York: Academic Press, 1965), pp. 187-220.

[3] A. R. Luria, The Role of Speech in the Regulation of Normal and Abnormal Behavior (New York: Liverright, 1961).

[4] Irving E. Sigel and Frank H. Hooper, ed. Logical Thinking in Children.

The process of reading itself appears to be composed of both perceptual and some abstract processes that clearly encompass integrative conceptual operations.[1]

Brekke wrote, the time for beginning reading instruction in first grade usually corresponds to the transition of children from the pre-operational to the concrete operational stages. She reported that there has been scant research to investigate the relationship between the simultaneous progressions of development of both conservation and reading.[2]

In 1971, Brekke found that children's performance on selected tasks of conservation was significantly related to selected factors in reading readiness. She used a multiple linear regression model to get her analysis. Brekke tested the children in her study on the Gates-MacGinitie Readiness Skills Test, the SRA Primary Mental Abilities Test, and conservation of number and substance.[3]

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[1]E. J. Gibson, "Learning to Read," Science. Vol. 148 (1965) pp. 1066-1072.

[2]Beverly W. Brekke and John D. Williams, "Conservation as a Predictor of Reading Achievement," Perceptual and Motor Skills Vol. 40 (1975), pp. 95-98.

[3]Beverly W. Brekke, "An Investigation of What Relationships Exist Between a Child's Performance of Selected Tasks of Conservation and Selected Factors in Reading Readiness," (Unpublished Doctoral Dissertation, University of North Dakota, 1972).

In another study done in 1975, Brekke and Williams studied seventy-two first grade students with an age range from 91 months to 102 months. Five tasks were given to assess the attainment of conservation, including two tasks for conservation of number, and three tasks for conservation of substance. Children who succeeded on all five tasks were defined as conservers, and those who succeeded on less than five tasks were defined as nonconservers.[1]

Brekke's data indicated that, despite a significant relationship between both conservation and intelligence regarding success on a reading achievement test, neither is a significant predictor when a reading test has been included in the initial test battery. There is a strong relationship between conservation and intelligence with reading readiness, which accounts for a lack of the independent contribution of either conservation or intelligence with these two measures of reading achievement. Both singly and in combination, conservation and intelligence were significant predictors of reading achievement.

Crutchfield conducted a study to determine the effectiveness of a program of training for the development of conservation

[1] Beverly W. Brekke and John D. Williams, "Conservation as a Predictor of Reading Achievement," Perceptual and Motor Skills, pp. 95-98.

in kindergarten pupils and she also considered the relationship of such training to readiness for reading. Her main hypothesis was that conservation training would significantly influence reading readiness.[1]

She used thirty-four pupils and used the results of individual mental tests to form experimental and control groups. Following pretests on conservation and reading readiness, the experimental group received six weeks of conservation training. The control group received six weeks of placebo training. The posttests were administered to both groups. The results showed highly significant positive correlations between conservation ability and reading readiness. The F ratio for treatment was significant at the .001 level.

Hurta reported on a study where two groups of twenty-five children, ages 7.0 to 8.5 were selected. One group consisted of reading disabled children who read at a level six months or more below their anticipated level. The other group read at a level of six months or more above their anticipated level.[2]

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[1]Majorice Alice Crutchfield, "Conservation Training: Posited Effects on Reading Readiness," (Unpublished Doctoral Dissertation, University of California at Los Angeles, 1970).

[2]Marilyn J. Hurta, "The Relationship Between Conservation Abilities on Selected Piagetian Tasks and Reading Abilities," (Unpublished Doctoral Dissertation, East Texas State University, 1973).

Hurta's results showed a significant difference between reading disabled and nondisabled readers in the level of functioning on the Piagetian tasks measuring conservation of length. She found a difference which was not significant at the expected level of confidence, on Piagetian tasks measuring conservation of substance, and weight, and on the total scores of all conservation tasks administered. She found a statistically significant relationship between reading grade levels on certain Durrell Analysis of Reading Difficulty subtests and level of functioning on certain Piagetian tasks of conservation when the data were analyized wihtout regard to reading classifications.

Wagnor conducted a study of the relations between reading ability and Piaget's developmental stages as determined by WISC subtest profiles. He found the comparison between best and poorest reading groups to be significant at the .05 level for grade seven.[1]

Kent investigated the relationships and differences of reading comprehension, conservation ability, auditory discrimination, and visual-motor development of third grade pupils. She found significant differences in the number of third grade pupils

[1]Omer Leon Wagnor, "The Relations Between Reading Ability and Piaget's Developmental Stages as Determined by Wisc Subtest Profiles," (Unpublished Doctoral Dissertation, University of Michigan, 1971).

categorized by gender, and reading comprehension on two classifications of conservation ability, auditory discrimination, and visual-motor development. Kent's overall findings indicated a relationship between reading comprehension and conservation ability for all subjects.[1]

This review of the current literature indicated that there is a relationship between reading readiness and ability to perform certain Piagetian conservation tasks. Chapter III describes a study designed to determine if conservation training of kindergarten pupils will increase their readiness to read. Posttesting did not take place for eighteen weeks after the training procedure had been implemented.

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[1]Anita H. Kent "The Relationship of Reading Comprehension, Conservation Ability, Auditory Discrimination, and Visual-Motor Development of Third-Grade Pupils," (Unpublished Doctoral Dissertation, University of Oklahoma, 1973).

CHAPTER III

PROCEDURES OF STUDY

In order to control for extraneous variables and to allow for replication, research studies must have well outlined procedures. This chapter discusses in detail the procedures for this study.

The purpose of this study was to determine the effects of two programs of training on reading readiness. By comparing gains in reading readiness skills it was determined which of the techniques for readiness training had been more effective during the time period involved, and with the kindergarten students included in the study. The effectiveness of conservation training on reading readiness was examined by these results.

The main question asked by this study is; whether training in conservation increases children's readiness for reading. Does the gender of the children have an influence on the outcome? The review of the professional literature in Chapter II indicated that there is a relationship between readiness and conservation skills, and gender does influence language and reading skills.

Selection of Schools

The community of Edmond is a suburban community of 24,000 persons, located in close proximity to Oklahoma City.[1] According to the 1970 U. S. Census, Edmond had three minority group persons living in the city limits.[2] The median household income for the town is $12,950 per year.[3] Thus, Edmond is considered to be a predominately white middle class community.

Clyde Howell and Sunset Elementary Schools within the Edmond Public School System were chosen to conduct the experiment. They house all of the kindergarten pupils in Edmond. They are two of eleven schools in the district. The total enrollment of the Edmond Public Schools is 6650, with 3312 of these in elementary school.

Clyde Howell and Sunset schools were selected because they were the only two schools in Edmond that house kindergarten pupils. They also met the other criteria for the study; neither school has ability grouping of kindergarten pupils, students are

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[1]U. S. Department of Commerce, Block Statistics: 1970 U. S. Census (Washington, C. D.: U. S. Government Printing Office, 1971).

[2]Ibid.

[3]City of Edmond, Community Indicators Report, (University of Oklahoma: Bureau of Government Research, 1975).

randomly assigned to classrooms. Neither of the schools are "open concept" schools. They are traditional in their approach to kindergarten. The children have one teacher, they have pre-planned activities, and follow a planned curriculum. The kindergarten teachers all have two or more years of experience teaching kindergarten, both schools have eight sections of kindergarten and both schools use the same reading readiness program in all kindergarten sections, the Distar I program.

Selection of Subjects

One of the criteria established by the study was that the schools have at least eight kindergarten sections. This gave the researcher sixteen sections of kindergarten pupils.

Eight of the sixteen sections were randomly chosen for experimental manipulation, as shown in Table I. Two classes were selected from each school to receive experimental treatment in the morning, and the other two morning classes at each school would be the control group. Then the same procedure was followed at both schools for the selection of afternoon experimental and control groups. Thus, four classes received treatment in the morning, and four received treatment in the afternoon.

TABLE I

RANDOM TEACHING ASSIGNMENTS

School	Sunset				Clyde Howell			
Teacher	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8
Conservation and Readiness Training	M	A	M	A	M	A	M	M
Readiness Training	A	M	A	M	A	M	A	M

KEY:

T--Teacher

M--Morning

A--Afternoon

The pretest was given on November 3, 4, and 5, 1975, and the posttest was given on March 9, 10, and 11, 1976. The test was given over a three day period because this was recommended by the manual. Each teacher gave the test to her own students following the manual exactly. They used the exact words indicated in the manual to give instructions. This allowed all the students to receive identical instructions. Checks were made during the test administration to ensure uniformity of administration. Since all the teachers had had experience administering the _Metropolitan Readiness Test_ in the past, no inservice training was provided. They were given the manuals four days prior to testing so they could become familiar with it. The test booklets for the students were delivered to each teacher the morning of the first day of testing. When given the manuals the teachers were cautioned about being careful not to do any advance preparation of students for testing. A volunteer was there to help insure that all children had their booklets open to the correct page, and to insure that all children had a pencil or crayon. The volunteer gave no other assistance during the test administration. In some instances the testing environment was not ideal and not without limited distractions. There was noise from the playground, and unexpected persons entering the room during the testing.

The eight experimental and eight control groups were analyized as intact groups, and they were analyized by gender, as shown in Table II. The sample consisted of 433 kindergarten pupils. The experimental group began with 217 students, and the control group had 216 students. When subdivided by gender, the experimental group began with 104 males, and 113 females. The control group began with 106 males, and 110 females. Before the data were analyized the students were screened to eliminate from statistical analysis those students who were repeating kindergarten, and those students who moved away or moved into the district during the eighteen week period. The final sample

TABLE II

TOTAL NUMBER OF STUDENTS IN EACH GROUP
BEFORE AND AFTER SCREENING

			Readiness Training		Conservation and Readiness Training		Total
			Morning	Afternoon	Morning	Afternoon	
School Sites		Sex					
Clyde Howell	Before*	m	29	27	24	23	103
		f	24	28	29	31	112
	After**	m	28	23	22	17	90
		f	24	24	28	30	106
Sunset	Before	m	24	26	30	27	107
		f	30	28	26	27	111
	After	m	19	25	26	17	87
		f	29	25	22	26	102
Totals	Before		107	109	109	108	433
	After		100	97	98	90	385

* Number of students before the screening procedures were conducted

** Number of students after the screening procedures were conducted consisted of 385 kindergarten pupils. The experimental group had 188 students, and the control group had 197 students. When subdivided by gender, there were 82 males and 106 females in the experimental group, and 95 males and 102 females in the control group.

Instruments

The instrument chosen for measuring the reading readiness of the student participants was the Metropolitan Readiness Test (Forms A and B). Form A of the Metropolitan Readiness Test was given as a pretest measure of reading readiness. Form B was given as a posttest measure of reading readiness.

Prior to reporting the reliability and validity of the Metropolitan Readiness Test, it is pertinent to discuss Ronald Carver's two dimensions of tests, the "psychometric" and the "edumetric" dimensions.[1] According to Carver, if the primary purpose of a test is to measure individual differences, then the test should be evaluated using psychometric principles. Psychometric principles are the extent to which the test reflects a stable between-individual differences. However, if the primary purpose of the test is to measure the gain or growth of individuals, the test should be evaluated from an edumetric standpoint. Edumetric evaluation is done in terms of reflecting the within-individual growth, as was done in this study.

[1]Ronald P. Carver, "Two Dimensions of Tests," American Psychologist, Vol. 29, No. 7 (July, 1975), pp. 512-518.

According to Carver, to evaluate empirically the psychometric validity of a test, individual differences on the test are compared to individual differences on another variable assumed to be highly related to the test.[1]

In this study there was no other criterion available to compare with the Metropolitan scores, thus the validity cannot be reported in numerical terms. Nunnally stated that the best argument for validity consists of an appeal to common sense. The test content is obviously related to what it is intended to measure.[2] There are reasons why this argument may not be correct, but for so many problems concerning test validity, and considering the other validity studies to be cited, it is the best argument that can be made for the present study.

According to Nunnally, the major issue with respect to test reliability is seldom faced, "Reliability for what?"[3] Cronbach and others have pointed out that measures of reliability concern the error involved in generalizations from test to test, examiner to examiner, and situation to situation.[4]

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[1]Ibid.

[2]Jum C. Nunnally, "Psychometric Theory-25 Years Ago and Now," Educational Researcher, Vol. 4, No. 10 (November, 1975), p. 7.

[3]Ibid.

[4]L. J. Cronbach and L. Furby, "How We Should Measure 'Change'--Or Should We?" Psychological Bulletin, (1970), pp. 1, 68-80.

The reliability coefficient has become a general measure of trustworthiness of an instrument. Nunnally reported that reliability theory is not highly important for basic research on individual differences unless the reliability is low, below .70.[1]

The manual lists the total test-retest reliability of the Metropolitan Readiness Test as .91, and the split-half reliabilities as ranging from .90 to .95.[2] Farr wrote that the reliability was determined with odd-even coefficients by the Spearman-Brown formula. He listed the total score reliability as .90.[3] Harry Singer listed the alternate-form reliability of the total score as .91.[4] The total score, alternate-form reliability in this study was .8037. Farr stated, "Most of the items are current and the majority appear to be drawn from the middle class experiences of suburbia."[5]

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[1]Nunnally, "Psychometric Theory-25 Years Ago and Now," p. 10.

[2]Gertrude H. Hildreth, Nellie L. Griffiths, and Mary E. McGauvran, Metropolitan Readiness Test (New York: Harcourt, Brace and Jovanovich, Inc., 1969), p.28.

[3]Roger Farr and Nicholas Anastasiow, Tests of Reading Readiness and Achievement (Newark, Delaware: International Reading Association, 1969), p. 21.

[4]Oscar K. Buros, ed., Seventh Mental Measurements Yearbook (Highland Park, N. J.: The Gryphon Press, 1972), p. 1176.

[5]Farr, Tests of Reading Readiness and Achievement, p. 19.

The concurrent validity of the Metropolitan Readiness Test was reported by the technical manual as correlated with the Murphy-Durrell Reading Readiness Analysis at .80.[1] The correlation with the Lee-Clark Reading Readiness Test was reported to be .70.[2] Farr reported the concurrent validity as a correlation between the Metropolitan and the Pinter-Cunningham Primary Mental Abilities Test as .76.[3] These reliability and validity indices appear to be more than adequate for measuring the reading readiness of the student participants of this study. The Metropolitan Readiness Test tests six areas presumed to be involved in reading readiness, they are: word meaning, listening, matching, alphabet, numbers, and copying.

The reading readiness program chosen for this study was Distar-I published by Science Research Associates. This program consists of 58 lessons designed to be used every day.

During the past decade there has been considerable concern over the fact that some pupils achieve less than others. It has been suspected that if pupils who appear likely to underachieve could be helped to perform better during their early years in school, then failure rates might be lowered. The Distar language reading, and arithmetic programs were created especially to help

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[1] Hildreth, Metropolitan Readiness Test, p. 16.

[2] Ibid.

[3] Farr, Tests of Reading Readiness and Achievement, p. 20.

children who are judged to be likely to underachieve, and these programs have enjoyed wide acceptance.

Distar adoption by school districts has had as much justification in a number of studies documenting its effectiveness, as any other new educational program. Luna tested kindergarten pupils in November on the Stanford Early School Achievement Test, and retested in May. The experimental group received thirty minutes in Distar language, in groups of ten pupils. The experimental and control groups received regular programs of instruction the rest of the day. The control groups scored higher on the pretest than the experimental groups. On the posttests the Distar pupils made significant gains in SESAT scores on the subtests for letters and sounds.[1]

Other research by Silberberg[2] has shown that successful teaching of letter names before reading is introduced does not improve achievement, however, Luna argued that prior mastery of letter sounds, as aided by Distar is a more helpful means of facilitating learning to read.[3]

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[1]Ermalinda Luna, "Distar Language and Reading Programs: Effects Upon SESAT Scores," Colorado Journal of Educational Research, Vol. 14, No. 1 (Fall, 1974), pp. 2-5.

[2]Norman E. Silberberg, Margaret C. Silberberg, and Iver Iverson, "The Effects of Kindergarten Instruction in Alphabet and Numbers on First Grade Reading," Journal of Learning Disabilities, Vol. 5, No. 5 (May, 1972), pp. 254-261.

[3]Luna, "Distar Language and Reading Programs: Effects Upon SESAT Scores," pp. 2-5.

The conservation program is that devised by Young and Austin in 1970 to induce conservation of number, weight, volume, area, and mass.[1] This program consisted of eight lessons to be presented over a three week period. The lessons were presented on November 10, 12, 14, 17, 19, 21, 24, and 25, 1975. (Appendix A). The lessons were designed to allow the children to manipulate the materials and check the correctness of their responses immediately after spatial arrangements were changed.

This program of conservation training was selected because of Young and Austin's conclusion that the lessons were both effective, and easy to use by inexperienced teachers.

Procedure

The method of training was randomly assigned to each class as shown in Table II, page 84. When the experimental group was receiving training in conservation, the control group was receiving instruction in arithmetic.

All eight teachers in the study were given four hours of inservice training on the use of the conservation lesson plans. A step-by-step explanation was made through the program of training. First the researcher demonstrated each lesson, then each teacher was allowed to demonstrate each lesson. They were then

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[1]Young and Austin, "Inducing Conservation of Number, Weight, Volume, Area, and Mass in Disadvantaged Preschool Children-A Math Readiness Final Report," ERIC, ED 060 154.

given four more days to practice the lessons on their own time. The researcher conducted the training session for the teachers. (Appendix B). The teachers already had been given an inservice training program on the use of the Distar program. This program of training was conducted by the publisher when the district purchased the program. All eight teachers had taught Distar the previous school year.

After the teachers had taught the first lesson plan, a meeting was held after school, questions were answered and it was determined by observation and questioning that the lesson plans were being followed.

The teachers were instructed to follow the lesson plans exactly. A minimum of four checks were made to observe the teachers, and answer questions, to insure that the lessons were followed exactly. All directions were also given to the teachers in writing for the conservation training program, they also were given a schedule of dates for the teaching of each conservation lesson plan. (Appendix B).

Data Analysis

The first step in the data analysis procedures was the calculation of the power of the analysis of variance to provide the basis for deciding the number of classrooms that were to be included in the experiment. (Appendix C). The calculation showed two levels of gender, two levels of treatment, and eight treatment cells. With degrees of freedom equal to one and twelve, a $\emptyset$ of 2.99 was calculated. This information indicated that we had a 98 percent chance of detecting a difference of 1 1/2 standard deviations at the .05 level of confidence.

The pretest and posttest were administered to each class by their own teacher. The pretests were administered in November, 1975, and the posttests were administered in March of 1976.

The next step in the data analysis was to compute the descriptive statistics for each of the groups. These statistics were computed to determine the direction of further statistical analysis. In particular, the researcher computed the mean ($\overline{X}$), the standard deviation (s), and the variance (s^2) of each group.

A Pearson product-moment correlation (r) was used to determine the relationship between the pretest measures of reading readiness, and posttest measures of reading readiness. Then a regression formula was used to predict the posttest scores based on the pretest scores. Then the difference between the predicted and the actual posttest scores was calculated, to provide the regressed gain scores.

The testing of the null hypotheses began with the performance of a 2x2x2 Analysis of Variance on the group mean gain scores: two methods of teaching at each school site, conservation and readiness training and readiness training alone; two elementary schools, Clyde Howell and Sunset; and two genders within each group. The .05 level of significance was chosen for rejection of the null hypotheses.

The dependent variable in the analysis was the mean posttest score obtained by each group. The covariate, or control variable, in each case was the mean pretest score obtained by each group.

CHAPTER IV

FINDINGS OF STUDY

The problem of this study was to determine if there are significant differences in the reading readiness scores of kindergarten pupils who were given reading readiness training, and those given reading readiness training and conservation training. Further study was made to determine if the gender of the student influenced the effectiveness of these two approaches.

There were eight experimental groups and eight control groups. After both groups were pretested on the Metropolitan Readiness Test, the experimental groups were given three weeks of conservation training. The posttest was administered after eighteen weeks. The .05 level of significance was set as the required level of statistical significance.

A screening procedure was followed to eliminate from statistical consideration those students repeating kindergarten and those students who moved into or out of the district during the course of the experiment. Table II, page 84, shows the number of students involved in the study both before and after the screening procedures were conducted. From an initial population of 433 kindergarten pupils in two elementary schools, a final group of 385 students was identified.

This section discusses in detail the sequence of activities in relation to the statistical treatment of the data collected in this study. First the data were described using mean ($\bar{x}$), standard deviation (s), and correlation (r). Gain scores were then computed for each student. Finally comparisons were made to test the null hypotheses using analysis of variance. The statistical comparisons which follow determined any significant differences between groups.

The descriptive statistics revealed the pretest and posttest means of the groups, as shown in Table III. It should be noted that posttest standard deviations were smaller than pretest standard deviations. Both means and standard deviations were consistent between treatment and control groups.

TABLE III

PRESTEST AND POSTTEST MEANS AND STANDARD DEVIATIONS

	Treatment		Control	
	Pre	Post	Pre	Post
$\bar{X}$	53.15	66.85	53.53	67.16
SD	13.98	11.47	13.50	11.93

The norms for the Metropolitan Readiness Test indicate a mean score of 53.3 and a standard deviation of 17.7[1] The differences between the mean and standard deviations of the population on the pretest and the mean and standard deviation of the norms would indicate that the sample was a normal population in terms of Metropolitan Readiness Test scores.

Next the correlation of pretest and posttest scores for each group and for the total group was computed, as shown in Table IV. The correlations of each of the groups did not differ from the correlation for the total group, indicating that the relationship between pretest and posttest for each of the groups was similar.

TABLE IV

PRETEST AND POSTTEST CORRELATIONS

	Treatment	Control	Total
r =	.8065	.8051	.8037

The norms for the Metropolitan Readiness Test indicate a total pretest-posttest correlation of .67.[2]

[1]Hildreth, Metropolitan Readiness Test, p. 18.

[2]Ibid.

Regressed Gain Scores

The relationship for the total group was used in a regression formula to predict the posttest scores of all students, then the predicted posttest scores were subtracted from the actual posttest scores to produce regressed gain scores for each student, thus the posttest score was adjusted for the pretest score.

The next step was to compute the mean and standard deviation of the scores for each class. Individual gain scores were not entered into the analysis. The class was used as the unit of analysis with the gender of the students forming a sub unit. The students in each class were grouped by gender and a mean was computed. The mean for each subunit represented the gain made by the students. The means were arranged in four classes, males in treatment, females in treatment, males in control, and females in control groups as shown in Table V.

The regressed gain score means varied from -6.50 to 4.85. This information alone indicated how the average student in each group performed. The grouping of gain scores by male and female students showed some differences that were not apparent between treatment and control pretest and posttest scores. Also reported in Table V are the standard deviations for each of the groups, the standard deviations ranged from 3.37 to 10.27. The variances are approximately equal.

TABLE V

REGRESSED GAIN SCORE MEANS AND STANDARD DEVIATIONS FOR SUBJECTS GROUPED BY TREATMENT AND GENDER CONDITIONS

	Control			Treatment		
	Class	$\overline{X}$	SD	Class	$\overline{X}$	SD
Males	1.	2.81	6.01	9.	-3.75	6.68
	2.	.83	4.72	10.	-1.18	8.00
	3.	4.85	6.05	11.	1.34	4.17
	4.	1.85	6.83	12.	1.49	7.92
	5.	1.26	7.76	13.	-1.06	6.65
	6.	-1.08	9.08	14.	2.93	7.25
	7	-2.44	9.21	15.	-6.50	7.62
	8.	-1.64	7.75	16.	1.79	4.32
Females	1.	-2.18	9.04	9.	-1.41	10.27
	2.	-3.78	5.58	10.	-2.00	3.37
	3.	3.85	8.59	11.	-1.74	9.22
	4.	2.80	3.98	12.	-1.33	7.11
	5.	-2.18	3.77	13.	1.62	4.48
	6.	-2.43	7.35	14.	0.13	5.95
	7.	-0.88	6.80	15.	2.24	7.02
	8.	-0.81	5.37	16.	2.50	5.03

Findings

A two-way factorial analysis of variance was used to test the hypotheses stated in Chapter I. The mean gain scores of students was the dependent variable. Independent variables were the gender of the students and their condition as members of experimental or control groups. Two of the F-ratio's, the F-ratio for experimental, and the F-ratio for gender, were used to test the hypotheses of no significant difference between scores made by male and female students, or by students in experimental and control groups. The third F-ratio, for interaction between gender and method of teaching was used to test the hypothesis of no differences between scores made by students in each of the four subgroups; male experimental, female experimental, male control, and female control.

Table VI, provides the summary table for the Analysis of Variance, failing to reject the null hypotheses stated in Chapter I. The two-way analysis of variance of regressed gain scores means resulted in no significant differences between methods, gender or interaction, between the variables at the $p = .05$ level of significance.

TABLE VI

TWO-WAY ANALYSIS OF VARIANCE: SOURCE OF VARIANCE FOR MEAN REGRESSED GAIN SCORES

Source	SS	DF	MS	F	Level of Significance
Total	199.42	31	--	--	--
Treatment 1	1.04	1	1.04	.155	ns
Gender 2	1.59	1	1.59	.237	ns
Interactions					
1 x 2	9.04	1	9.04	1.35	ns
Error	187.77	28	6.71	--	--

No significant differences between the regressed gain score means for any of the groups was found. Therefore no significant effects can be reported for differing methods or gender on the regressed gain scores of the students. Although there were numerical gains from pretest to posttest in each group, there were no significant differences in the pretest-posttest regressed gain score means between the groups, as shown in Table VI. Since this analysis included all sources and interactions, it was not necessary to consider pair-wise comparisons.

DISPOSITION OF HYPOTHESES

The three general hypotheses were stated in the null form (hypothesizing no significant differences), and no significant differences were found between any groups on the regressed gain scores, thus, all of the hypotheses were accepted as stated.

Results of Testing Hypothesis One

Hypothesis one stated that there would be no significant difference between group mean gain scores in reading readiness of those students taught by readiness techniques and those students taught by a combination of conservation and readiness techniques. To test this hypothesis a two-factor factorial design for analysis of variance was used.[1] The results of the analysis was given in Table VI, page 100. The calculated F-ratio of .155 was less than significant at .05 level, therefore hypothesis one cannot be rejected. There was no statistically significant difference between pretest and posttest scores in reading readiness, as measured by the Metropolitan Readiness Test, over the time span of the study, of those students taught by conservation and readiness techniques, and those taught by readiness techniques alone. All students in the experimental group received

[1]James L. Bruning and B. L. Kintz, Computational Handbook of Statistics (New York: Scott, Foresman & Co., 1968), pp. 25-30.

the same conservation training from identical lesson plans. Checks were made to insure that the teachers followed the lessons exactly, and the instructions during pretesting and posttesting were identical.

Results of Testing Hypothesis Two

Hypothesis two stated that there would be no significant differences between group mean gain scores for those girls taught by readiness techniques and those boys taught by readiness techniques. The two-factor design was used for the analysis of variance. The results of the analysis are reported in Table VI, page 100. The F-ratio calculated at .237 was not significant at .05, thus hypothesis two cannot be rejected.

Results of Testing Hypothesis Three

Hypothesis three stated that there would be no significant difference between group mean gain scores for those girls taught by conservation and readiness techniques and those boys taught by conservation and readiness techniques. The two-factor design was used for the analysis of variance. The results were reported in Table VI, page 100. The F-ratio was not significant at .05, thus hypothesis three cannot be rejected. Table VI, page 100, indicates that no sigificant difference in any interactions involving method and gender.

Both the males and females in the experimental groups received identical lessons on conservation for the same time period, and under the same classroom conditions. The males and the females in the control group received their normal arithmetic program when the experimental group was receiving conservation training. The experimental group received the arithmetic program after the conservation training was completed. Because of the time consumed by the conservation training, it was not possible to present both simultaneously. The instructions for the pretest and posttest were identical for all students, male and female, experimental and control.

Major Findings

The analysis of the data for the study resulted in the findings listed below. Level of significance was set at $p < .05$.

1. There was no significant difference in the group mean gain scores in reading readiness of those groups taught by readiness techniques and those groups taught by a combination of conservation and readiness techniques.

2. There was no significant difference in the group mean gain scores for those girls taught by readiness techniques and those boys taught by readiness techniques.

3. There was no significant difference in the group mean gain scores for those girls taught by conservation and readiness

techniques, and those boys taught by conservation and readiness techniques.

4. There was no significant interaction between the method of treatment and the gender of the students.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of the study was to determine the effects of two programs of training on reading readiness. By comparing gains in reading readiness skills it was determined which of the techniques for readiness training had been more effective during the time period involved, and with the kindergarten students included in the study. The value of conservation training on reading readiness was questioned by these results.

Gender differences were also analyized to determine their effect on readiness and conservation training, and readiness training measures as measured by the Metropolitan Reading Test.

The use of reading readiness programs by classroom teachers is common practice. The manuals which accompany the many programs suggest the methods teachers may use to present readiness activities and the type of activities to be presented.

Some teachers have recently begun to look at the Piagetian concept of conservation and its relationship to reading readiness. Chapter II discussed the research in this area. The results of these studies have shown a significant difference in the reading levels of students who received training in conservation skills.

The present study was conducted to determine a longer range effect of such conservation training on reading readiness.

Subjects for the study were 385 kindergarten pupils from two elementary schools. Both of the schools are in the Edmond Public School System, a suburban school system near Oklahoma City, Oklahoma. The sample population was screened for repeaters, and students who moved in or out of the district during the time period of the study. The mean and standard deviations of the sample on the Metropolitan Readiness Test when compared to the national norms indicated that this was a normal heterogeneous population.

The Metropolitan Readiness Test, Form A was used as a pretest. Form B of the same test was given as the posttest. An analysis of variance using regressed gain scores was the statistical procedure employed.

Two teaching methods were employed: (1) the Distar I reading readiness program was used all during the eighteen week period with all students, the teachers taught the lessons exactly as prescribed by the manual; (2) for three weeks the experimental group received the conservation skills training in conjunction with the Distar I program. The control group received their normal arithmetic program when the experimental group was receiving conservation training. The experimental group received the arithmetic program after the conservation training was completed.

Because of the time consumed by the conservation training, it was not possible to present both simultaneously. The conservation training was given orally with many opportunities for the students to manipulate the materials and check their responses for accuracy. The Distar I Arithmetic program has 160 lessons designed to be used everyday. The Distar I Arithmetic program is designed so that the children learn to handle the basic operations of addition, subtraction and algebra addition and subtraction. This may have had an effect on conservation of number skills, however the program does not appear to deal with conservation of weight, volume, area, or mass.

Included in the study was a comparison of the effectiveness of these treatments on male and female students. Would females who received conservation training do better on reading readiness than males who received conservation training? Would females who received only readiness training do better on reading readiness tests than males who received only readiness training?

Three hypotheses were developed to investigate the problem. These hypotheses were:

1. There is no difference between group mean gain scores in reading readiness of those groups taught by readiness techniques, and those groups taught by a combination of conservation and readiness techniques.

2. There is no difference between group mean gain scores for those girls taught by readiness techniques and those boys taught by readiness techniques.

3. There is no difference between group mean gain scores in reading readiness for those girls taught by conservation and readiness techniques and those boys taught by conservation and readiness techniques.

Conclusions

The data for this study have shown that the kindergarten boys and girls of this study have scored about the same on the pretest and posttest measures of reading readiness, regardless of gender or treatment method applied. In all comparisons made it was found that conservation training made no significant difference, at the .05 level of confidence, on the reading readiness scores of the kindergarten pupils included in the study.

The findings of the present study do not support the findings of earlier studies cited in Chapter II, that conservation training in conjunction with readiness training increases reading readiness. It is therefore concluded that the boys and girls of this study do not differ in their reading readiness levels as measured in this study. Since the boys and girls of this study appear to represent a similar population as that used in norming the Metropolitan Readiness Test, there is a basis for concluding that conservation training for reading readiness has no effect on reading readiness for this type of population.

The following further conclusions were reached:

1. There was equal advantage in giving readiness training via the Distar I program as in giving conservation training and readiness training.

2. There was equal advantage in giving readiness training via a combination of Distar I and conservation training as in giving just readiness training.

3. There was equal advantage in giving readiness training to both males and females via the Distar I program as in giving a combination of Distar training and conservation training.

The scores on the pretest and posttest readiness tests indicated that for the boys and girls of this study there was no significant relationship between conservation and reading readiness training.

Recommendations

This study sought to investigate the value of conservation training techniques on reading readiness. If this study were repeated and similar results were obtained, the assumption of value in conservation training for reading readiness could be further challenged. The following changes are recommended in repeated studies:

1. Use different students in these studies.

2. Use different school systems in each study.
3. Continue the study for a year rather than eighteen weeks in part of the studies.
4. Continue the conservation training for a longer time in part of the studies to determine if repeated exposure to the concepts helps with retention.
5. Use different methods of measuring growth in reading readiness to see if the measuring instrument is truly valid for the population being studied.
6. Test for acquisition of conservation skills after giving the conservation training. Then do the statistical analysis on only those children who can conserve.

If the results of this study were validated with similar studies there would remain many other situations in which conservation training at the readiness level might be beneficial. It would take studies in many areas before the concept of conservation training as an aid to reading readiness could be completely challenged or completely accepted. Some of these situations would include:

1. Studies or controls in first grade.
2. Studies or controls with groups of various IQ levels.
3. Studies or controls involving students from a variety of backgrounds, including high socioeconomic, middle socioeconomic, and low socioeconomic backgrounds.

4. Studies or controls of schools using a variety of instructional approaches.
5. Studies or controls involving students with different learning handicaps, such as perceptual-motor deficits, vision and/or hearing impairments.

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APPENDIX A*

* These lesson plans were taken from those devised by Young and Austin in 1970. They are the identical plans they devised, with the exceptions of a change in materials in a couple of the plans, for example; Young and Austin used doll socks and doll shoes, this study substituted toy soldiers and sticks.[1]

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[1]Beverly S. Young, and Stephen F. Austin, "Inducing Conservation of Number, Weight, Volume, Area, and Mass in Disadvantaged Preschool Children-A Math Readiness Final Report," ERIC, ED 060 154.

Lesson 1

Topic--Conservation of Number

Materials--plates, candy, and a small bowl.

Beginning Procedure--Distribute a plate to each child. Then give each child a candy, and ask them to lay it on their plate. Put a small bowl in the center of the table.

Say--Do we each have a plate?

Do we each have a candy?

Now everyone put his candy in the bowl.

Were there as many candies as there were plates?

Were there as many candies as there were children?

Now, take the candy back out of the bowl so we can be sure. Put the candy back on your plate. Now hold the candy in your hand and put your plate in the middle of the table. Just lay the candy on the table in front of you.

Are there the same number of candies as plates?

Are there as many?

Now put your candy in a tiny pile in the middle of the plates.

Are there the same number of plates as candy?

Take your plates back and put your candy on them.

Are there the same number of candies and plates?

Stack up the plates and put the candy in a row.

Are there the same number of candies as plates?

Put your candies into the bowl again. Close your eyes.

I will take out one candy and put it back into the sack.

Will there be a candy for every plate now? Why not? Each person put his candy on his plate. Are there the same number of candies as plates? What should be done? (The examiner does as the children suggest and puts one back.)

Now are there the same amount? Why wasn't there enough for everyone?

Put your plates in a line down the center of the table and put your candy in a short line beside them.

Are there the same number of candies as plates?

It looks as though there are more plates.

I will take away enough plates to make the rows look the same. Now are there the same number of plates as candy?

Put the candy and plates back in front of you to be sure.

Are there the same number? What should we do?

Why weren't there enough plates?

Stack your plates in the center of the table and lay the candies around the sack. There doesn't appear to be enough plates for that many candies. I'll add two more. Will there be the same number of plates as candies? Why not? (Replace the plates and candies).

Are there the same number of plates as candies?

Why not? (Put the extras back in the sack). Put your candies in a small circle. Now put your plates around the candy. Take a good look at the plates and the candy. Are there the same number of plates as candies?

Now each person take a candy and put in on your plate to be sure they are the same.

Collect plates, let children eat candy.

Lesson 2

Topic--Conservation of Number

Materials--Spoons, forks, and a box of spoons, cups, plates, and candy.

Beginning Procedure--Part I, a box of spoons is set in the middle of the table. Part II, each child is given a spoon and fork.

Part I: Say--Can you count out three spoons?, 5?, 6,? etc. (each child counts out some number between 1 and 10 which is within his capacity, and listens to the others who can count farther, or to ten. No errors are allowed, if the child begins to falter the examiner comes to his aid. When each child has had a turn, the spoons are put away, and a spoon and fork are handed to each child.

Part II: Say--Do we each have a spoon? Do we each have a fork? Do we have the same number of spoons as forks? do we have as many forks as children? As many spoons as children?

Put the forks in a long row. Now put the spoons in a short row. Are there the same number of spoons as forks, or are there more of one than the other?

Put your spoon and fork back together to see whether they are both still there. Now stack your spoons up in a stack, and lay the forks in a row. Are there the same number or are there more of one than the other?

Lay the spoons and forks in a row again and then I'll take one spoon away. Are there the same number of spoons and forks, or are there more of one than the other? Put them together again. What should I do? (Examiner replaces the spoon, then she lays the spoons and forks in a fan shape and asks one child to remove the forks, or are there more of one than the other? Why? What should we do? (Have the child replace the fork. Have them placed side by side, and then given to the examiner to put away.)

(Pass out one cup and one plate to each child. Repeat the process just done with the spoons and forks. Collect the cups, and give each child a candy to go with his plate). Now put your candy in the center of the table. (The examiner now gives the child another candy to put in the center of the table).

If you all took your candy back, how many candies would you have? How do you know? (The answer wanted is: Because that was how many I put there. If this answer is not given the examiner asks if it is because that was how many they put there. Then the examiner gives each child another candy which is also put in the center of the table.)

If you took all your candies back now, how many candies would you have? Why? (Now the examiner gives the children one more candy.)

Don't do it, but <u>if</u> you put that candy in the middle too, how many candies would you have there? How do you know?

(Let the children eat the piece of candy they are holding, collect all the candy in the center of the table).

Lesson 3

Topic--Conservation of cardinal number (provoked and unprovoked correspondence.) Multiplicative operations, and rational counting.

Materials--Cups, plates, pencils, cards, toy soldiers, sticks, candy, and a tennis ball.

Beginning Procedure--Part 1, the lesson begins by counting in unison the number of times the examinder bounces a ball on the table. Part 2, each child is equipped with a toy soldier and a stick, when they are collected, each child is given 2 pencils and 2 cards. These are subsequently collected, and each child receives a cup, a plate, and a candy.

Part 1: Say--See if you can count how many times I bounce this ball. (Children count in unison numbers between 1 and 10.) Now let's see if you can do it alone. (Each child has a chance to count alone to a specified number.)

Part 2: Say--(Each child is given a toy soldier and a stick). Does everyone have as many soldiers as sticks? Put the soldiers in a row in the center of the table end to end. Now put the sticks in a row in the end to end. (As the sticks are longer, the make a longer row.) Are there the same number of soldiers as sticks? How do you know? Everyone take back his soldier and stick to be sure. Now put the soldiers in a pile in the center of the

table. Put the sticks in a circle around them.
Are there the same number of soldiers as sticks? How do you know?
How can we be sure? Now hand back the soldiers and sticks. (Now the examiner passes out 2 pencils and 2 cards to each child.
Do you have the same number of pencils and cards?
Put the paper cards in a stack in the center of the table. Now will someone let me have one of their pencils?
Are there the same number of pencils as cards now? How do you know? Let's put them all back together to be sure.
Were you right? What should I do? (The pencil is returned and the procedure is repeated with pencils and cards laid in a line in the center of the table.)
That is such a long line Ibelieve that I should add about two more cards and make the line the same as the pencils.
Are there the same number of pencils and cards now? Why not? What should I do? (Examiner removes extra cards.)
Is it the same now? Let's check to be sure, get your pencils and cards.
(Collect pencils and cards, pass out a cup and plate to each child. Repeat the above procedure with one addition and one subtraction. The collect the cups. Give each child a candy to put on his plate.) Now put your candy

in the center of the table. (Give each child another candy to put in the center of the table.) If you took all your candies back, how many would you have? How do you know? (The answer wanted is because that is how many I put there, if this answer is not forthcoming, the examiner asks if it was because that was how many they put there. Then the examiner gives each child another candy which is also put in the center of the table.) If you took all of the candies back now, how many would you have? Why?

(Now the examinedr gives each child one more candy.) Don't do it, but <u>if</u> you put that candy in the middle too, how many candies would you have there? How do you know?

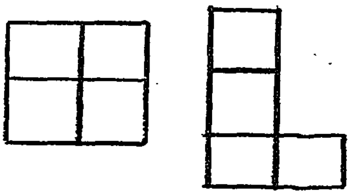
(Let children eat the candy they have in their hand, collect the rest.)

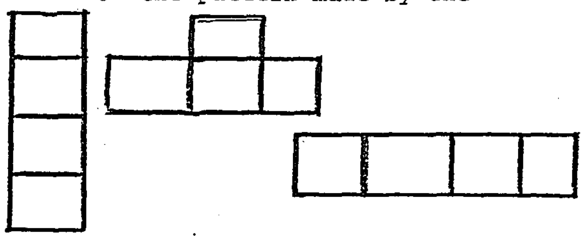
Lesson 4

Topic--Conservation of Area, Mass, and Volume.

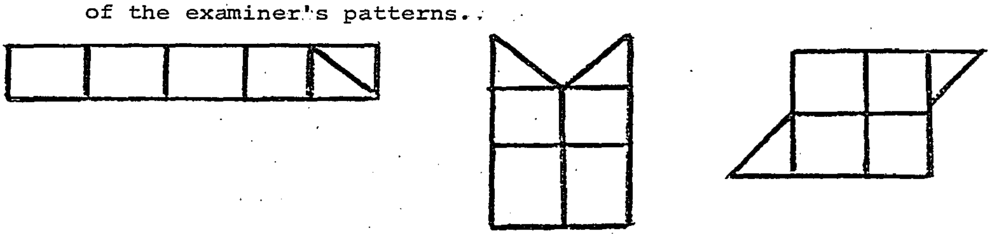
Materials--Squares of gum, paper squares.

Procedures--Each child is asked to count out four squares of gum. Then they are asked to arrange them in the following patterns in duplication of the pattern made by the examiner.





After each arrangement, the subjects are asked; Do you still have four squares of gum? If they are not sure, they are asked, Have you taken any away? Have you added any? Then are there still the same number? Count to be sure. (Then each child is asked to count out five squares of paper. Each child has one square cut through diagonally. As this is done, each child is asked,) Am I giving you more squares? Am I taking any squares away? Do you still have the same squares you had before? (The pieces are then placed in the following arrangements in duplication of the examiner's patterns..



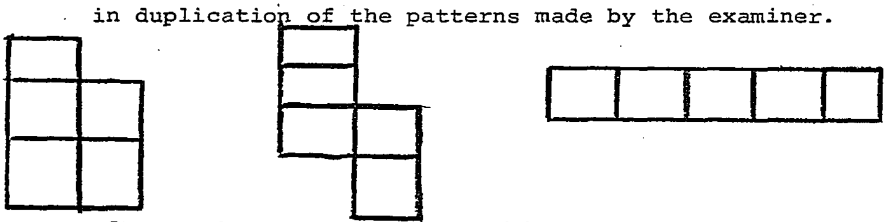
After each arrangement, the question is asked; Do you still have the same number of squares? Do you still have the same number of pieces? How could you count it to be sure? (The answer is to put the two halves together to make a whole piece and then count.)
Now let the children chew the gum.

Lesson 5

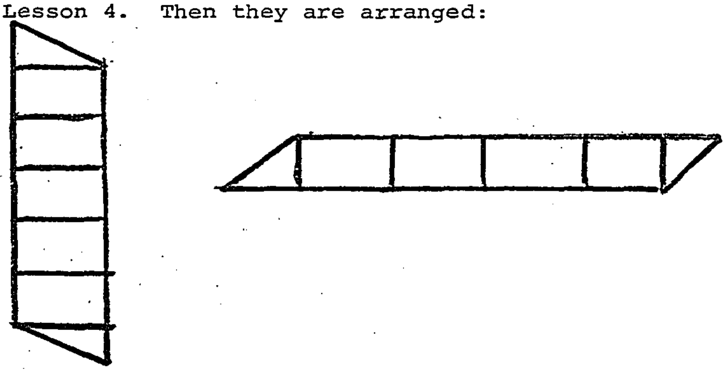
Topic--Conservation of Area, Mass, and Volume.

Materials--A box of 1" squares of paper, and a sack of softly blown balloons.

Beginning Procedure--Part I, this is a duplication of Lesson 4. The subjects are asked to count out five squares of paper. These are then arranged in the following patterns in duplication of the patterns made by the examiner.



After each arrangement the subjects are asked questions the same as in Lesson 4. They are urged to think whether any had been taken away or added, and then to recount to be sure. Then the examiner cuts one square into two pieces, each time the question and procedure are the same as in Lesson 4. Then they are arranged:



and the subjects are questioned as before. Then the paper is collected.

Part 2--The examiner demonstrates with a softly blown balloon.

Say--What is inside? Can it get out if I don't break or untie the balloon? If I squeeze the balloon here, where does the air go? (Short and Fat). It is the same air? Is there any more or less? Did I put in amy more? Did I take any out? Then it must be the same amount.

(Next balloons are given to each child.)

Let's see if yours acts the same way as mine. Can the air get out?

Now squeeze it this way. Where did the air go? (Up and down). What shape did the balloon get? (Tall and skinny).

Now squeeze it this way. Where did the air go? (sideways). What shape did the balloon get? (Short and fat).

Did you put in any more air?

Did you let any air out?

Is it still the same air?

When it is short, when it is fat, when it is tall, when it is skinny?

Lesson 6

Topic--Conservation of weight, mass, rational counting, discrimination of length and seriation.

Materials--One balloon, two balls of clay, teeter-totter made from a ruler and a juice can, ball, box of plastic straws, and a set of wooden blocks.

Beginning Procedure--This lesson, except for counting out straws and seriating the blocks, is entirely a demonstration lesson. Pupil participation is limited to verbal replies to rather continuous questioning. This method of presentation seems in no way to lessen interest, as interest should be high and answers immediately forthcoming from the pupils. Part 1 deals with conservation of weight and mass. Part 2 deals with rational counting, and Part 3 with discrimination of length and seration.

Part 1: Say--Remember the balloon? When we squeezed it the side got taller. (Examiner demonstrates with a balloon coincident with comments).

When we squeezed it down, it got fatter, but the air stayed the same.

(Now the examiner works in the center of the table with clay). Now let's see if it works with clay the same way. (The examiner demonstrates with a soft ball of clay). Where did it get smaller? Where did it get longer? Is it more clay?

Now I'll make it back into a ball and squeeze it down on the top. Did it get fatter? (The examiner then makes it back into a ball). Now I'll make a cup out of it. Is it still the same piece of clay? Where did it get larger? Where did it get smaller? (The examiner takes a piece off the bottom and puts it on the sides). Is it still the same amount of clay? Who has teeter-tottered? If one person is heavier than the other what happens? If two people get on one side and one on the other end, what happens? (The examinder than makes a miniature teeter-totter from a ruler and a juice can, and demonstrates how it is tipped up and down.)

See the side that is heavier goes down. (Demonstrate, then repeat the demonstration with weight.)

These clay balls are the same. See they balance. Now I'll put a piece of one back into the sack. Now are they the same? Now I'll add a piece. Are they the same? Now I'll take it back off and put the clay away.

Part 2: I'll bounce this ball and let's count together. (1-10).

Part 3: (Each child is asked to count out 3 to 10 straws).

Part 4: Put these blocks in order with the smallest here and the largest here. Who can make a stairs out of these blocks? (Let several children do this.)

Lesson 7

Topic--Conservation of Volume, seriation with interpolation, and rational counting.

Materials--Nest of plastic cups, a small rubber ball, several pitchers of kool-aid, 6-ounce cups, 3-ounce cups, paper sauce dishes, box of crackers.

Beginning procedure--The lesson begins with a review of rational counting and seriation. The examiner bounces the ball and the children count in unison and then individually the number of bounces is from 3 to 10. Then each child tries to make a stairs out of the cups, starting with the largest, and each time choosing largest of the remaining cups.

Now each child seriates the set of cups from which one cup has been removed and given to the next child. After the cups are seriated, the next child places the extra cup in the proper order the series. (Use a different cup each time).

(Now the examiner demonstrates with a 6 ounce cup and two 3 ounce cups, and a saucer. He fills the 6 ounce cup and puts the contents into the two smaller cups saying,) Did I put any back into the pitcher? Did I take any more out of the pitcher? Is it still the same juice? Is the amount of juice still the same? Why? (Examiner tries to get the answer that it is still the same juice? Now I'll our it into the flat wide saucer. Did I take any out?

Put in any extra? Is there still the same amount as there was in the cup?

It looks taller in the cup. In what way is it smaller?

If it gets wider this way, where does it get smaller?

Did the balloon act that way?

Did the clay act that way?

Now let's see if it works that way for you.

(The examiner gives each child a 6-ounce cup, two 3-ounce cups, and a saucer. He fills each 6-ounce cup with juice until all are agreed they are filled equally. Then he asks each child to pour into his other cups the juice from his big cup.)

Did I give anyone more juice?

Did I take juice away from anyone?

Does everyone still have the same juice he had?

Does Mary still have the same amount of juice as John?

Let's pour it back into the first cup to be sure.

(The examiner then passes out squares of crackers and asks the children to break theirs into two or three or four pieces.)

Does everyone still have the same amount of crackers and juice?

Put the pieces back together to be sure. Now if you all have the same of everything you can eat it.

Lesson 8

Topic--Multiplication, seriation, additive composition.

Materials--Three types of small candies, plastic cups.

Beginning Procedure--The lesson on seriation of cups is repeated exactly as in Lesson 7. The lesson multiplicity processes is then repeated exactly as in Lesson 4.

Then each child is asked to put these materials away, and count out five pieces of candy. These are then arranged in duplication of the examiners design in the following patterns:

xxx	xx	xxxx	x	xxx	x
xx	xxx	x	xxxx	xx	xxxx

After each arrangement is made, each child is asked; Do you still have five of each candy? (They are urged to rearrange them in one to one correspondence and then to count for a recheck.)

(These materials are then put away and each child is given a random sized group of candy, each group ranging in size from 5-12. The question is then asked.)

Do you have the same amount, or do some have more than others? (Each is urged to count to be sure.) After they have counted, they should pass the candies around until all have equal amounts. Then they can eat two candies, and the examiner collects the rest.

APPENDIX B

PROJECT INSTRUCTIONS

For the purpose of my study it is very important that you follow the instructions and format of the eight lesson plans, and the _Distar I_ lessons exactly.

This is to be sure that all students receive an equal amount of teaching in the area of readiness, and that the experimental groups receive an equal amount of teaching in the conservation skills.

Since rate of instruction could also influence the outcome, I have enclosed a schedule. Please follow this.

It is important that the students do not have access or exposure to these lessons prior to your introducing them in class.

When the lesson plan calls for materials, I will provide them.

I will be making spot visits during the experiment. Please call me at any time that you have a question.

Thank you for your cooperation.

Kathy Roberts

Home: 348-0119

School: 677-5211

SCHEDULE OF PROJECT

DATE	LESSON PLAN
11-10	1
11-12	2
11-14	3
11-17	4
11-19	5
11-21	6
11-24	7
11-25	8

APPENDIX C

Power of the F Test

$$\phi_a = \sqrt{\frac{K\ I\ \Sigma\alpha^2}{J\ \sigma_e^2}}$$

K=2 levels of gender

J=2 levels of treatment

I=8 treatment cells

α = treatment effect expressed in standard deviation units

σ_e^2 = error variance

$$\phi_a = \sqrt{\frac{2\ (8)\ 1.12}{2}}$$

$$\phi_a = \sqrt{8\ (1.12)}$$

$$\phi_a = \sqrt{8.96} = 2.99$$

if α = 1.5 S.D. or 5.1 points

then

	σ	σ^2
α_1 =	7.5	.5625
α_2 =	.75	.5625
$\Sigma\alpha^2$		1.1250

$df_1 = 1$

$df_2 = 12$

There is a 98 percent change of detecting a difference of 1 1/2 standard deviation difference at the .05 level.

APPENDIX D

METROPOLITAN READINESS TEST (FORM A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # I

	Conservation and readiness training		Readiness training	
Boys	pre	post	pre	post
1	59	70	41	64
2	57	57	67	79
3	39	62	55	71
4	48	66	54	81
5	45	67	66	74
6	27	42	83	87
7	72	79	69	78
8	43	53	22	53
9	58	58	47	56
10	35	47	31	62
11	24	48	46	59
12	50	53		
Girls				
1	47	72	52	65
2	50	73	42	43
3	59	73	59	73
4	53	62	77	85
5	54	75	81	85
6	50	59	66	81
7	51	67	62	77
8	45	41	45	70
9	75	78	58	70
10	69	79	73	82
11	54	75	65	54
12	71	53	50	54
13	40	61		
14	54	64		
15	59	75		

METROPOLITAN READINESS TEST (FORMS A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 2

	Conservation and readiness training		readiness training	
Boys	pre	post	pre	post
1	26	47	53	85
2	65	58	56	67
3	24	44	59	73
4	52	80	65	73
5	73	86	81	81
6	58	64	35	58
7	61	74	52	70
8	81	81	74	84
9	48	63	71	75
10	64	74	56	65
11			32	51
12			53	71
Girls				
1	53	64	52	68
2	64	69	84	84
3	46	62	71	64
4	65	66	53	59
5	46	65	50	70
6	61	71	43	50
7	57	65	56	67
8	73	82	59	66
9	76	83	83	82
10	60	72	50	63
11	66	70	78	80
12	62	72	49	66
13	49	62		

METROPOLITAN READINESS TEST (FORMS A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 3

	Conservation and readiness training		readiness training	
Boys	pre	post	pre	post
1	56	72	45	72
2	58	71	62	81
3	56	71	41	63
4	54	77	26	54
5	73	88	69	72
6	62	79	49	64
7	33	49	43	73
8	62	71	70	87
9	25	43	68	74
10	52	63	67	83
11	34	58		
12	43	59		
13	38	57		
14	48	63		
15	52	67		
Girls				
1	50	57	63	77
2	57	73	60	75
3	45	64	50	59
4	32	53	54	74
5	61	66	44	80
6	44	68	49	71
7	26	28	52	75
8	30	57	53	70
9			60	83
10			31	46
11			65	82
12			37	43

PLEASE NOTE:

This page not included in material received from the Graduate School. Filmed as received.

UNIVERSITY MICROFILMS

METROPOLITAN READINESS TEST (FORMS A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 4

	Conservation and readiness training		Readiness training	
Boys	pre	post	pre	post
1	45	53	63	79
2	37	50	73	73
3	42	76	48	73
4	48	70	35	49
5	34	54	44	57
6	47	69	57	71
7	55	63	54	82
8	53	56	48	62
9	55	75	50	60
10	38	60	50	75
11	61	79	67	87
12	48	64	77	87
13			74	78
14			57	69
15			56	67
Girls				
1	42	51	62	76
2	38	63	67	75
3	76	81	54	71
4	66	78	73	83
5	59	77	45	65
6	39	51	72	78
7	49	62	69	72
8	55	62	49	70
9	48	70	55	69
10	38	51	43	68
11	49	48	37	60
12	58	73	71	87
13	54	76	44	66
14	46	56		

METROPOLITAN READINESS TEST (FORM A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 5

	Conservation and Readiness Training		Readiness training	
Boys	pre	post	pre	post
1	49	77	48	76
2	63	73	74	93
3	54	63	70	81
4	73	76	49	74
5	58	63	46	70
6	73	77	53	65
7	71	79	50	62
8			21	49
9			68	78
10			51	59
11			42	55
12			40	43
13			46	64
14			34	49
Girls				
1	59	75	40	58
2	43	56	68	73
3	68	76	40	56
4	59	77	63	78
5	70	85	48	65
6	65	78	61	71
7	77	92	56	64
8	67	79	38	57
9	68	77	58	62
10	60	68	69	74
11	59	78	56	62
12	64	70		
13	53	65		
14	77	80		
15	58	75		

METROPOLITAN READINESS TEST (FORM A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 6

	Conservation and readiness training		readiness training	
	pre	post	pre	post
Boys				
1	56	76	56	73
2	51	56	47	68
3	58	60	21	21
4	23	59	49	64
5	45	66	47	61
6	42	66	44	66
7	55	74	53	66
8	65	79	26	50
9	60	74	51	72
10	27	54	43	52
Girls				
1	33	50	39	56
2	64	72	45	55
3	54	59	70	69
4	60	65	41	47
5	71	79	37	48
6	67	72	42	59
7	50	72	25	50
8	40	66	68	85
9	65	73	49	62
10	63	80	54	76
11	41	65	74	74
12			39	60
13			47	71
14			52	52
15			46	55

METROPOLITAN READINESS TEST (FORM A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 7

	Conservation and readiness training		readiness training	
	pre	post	pre	post
Boys				
1	70	74	60	67
2	65	71	51	60
3	47	64	49	46
4	58	59	58	77
5	22	38	53	65
6	55	69	55	56
7	28	29	44	65
8			53	64
9			38	66
Girls				
1	32	66	60	74
2	34	68	65	76
3	22	44	63	66
4	78	83	41	56
5	70	87	38	62
6	56	67	66	74
7	60	67	30	44
8	68	77	46	73
9	58	75	71	77
10	47	53	53	61
11	53	73	51	67
12	72	72	36	62
13	58	74	54	69
14	47	69	31	36
15	57	78		

METROPOLITAN READINESS TEST (FORM A AND B)
PRETEST AND POSTTEST RAW SCORES
TEACHER # 8

	Conservation and readiness training		Readiness training	
	pre	post	pre	post
Boys				
1	17	45	53	53
2	52	67	64	69
3	52	70	46	55
4	69	76	67	85
5	59	71	69	90
6	61	68	33	52
7	44	69	45	55
8	63	81	44	61
9	71	83	62	68
10	15	37	67	77
11			38	41
12			44	65
13			71	83
14			48	75
Girls				
1	37	60	63	71
2	56	70	69	85
3	31	47	13	30
4	66	80	55	68
5	60	71	39	53
6	57	66	64	71
7	41	65	47	65
8	71	76	56	77
9	42	70	51	59
10	51	68	54	61
11	38	64	65	80
12	76	83	71	79
13	48	70	40	57
14	81	82		
15	59	80		