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MCBRIDE, JEAN CARTER
THE INFLUENCE OF THE EFFECTS OF SELECTED VARIABLES UPON VISUAL PERCEPTUAL LEARNING.

THE UNIVERSITY OF OKLAHOMA, ED.D., 1978

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GRADUATE COLLEGE

THE INFLUENCE OF THE EFFECTS OF SELECTED VARIABLES UPON VISUAL PERCEPTUAL LEARNING

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF EDUCATION

BY

JEAN CARTER MCBRIDE

Norman, Oklahoma

1978

THE INFLUENCE OF THE EFFECTS OF SELECTED
VARIABLES UPON VISUAL PERCEPTUAL
LEARNING

APPROVED BY

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DISSERTATION COMMITTEE

This work is dedicated to my parents, "Bill" and "Tina," and my paternal grandparents, "Colonel" and "Mama Dile," to whom I am most grateful.

ACKNOWLEDGMENTS

The research and writing of this dissertation has taken an extensive amount of cooperation from many. It would be impossible to mention every individual who has been helpful.

I wish to express my sincere gratitude to Dr. Gene D. Shepherd, my major professor and committee chairman, for his personal interest, encouragement, and guidance throughout this study. Dr. Shepherd's efforts combined with those of the late Dr. William B. Ragan of the University of Oklahoma and Mrs. Onnie S. McGee, a retired classroom teacher of the Oklahoma City Public Schools, have been most influential in nurturing and developing my professional career in Oklahoma.

A great deal of appreciation is expressed, for their support throughout the course of study, to the following members of my advisory committee: Dr. Mary Clare Petty, Dr. John W. Renner, Dr. Sarah E. Robertson, and Dr. Omer J. Rupiper.

Thanks is expressed to my family--Bervis, my husband; Tina Maria, my daughter; Bervis, III; and my younger son, fondly referred to as "Mr. Carter"; relatives; personal friends; and professional associates who assisted in a multitude of ways.

I am, especially, grateful to Delta Kappa Gamma Society International, an honor society for outstanding women in education, for personal and professional encouragement and financial assistance at all organizational levels. The financial assistance was possible through a short-term grant awarded by Gamma State (Oklahoma) for 1975 summer study; and the Alida W. Parker Scholarship granted by the International Office for long-term study, for 1976-77 school year. Appreciation is also expressed to the Oklahoma State Regents for Higher Education for Doctoral Grants for 1976-77 and 1977-78 academic years.

To Dr. Thomas J. Smith, superintendent of the Oklahoma City Public Schools and his staff, Mrs. Maxie Wood, Senior Research Associate; Mr. Aristle C. Russell, Director of Elementary Schools; Mr. Terry C. Hayes, Principal of Hillcrest Elementary School, and Mr. William P. Henry, Principal of Southern Hills Elementary School--his staff, parents and pupils, go a world of thanks for their friendly cooperation in this research endeavor.

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CHAPTER I

BACKGROUND AND THEORETICAL FRAMEWORK

This study concerned itself with perceptual development and learning. The problem dealt with the effects visual perceptual experiences, chronological age level, and Piaget's stages of intellectual development have upon visual perceptual learning.

Since the researcher accepted Piaget's viewpoint on the meaning, understanding, and formulation of knowledge, it seemed appropriate that this viewpoint be restated and applied to the concerns of this study.

Piaget stated that:

> Scientific knowledge is in perpetual evolution; it finds itself changed from one day to the next. As a result, we cannot say that on the one hand there is the history of knowledge and on the other its current state today, as if its current state were somewhat definitive or even stable. This current state of knowledge is a moment in history, changing just as rapidly as the state of knowledge in the past has ever changed, and in many instances, more rapidly. Scientific thought, then, is not momentary; it is a static instance; it is a process. More specifically, it is a process of continual construction and reorganization. This is true in almost every branch

of scientific investigation.[1]

The researcher attempted to apply the above viewpoint to this study. The researcher concluded with Gibson that early and contemporary literature in the area of perceptual development and learning provided evidence for the following summary statements: First, the problems of perceptual learning had a long history in philosophy before it became a matter of concern in psychology. Second, the Nativism-Empiricism Controversy, the major intellectual controversy pertaining to the source of knowledge, was the antecedent of the traditional and contemporary theories of perceptual development and learning.[2] And third, for specific purposes of this study, as the cognitively oriented theories were explored, Jean Piaget emerged as a contemporary cognitive theorist, whose theoretical viewpoints had implications for study of visual perceptual development and learning.[3]

Amplification of the above summary statements seemed in order. Gibson described the historical process reported in the first summary statement.

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[1]Jean Piaget, Genetic Epistemology (New York: Columbia University Press, 1970), p. 2.

[2]Eleanor Gibson, Principles of Perceptual Learning and Development (New York: Appleton-Crofts Educational Division, Meredith Corporation, 1969), p. 19.

[3]Henry W. Maier, Three Theories of Child Development (New York: Harper & Row Publishers, 1965), p. 88.

> Perceptual learning, as a topic in the literature of experimental psychology, is new, stemming from the recent marriage of learning theory and to a lesser degree perception. The old marriage, the concept of perception as a function which develops by way of past experience, is as old as philosophy itself. When the British empiricists, beginning in the seventeenth century, elaborated the laws of association it was principally with the object of explaining perception. It could be said with some justice that the psychology of learning was born in the empiricists' attempts to explain man's perceptions of objects, space, and the relations between them. The epistemology of the philosophical empiricists does not seem to concern the experimental psychologists of the present day, but the extent to which the vocabulary and concepts of these philosophers are ingrained in psychological terminology and thinking cannot be overstated. The roots of psychological problems and concepts are their works.[4]

The Nativism-Empiricism Controversy reported in the second summary statement is described below:

> A major intellectual controversy of all times is the opposition between nativists and empiricist tenents regarding the origins of knowledge. Both sides attempted to answer the question: where does our knowledge of the world, its spaces, objects, qualities, and properties come from? One solution was the notion that ideas of space and things were innate, prototypical, universal, and God given. The opposition to the nativist position was mustered in great strength by the British empiricists who sought to supplant it with the notion that knowledge arises from experience alone; and that experience comes by way of the senses.[5]

It was reported that "The Nativism-Empiricism Controversy reached a peak of prominence among epistemologists between the seventeenth and nineteenth centuries."[6] Later it was assumed and "argued by the empiricists that experience

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[4]Gibson, Perceptual Learning and Development, p. 19.

[5]Ibid.

[6]Ibid., p. 35.

came originally as bits of punctiform and unrelated sense data, which must be in some way combined."[7] The results of such behaviors resulted in the doctrine of association--". . . the linking force by which meaningful perceptions and complex ideas were composed. Association supplied a means for going beyond simple, isolated sensations."[8]

By the late nineteenth century, philosophers as well as psychologists relinquished the dichotomy of nativism vs. empiricism and compromised. The dichotomy of nativism vs. empiricism was stated as the nature-nurture problem: "What has nature conferred with nurture shapes later?"[9] The empiricist position, however, remained a stronghold.

In the beginning of scientific psychology, four contrasting positions stood out as the traditional theories of perceptual development and learning. Position one, Helmholtz's Unconscious Inference, represented ". . . an interpretation of incoming sense data in the light of earlier accumulated experience."[10] Position two, Titchener's Context Theory, associated ideational context, represented, ". . . explaining complex perceptions as an accrual of imaginal content, derived from past experience to a sensory core."[11]

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[7]Ibid., p. 20.

[8]Ibid.

[9]Ibid.

[10]Ibid., p. 35.

[11]Ibid.

Position three and four involved two movements, functionalism in the United States and Gestalt psychology in Germany.

> The functionalists were staunch empiricists, but for associated imagery they substituted associated movements--localizing movements, primarily, since their work in perception was generally confined to space perception.[12]

The Gestalt psychologists were interested in form and organization, and thought of any change in them as due to a dynamic redistribution of forces, both in the brain and, isomorphically, in perception.

> Rather than studying the contribution of learning to perception, they thought of learning as dependent on perceptual reorganization--a kind of reversal of the roles of learning and perception. Perceptual development was thought of as differentiation. Creative learning, that is, perceptual reorganization, was due not to experience, but to self-redistribution of forces within the organism.[13]

These traditional theories of perceptual learning had many descendents. In the newer psychology, perceptual learning had come into prominence and a number of theoretical viewpoints had emerged as the contemporary theories of perceptual learning.

> Some of the theoretical biases which play a major role were derived from Helmholtz and the functionalists. Some, on the other hand, reflect the emphasis on response and reinforcement of the current S-R learning theories. In both cases, they can be categorized as enrichment theories, in the sense that something is thought to be added to preliminary registration of the environmentally produced stimulation, itself an elementary, meaningless, even punctuate affair. The contribution of the perceiver has been thought to lie in

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[12]Ibid., p. 36.

[13]Ibid.

> various processes--hypotheses, inferences, probabilistic weighting of cues, distortion produced by affect and attitudes, new cues produced by his own responses--but always something is presumed to be added by way of a mediating process.[14]

Gibson reported that these theories can be classified in ways as similar and different. She offered the chart shown in Figure 1 which has the theories arranged to show two major dimensions of difference and overlapping.

> The columns group the theories according to the psychological status of their principal concepts; whether they are cognitively oriented (one could say judgmentally), whether they are response oriented, or whether oriented to information in stimulation. The rows group the theories according to the kind of process which is considered the key to understanding perceptual change in development and in learning. Of the cognitively oriented theories, most assume an inferential process as the basic concept. The cognitive schema theories may include inference, but emphasize principally the construction of a conceptual or imaginal representation of external objects and events. The response-oriented theories divide into two kinds, one of which, the motor copy theory, resembles schema theories in positing construction of a representation which underlies perception, the representation, however, deriving from motor activity. The other type of response-oriented theory thinks of perceptual development as an improvement in discrimination, the improvement occurring by way of associated responses produce added stimulation. The last type of theory I have called stimulus oriented, because it considers perceptual development to be an improvement in discrimination of information which is actually presented in stimulation. Differentiation of perception occurs as response to aspects of information in the stimulation becomes more selective and specific.[15]

To amplify the third and final summary statement, the researcher blended the views of Elkind, Maier, Ginsburg and Opper, and Baldwin. Elkind viewed Piaget as the Swiss

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[14]Ibid., p. 37.

[15]Ibid.

		PSYCHOLOGICAL STATUS OF MAIN CONCEPT		
		Cognitively-Oriented	Response-Oriented	Stimulus Oriented
Type of Learning Process	Inference	Theories assuming unconscious inference of problem solving		
	Formation of a Representation	Schema theories	Motor copy theory	
	Improvement of discrimination		Additive mediation theories	Differentiation

Figure 1. Gibson's Classification of Theories of Perceptual Learning.

psychologist best known for his developmental theory of intelligence. "Piaget has also elaborated a theory of perceptual development that complemented and supported his work on the growth of intelligence."[16] Elkind provided a brief resumé of Piaget's theory of intelligence.

> He assumes that intelligence is an extension of biological adaptation and that it results in the formation of new mental structures. These mental structures, however, are not performed, or acquired; rather they are constructed in the course of development. Piaget's interest in perception thus grew out of his desire to demonstrate that perception, no less than intelligence, is neither entirely performed (as Gestalt psychology claimed) or simply acquired (as some contemporary

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[16]David Elkind, "Perceptual Development in Children," American Scientific, 63 (September-October, 1975), p. 533.

theorists, such as Gibson [1969] contend).[17]

Elkind also shared a brief resumé of Piaget's theory of perception.

> In Piaget's view, the perception of the young child is centered in the sense that it is caught and held by one or another dominant aspect of the perceptual field. In each case the dominant feature of the perceptual field is determined by organizational characteristics that the Gestalt psychologists describe as continuity, closure, good form, and so on. A closed-line drawing shows both continuity of line and closure of form and hence is a more dominant figure than an unclosed or incomplete line drawing. These organizational characteristics of the stimulus are what Piaget calls field effects. This liberation comes about because of the development of new perceptual abilities that Piaget speaks of as perceptual regulations; semi-logical processes that enable the child to act mentally on the visual material. They enable the child to reverse figure and ground, to coordinate parts and wholes, to explore systematically, to make comparisons at a distance, and to integrate the spatial and temporal features of a visual presentation.[18]

Piaget's theoretical views in relation to other prevailing theories were stated by Maier, Anthony and Flavell.

> Although the first to acknowledge the limitations of a one-dimensional theory, Piaget is nonetheless inclined to be parochial and to rely upon his own system of logical thought. At the same time, he maintains contact with contemporary psychologists and applies their teachings to his work. Piaget's theory and psychoanalysis share jointly an attempt to explain human behavior within one system and to avoid quantitative data. Piaget's interest in the genesis of the whole and its parts occurred without an awareness of Gestalt psychology, which he did not know until he had completed his initial research on this question.[19]

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[17]Ibid.

[18]Ibid.

[19]Maier, Three Theories of Child Development, p. 88.

> He is a creative borrower of genius, transposing and amplifying all that he borrows while generously acknowledging the sources. Piaget's theory is an ego psychology, leaning upon the cognitive, conflict--free, side of human behavior.[20]

John H. Flavell referred to the striking absence of any explicit recognition of learning theory.[21] Maier justified this absence learning theory.

> This is justified by Piaget in one of his most recent writings (1967) when he comments that the learning theory of Hull, Toman, and Associates had little influence upon education and other practice professions, because it is based upon the study of rats which are apt to have lost much of their rodent instincts. Moreover, Piaget conceives learning as a function of development. Learning cannot explain development, while stages of development can in part explain learning. For the learning theorist, however, development is perceived either as an independent process, a part of the primary process of learning, or as a function of learning.[22]

Maier's statements describing Piaget were corroborated by Gibson. Following explosure to Gibson's ideas pertaining to five cognitively oriented theories and their implications for visual perception development and learning, the researcher drew the conclusions stated below:

(1) These cognitively oriented theories were filiations of the traditional theories; and (2) Piaget had not committed himself to one theory of perceptual learning.[23]

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[20]E. J. Anthony, "The Significance of Jean Piaget for Child Psychiatry," British Journal of Medical Psychology, 29, (1956) p. 20.

[21]J. H. Flavell, The Developmental Psychology of Jean Piaget (Princeton, New Jersey: Van Nostrand, 1963), p. 3.

[22]Maier, Three Theories of Child Development, p. 88.

[23]Gibson, Perceptual Learning and Development, p. 47.

For purposes of amplification of conclusion number one, Gibson summarized these five cognitively oriented theories.

> Brunswick's theory of probabilistic cue learning in perception assumes that perception is always of the distal object, but that man's environment is such that it provides only uncertain information in the stimuli reaching the sense organs. These stimuli became cues or indicators of the real distal object and must be assessed against a cue-family hierarchy which gives the probable validity of the cue. Inferences are made of a sort essentially like those in gambling, using the store of previous experiences when the cue and the referent have been associated. Cue learning by association is the essential mechanism of perceptual learning for Brunswick.
>
> The Transactionalist view of perception, with Ames, Cantril, and Ittelson as its principal proponents, is similar to Brunswick's view in its emphasis on unconscious inference from previous experience, but is subjectively oriented. The individual lives in his own world of assumptions, which may be illusory, and which determines his perceptions. The subjective evaluation of impinging stimulation is thought to be directed not only by previous experiences leading to weighted assumptions but also by personal values and attitudes.[24]

Gibson further stated that the remaining three theories place greater emphasis on the constructive and problem solving nature of perception.

> The schema theory of Bartlett and Vernon looks at perception as a constructive process. Schemata, essentially conceptualizations of the past experience, are constructed as the individual develops and these serve to mediate perception. Meaningless sensations are interpreted in terms of schemata. Perceptual learning in this theory is the construction of schemata.
>
> Piaget has also made use of the schema and thinks of perception as an active, constructive process. However, Piaget makes a sharp distinction between perception and logical intellectual processes. Perception involves

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[24]Ibid., p. 51.

assimilation of the sensory input to a schema, so that acquisition of schemata is a fundamental process in perceptual learning. So is equilibration, putting things into relation by active exploratory processes. But schemata direct exploration as they become available. Furthermore, perceptual activities become less autonomous as development proceeds, and are increasingly directed by intellectual processes.

For Bruner, problem-solving is the model for perception. Perception is achieved by a sequence of operations including hypotheses, trial and check, and matching to a category. Perception always involves an act of categorization. Cues in the stimulus input are used to infer categories. Perceptual learning, therefore, must involve the formation of categories and the allocation of each stimulus input to the appropriate category. The hypotheses which direct the search for the right category may, for Bruner, reflect the personal needs and values of the observer.[25]

Gibson amplified conclusion number two.

Briefly, then, Piaget's view of perceptual development includes two rather distinct theoretical concepts. Basically, perception depends on sensory information which must be structured in some way by the observer, and his view is thus similar to that of Bartlett and Vernon. Development of a schema is vital to the construction. There is also the hint, in some of his writings, of a motor copy theory . . . .

Perception for Piaget involves assimilation of sensory input to a schema and often, ensuing upon this, accomodation of the schema to the specific object. Thus acquisition of schemata must be the fundamental process of perceptual learning. Perception is also probabilistic and subject to distortion, although the thought processes (at least at maturity)are not. The schema for Piaget is a sensory-motor plan, a cognitive structure referring to a class of action systems relating recurrent situations to a disposition to act in a characteristic way. It is categorical in the sense that there are similar action sequences forming a class which defines the schema. Repetition of situations is essential for schema formation, since the assimilation of similar situations strengthens (nourishes) the schema. Assimilatory activity engenders the schema, but it is not a mere accumulation since it is the product of continuous activity. A schema becomes more generalized, as

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[25] Ibid., p. 52.

more objects are assimilated to it. Differentiation can also occur, dividing a very general schema into subordinate ones.

In a rare discussion of perceptual learning as such, Piaget suggested that there were two kinds of perceptual modification (Piaget, 1960). One was a gradual equilibration, in the sense of progressive compensation for errors and distortion, produced by active exploration and putting things into relation. The other was increasing generalized assimilation, schematization. The schemata resulting from repetition have the effect, furthermore, of directing exploration. And finally, Piaget stated that the perceptual activities involved in perceptual learning are not themselves autonomous, but are increasingly directed by the active operation of intelligence.

Throughout his work, Piaget has emphasized the role of activity and motor processes as distinguished from passive perception. The importance of exploratory activity in perception, and especially in its development, is often remarked. Examples of progress in skilled exploratory activities are fundamental to schema formation, and there is the hint that adequate perception of forms and objects develops as a kind of copy of motor exploration by hand and eye. How seriously one can take the suggestion that perception of form is indeed a motor copy is hard to say, since the active intelligence enters in, at some point, and the lines between percept, schema, and concept are hard to draw. For the young infant, the object is merely a sensory image at the disposal of actions. The objective shape is constructed through movements governed by the child's actions. Objects become localized in space as they acquire permanent dimensions (constancy). Perceptual space may then be transformed as movements guided by vision become systematized, and consequently react back on it. As the sensory-motor schemata are built, so percepts change, and virtual relations between the schema and earlier or contingent perceptions become determining. The role of the motor copy in perceptual learning appears to be indirect, by way of the schema to which the percept is assimilated.[26]

The researcher extended the description of Piaget with the views of Ginsburg and Opper and Baldwin. Ginsburg

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[26]Ibid., p. 47.

and Opper stated that since the early 1950's, it became increasingly clear to child psychologists, educators, and others in diverse areas, that Jean Piaget was the foremost contributor to the study of intellectual development. "From 1920 until the present, Piaget and his collaborators have produced more worthwhile research and theory than any other individual or group of investigators in psychology."[27] It was further reported that the sheer volume of Piaget's output is staggering. Baldwin stated that Professor Jean Piaget of the University of Geneva is doubtless the century's most prolific writer and theorist on the development of the child.[28]

To focus on quantity alone did not tell the full story. Ginsburg and Opper extended this story by further discussing quality. "Piaget has captured the interest of modern psychologists and educators for several important reasons."[29]

> First, he has introduced a score of new and interesting problems which previously went unnoticed. For example, it was Piaget who discovered the profoundly complex problem of conservation, which has caught the imagination of many investigators. This problem taps on one aspect of the child's ability to construct a reality

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[27]Herbert Ginsburg and Sylvia Opper, Piaget's Theory of Intellectual Development, An Introduction (New Jersey: Prentice-Hall, Inc., 1969), p. ix.

[28]Fred L. Baldwin, Theories of Child Development (New York: John Wiley & Sons, Inc., 1967), p. 117.

[29]Ginsburg and Opper, Intellectual Development, p. ix.

> which transcends the mere appearance of things. Second, Piaget's theories have reoriented current conceptions of the child's development. His ideas are novel, imaginative, and comprehensive. Some persons now feel that his theories are the first to offer a successful challenge, or at least a viable alternative, to the trend dominant in American child psychology, namely the stimulus-response behaviorist tradition. And finally, of all the theories of child development, Piaget's is the one most securely founded upon the study of the child. None of the investigators whose theories have been used to explain the development of children--Freud, Lewin, Hull, Miller and Dollard, Skinner, Werner--has studied children as extensively as has Piaget. In fact some of these figures--e.g., Freud, Hull, Skinner--hardly studied children at all. Gesell did study children, but did not produce a serious theory. By contrast, Piaget has for nearly fifty years observed, interviewed, and tested children of all ages, and this enormous set of empirical data is the foundation of his theory.[30]

Value of Study

According to Ginsburg and Opper, scientists usually employ a theoretical framework to guide their experimentation and theorizing. These authors defined a theoretical framework as ". . . a point of view or a set of attitudes which orient the scientist's activities."[31] It was Piaget's statement, ". . . the perceptual activities involved in perceptual learning are not themselves autonomous, but are increasingly directed by the active operation of intelligence."[32] that provided ". . . a point of view or a set of attitudes . . ."[33] for this study.

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[30]Ibid., p. x.

[31]Ibid., p. 13.

[32]Gibson, Perceptual Learning and Development, p. 51.

[33]Ginsburg and Opper, Intellectual Development, p. 13.

There existed divergent predictions of the Gestalt and Piagetian conceptions of figure-ground reversal. As reported by Elkind, figure-ground reversal appeared to be the result of the innate organizing principles described by Gestalt psychology rather than developmentally arrived at regulations described by Piaget.

> Indeed the Gestalt psychologists Köhler and Wallach (1944) argued (on the basis of what today appears to be erroneous physiological assumptions about brain tissue) that figure-ground reversal should be more prominent in younger than in older children.
>
> From a Piagetian standpoint, however, just the reverse prediction would be made. In Piaget's view, figure-ground reversal is mediated by logic-like processes that do not emerge until about the age of six or seven.[34]

If early childhood theoreticians and practitioners were going to accept the challenge of assisting in developing children who possess skills and abilities that contribute to readiness for successful instruction, then strategies ought to be confirmed and applied, or disconfirmed and discarded. The results of this study will provide information to theoreticians and practitioners which will direct their energies toward more productive strategies.

Statement of the Problem

The problem for this study was: What effects do visual perceptual experiences, chronological age level, and Piaget's stages of intellectual development have upon visual perceptual learning?

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[34] Elkind, "Perceptual Development," p. 533.

Specifically, the following questions were, therefore, investigated:

1. What was the effect of visual perceptual experiences upon visual perceptual learning?

2. What was the effect of three chronological age levels upon visual perceptual learning?

3. What was the effect of Piaget's stages of intellectual development upon visual perceptual learning?

Hypotheses

General Developmental Hypothesis

In an attempt to investigate the problem for this study, the problem was reduced to the hypothesis form:

> The perceptual phenomenon of figure-ground is neither entirely innate nor entirely learned, but rather derived from the interaction of maturation and experience.

Specific Hypotheses

Since the general developmental hypothesis was too broad to be directly tested, the following specific-null hypotheses were deduced from it:[35]

H_{01} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects (on pretests, posttests, or delayed posttests) between the experimental and control groups.

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[35] Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1964), p. 21.

H_{02} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and posttests.

H_{03} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on post and delayed posttests.

H_{04} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and delayed posttests.

H_{05} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages six and seven.

H_{06} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages six and eight.

H_{07} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages seven and eight.

Definition of Terms

The following terms were used in accord with the definitions stated here.

1. Influence. Webster defined influence as the act or process, or the power, or producing an effect without apparent force or direct authority.[36]

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[36]William Allan Neilson, ed., Webster's New International Dictionary of The English Language (Mass.:

2. Effects. Webster defined effect as something that is produced by an agent or cause: something that follows immediately from an antecedent: a resultant condition: RESULT, OUTCOME.[37]

3. Selected variables. The selected variables in this study were: visual perceptual experiences, chronological age level, and Piaget's stages of intellectual development.

4. Development and learning. Piaget defined development of knowledge as a spontaneous process which concerned itself with the totality of the structures of knowledge. Piaget defined learning as a provoked process with respect to some didactic point or by an external situation. It is a limited process, limited to a single problem or a single structure. Development was defined as the essential process and each element of learning occurred as a function of total, rather than being an element which explains development.[38]

5. Visual perceptual experiences. The researcher defined visual perceptual experiences as the following figure-ground perceptual experiences: (1) shifting attention appropriately, (2) concentrating upon relevant stimuli; (3) scanning adequately; and (4) exhibiting more organized

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G & C Marriame Co., 1937), p. 1276.

[37] Ibid., p. 818.

[38] Jean Piaget, "Development and Learning," Journal of Research in Science Teaching, 2 (Issue 3, 1964): 176-86.

behavior.[39] These experiences are described in more detail in the section on Treatment.

6. Chronological age level. Six, seven, and eight year olds located in attendance in the Oklahoma City Public Schools represented age level.

7. Piaget's stages of intellectual development. Renner defined the stages of intellectual development as a developmental continuum included within Piaget's theory of intelligence model. The continuum described certain characteristics or properties of mental functioning that began at birth and end with death.[40] From the curriculum-methodology frame of reference, Renner's developmental division consisted of four levels: (1) The sensory motor stage; (2) the preoperational stage; (3) the concrete operational stage; and (4) the formal operational stage.[41] A more detailed description of each stage appears in Appendix A.

8. Perceptual learning. Gibson defined perceptual learning as both a product and a process. As a product, perceptual learning referred to an increase in the ability to extract information from the environment as a result of

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[39] Marianne Frostig and David Horne, The Frostig Program for the Development of Visual Perception, Teacher's Guide (Chicago: Follett Educational Corporation, 1964), p. 3.

[40] John W. Renner, et al., Research, Teaching and Learning with the Piaget Model (Norman, Oklahoma: University of Oklahoma Press, 1976), p. 19.

[41] Renner, et al., Piaget Model, p. 19; Renner, Don G. Stafford, and William B. Ragan, Teaching Science in the Elementary School (New York: Harper & Row Publishers, 1973) p. 69.

experience and practice with stimulation coming from it. As a process, perceptual learning is active, in the sense of exploring, searching, extracting and reducing information in stimulation. It is also self-regulating.[42]

9. Figure-ground perception. Elkind defined figure-ground perception as one of several perceptual abilities, regulations, or semi-logical processes that enable the child to act mentally on visual material-to reverse figure and ground, to explore systematically, to make comparisons at a distance, and to integrate the spatial and temporal features of a visual presentation.[43]

10. Figure-ground. Frostig defined figure as that part of the field of perception that is the center of the observer's attention, be it auditory, tactile, olfactory, and visual. When the observer shifts his attention to something else, the new focus of attention becomes the figure, and the previous figure recedes into the ground.[44]

11. Action. Renner defined an action as something a child does that is mainly physical.[45]

12. Operation. Renner defined an operation as an intellectual procedure-when an action is taken into the

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[42]Gibson, Perceptual Learning and Development, p. 3.

[43]Elkind, "Perceptual Development in Children," P. 533.

[44]Frostig and Horne, "Development of Visual Perception," p. 29.

[45]Renner, et al., Teaching Science, p. 71.

child's cognitive structures and he is able to reverse his thinking anywhere in the action and go back to the starting point.[46]

13. Hypothesis. Renner defined an hypothesis as an estimate of what the solution to a problem might be.[47]

14. Adaptation. Ginsburg and Opper defined adaptation as a basic tendency of the organism which consisted of two processes--assimilation and accommodation.[48]

15. Assimilation. Ginsburg and Opper defined assimilation as one of two complementary processes involved in the invarient function (a basic tendency) of adaptation. It is the complementary process by which the individual deals with an environmental event in terms of his current structures.[49]

16. Accommodation. Ginsburg and Opper defined accommodation as one of two complementary processes involved in the invarient function (basic tendency) of adaptation. This process describes the individual's tendency to change in response to environmental demands.[50]

17. Structures. Battro defined structures as a

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[46]Ibid.

[47]Ibid.

[48]Ginsburg and Opper, Intellectual Development, p. 18.

[49]Ibid.

[50]Ibid., p. 19.

form of organization of experience.[51] . . . only a momentary crystallization always surpassed in fact by the mind in its functioning.[52]

18. One-dimensional theoretical viewpoint. Maier defined a one-dimensional theoretical viewpoint as one that is parochial; one that relies upon one system of logical thought.[53]

Assumptions

> (1) that intelligence is an extension of biological adaptation and that it results in the formation of new mental structures. These mental structures, however, are not performed, or acquired; rather they are constructed in the course of development.
>
> (2) that the perception of the young child is centered in the sense that it is caught and held by one or another dominant aspect of the perceptual field. In each case the dominant feature of the perceptual field is determined by organizational characteristics that the Gestalt psychologists describe as continuity, closure, good form, and so on . . . . This liberation comes about because of the development of new perceptual abilities that Piaget speaks of as perceptual regulations; semi-logical processes that enable the child to act mentally on the visual material. They enable the child to reverse figure and ground, to coordinate parts and wholes, to explore systematically, to make comparisons at a distance, and to integrate the spatial and temporal features of a visual presentation.[54]

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[51]Antonio M. Battro, Piaget: Dictionary of Terms, trans. and ed. by Elizabeth Riitschii-Hermann and Sarah F. Campbell (New York: Pergamon Press, Inc., 1973) p. 168. [Citing] Jean Piaget, "Le développement intellectual chez les jeuner enfants," Mind 40 (1931) 137-160.

[52]Ibid.

[53]Maier, Three Theories of Child Development, p. 89.

[54]Elkind, "Perceptual Development in Children," p. 533.

Procedure

Selection and Size of Subjects

With the assistance of the Research Department and the Director of Elementary Schools of the Oklahoma City Public School System, District #89, Southern Hills Kindergarten-Fourth Year Center was selected as the research site. The principle criteria for site selection were: (1) Enrollment size of the population; and (2) low mobility rate of the school population. From the population of pupils attending this site, 30 subjects from each chronological-age-level, six, seven, and eight, were selected to participate. This totaled 90 subjects. The researcher referred to the following authors for a justification of this sample size.

"In most experiments 10-15 subjects per group are used."[55] The use of this size sample is extended by Kerlinger. "Use large samples as possible."[56] Weinberg and Schumacher added, "The larger the samples are the more closely their means cluster together. As a matter of fact, it is generally thought adequate to use the normal distribution so long as one's sample is made up of at least 30 cases."[57]

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[55] James L. Bruning and B. L. Kintz, Computational Handbook of Statistics (Glenview, Ill.: Scott, Foresman, and Co., 1968), p. 154.

[56] Kerlinger, Behavioral Research, p. 127.

[57] George Weinberg and John A. Schumacher, Statistics: An Intuitive Approach (Belmont, Calif.: Wadsworth Publishing Co., 1965), pp. 20, 198.

The mean age for the three strata-age-levels in this sample were: 78 months, 87 months, and 101 months, respectively. The demographics of the site population, which appear in Appendix B was obtained for purposes of making assumptions related to the scope of the sampling.

The 90 subjects were randomly selected from the stratified samples of kindergarten, first, second, and third year primary pupils by the following procedures. Letters for permission (Appendix C) to take part in all research experiences were sent to the parents of all children. After a specified deadline for the return of all letters, the obtained letters were divided into three strata-age-levels. Each chronological age level was processed as follows: The name appearing on each letter was assigned a number which was written on a slip of paper, folded, and placed in a container. Names were then mixed-up and one person pulled the desired number of names out of the container.

Formation of Groups

From this stratified random sample, the subjects at each chronological age level were randomly placed into the experimental group and the control group which were comprised of 15 subjects each. Procedures for this placement were identical to those described above.

Subjects selected for the experimental group participated in visual perceptual experiences consisting of:

(1) Experiences with Three-Dimensional Objects[58] and (2) Figure-Ground Paper and Pencil Experiences.[59] Subjects selected as the control group received none of the visual perceptual experiences, nevertheless, both groups were given The Six Piagetian Conservation Tasks[60] and Marianne Frostig Developmental Test of Visual Perception, (DTVP), Test #II, Figure-Ground.[61]

The Six Piagetian Conservation Tasks were administered by the researcher to each of the 90 subjects, individually, at Phase I-Pretesting; Phase III--Posttesting; and Phase IV--Delayed Posttesting.

Marianne Frostig Test of Visual Perception, Test #II, Figure-Ground was administered by the researcher to each of the 90 subjects according to Frostig's recommendations at Phase I--Pretesting; Phase III--Posttesting; and Phase IV--Delayed Posttesting.

Frostig Suggested that experienced and skillful examiners have tested up to 30 children at a time in first and second grades, but smaller groups are preferable. The researcher used smaller groups as recommended above. Frostig further stated that the largest recommended sizes

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[58]Frostig and Horne, Visual Perception, p. 32.

[59]Ibid., p. 113.

[60]Renner, et al., Teaching Science, pp. 79-83.

[61]Marianne Frostig, Welty Lefever, and John R. B. Whittlesey, The Marianne Frostig Developmental Test of Visual Perception (Calif.: Consulting Psychologists Press, 1966).

	Age-Level	Optimum Number of Children in Group
Nursery School	3-4 years	1-2
Nursery School	4-5 years	2-4
Kindergarten	4-5 years	8-10
First Grade		12-16
Second Grade		10-20
Third Grade		20-40

Figure 2. Frostig's recommendations for size of test groups.

for second and third require one or more proctors who are also familiar with the test and can circulate among the children.[62] The researcher did not use groups this large. The researcher controlled the group size to no more than 15.

For the purposes of treatment

Visual perceptual experiences consisting of (1) Experiences with Three-Dimensional Objects and (2) Figure-Ground Paper and Pencil Exercises, took place in group sessions. In order that the visual perceptual experiences might be effective, the researcher divided the subjects comprising the experimental group which had been randomly selected into two heterogeneous groups. Group I consisted of 22 subjects

[62]Frostig, et al., Administration and Scoring Manual, Developmental Test of Visual Perception, p. 8.

and Group II consisted of 23 subjects. The site principal selected the subjects for each group based upon school activities within classrooms involved.

Treatment

> Training in figure-ground perception should result in improved ability to shift attention appropriately, to concentrate upon relevant stimuli, to scan adequately, and in general to exhibit more organized behavior.
>
> As with all visual perception training, the pencil-and-paper exercises should be preceded by games and exercises involving three-dimensional objects.[63]

Outline of apparatus or materials

As suggested by Frostig, as with all visual perceptual training, the pencil-and-paper exercises should be preceded by games and exercises involving three-dimensional objects. Some examples follow.

1. Exercises with Three-Dimensional Objects:
   a. Discriminating objects in the room;
   b. Finding objects that are different;
   c. Sorting objects;
   d. Shifting attention.[64]
2. Figure-Ground Paper and Pencil Exercises, 1-69b.
   a. Intersecting lines;
   b. Intersecting figures;
   c. Hidden figures;

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[63]Frostig, et al., Test of Visual Perception, Teacher's Guide, p. 31.

[64]Ibid., p. 31.

d. Overlapping figures;

e. Figure completion;

f. Figure assembly;

g. Similarities and differences of details;

h. Reversal of Figure-Ground.[65]

A detailed description of each of the above exercises and accompanying materials can be found in Appendix C, page 154.

Instructions for work sheets, Figure-Ground Perception, Exercise A, Intersecting lines and accompanying materials can be found in Appendix E, page 156. The researcher provided a sample lesson plan which exhibits these exercises as executed. This plan appears in Appendix F, page 157.

In her discussion of visual perceptual experiences, Frostig made pertinent general suggestions.[66] These suggestions deserved consideration, and were, therefore, incorporated into this study.

General suggestions related to visual perceptual experiences sessions

Emphasis. The main emphasis of the visual perceptual experiences sessions was on visual perception, specific ability, figure-ground, but physical movement, touch, and listening were also important parts of each session.

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[65]Ibid., pp. 113-30. [66]Ibid., p. 95.

> Every human action involves the integration of a number of psychological manifestations. Perception, thought, speech, movement, and emotion, may be involved in a single act, and since each of these is always used in conjunction with others, none can be trained in isolation. When we speak of language training, for instance, we mean that language is given particular emphasis, but thought processes, perceptual abilities, and emotions are also included. Training in visual perception should likewise be integrated into a wider program of activities. Not only are the various psychological abilities always used in conjunction with each other, but so are the various senses. The simple act of standing in a normal posture depends upon the fusion of muscle sense, vision, touch, and a sense of balance. Judgment, too commonly depends upon evidence collected by several sensory channels working together.[67]

Format. Visual perceptual experiences sessions were divided into two parts. Part I, stressed Exercises with Three-Dimensional Objects (approximately 5 minutes) and was followed by Part II--Figure-Ground Paper and Pencil Exercises (approximately 25 minutes). Total 30 minutes.

Sustaining attention. Six areas were planned to aid in sustaining attention:

1. Length of training sessions--Visual perceptual experiences sessions were approximately thirty minutes. These sessions were held twice a week on Tuesdays and Thursdays, following lunch and recess--Group I, 12:30-1:00, and Group II, 1:30-2:00 for four weeks. This totaled eight sessions.

2. Grouping--The experimental subjects were grouped heterogeneously. It was, specifically, observed that all

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[67] Ibid.

levels, kindergarten, first, second, and third graders worked well together.

3. Positive tone--

> Children who are unhappy, angry, sullen, or frightened cannot learn, and punishment for not learning only deepens their resentment and further incapacitates them.
>
> Rapport is essential. The children should feel that their efforts are appreciated even if those efforts are unsuccessful. Their tasks, while providing the necessary training, should appeal to them as much as possible and you should use your ingenuity to try to present work in the form of games.[68]

4. Step-by-step progress--The researcher began with easy enough exercises to insure success, and the gradient of difficulty of the exercises were such that the subjects progressed comfortably.

5. Reduction of irrelevant stimuli--The reduction of distracting stimuli as distracting objects, glare, and view from lower windows, the wearing of unnecessary jewelry or shiny buttons or materials and irrelevant movement was considered.

6. Accentuation of relevant stimuli--

> If the children are required to start to write or draw at a certain point on a piece of paper, a heavy mark can be made at that point so that their attention will be drawn to it and they will be better oriented to the task.
>
> . . . It has been stated that bright colors are too stimulating for many slow learners. We have found this to be only rarely true. Colors should be used wherever possible in writing, spelling, and reading lessons.
>
> Use movements, either actual or implied, in giving

[68] Ibid., p. 97.

instructions. You should, for instance, use your finger or pointer to illustrate how a line is to be drawn from one point to another. Exercises can be made more attractive by using stories of illustrations involving motion.

> . . . The children's understanding will be enhanced if you give them detailed explanations of what they are to do, provided the instructions are coached in simple and repetitive language. This principle is used in the instructions for the exercises, and it can be extended to any phase of classroom activity.[69]

Instrumentation

The Six Piagetian Conservation Tasks

These tasks, developed by Jean Piaget, were used to test children for their ability to conserve.

> A child who conserves can hold a concept regarding an object in his cognitive structure, while a second object, like the first, is distorted and can see that the distorted object is still like the nondistorted object in many specific ways.[70]

The researcher administered The Six Piagetian Conservation Tasks as described by Renner. They were: (1) Conservation of Number; (2) Conservation of Solid Amount; (3) Conservation of Liquid Amount; (4) Conservation of Length; (5) Conservation of Area; and (6) Conservation of Weight.

Renner reported that

> The utilization of these tasks is illustrated in the film Piaget's Theories: Conservation, produced and distributed by John Davidson Films, Inc., San Francisco. The directions for these tasks have been tried by

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[69] Ibid., p. 97.

[70] Ibid.

> several hundred elementary school teachers and we appreciate their suggestions and contributions. We are especially indebted to Dorsee Bennett Cohenour and Sandra Thompson Quigley who, after extensive tryouts with children, assisted in rewriting the directions for each test.[71]

The researcher underwent an instructional process in the administration of The Six Piagetian Conservation Tasks. The instructional process included the following procedures;

(1) Observed, administered, and recorded The Six Piagetian Conservation Tasks as a student enrolled in a Piagetian Seminar--Education 6970, Piaget and Curriculum. This seminar was conducted by Renner.

(2) Practiced, taped, and photographed the administration of The Six Piagetian Conservation Tasks with six, seven, and eight year olds and critiqued this material with Renner for the purpose of recommendations for improvement.

According to Ginsburg and Opper, whether or not the revised clinical procedure gives an accurate assessment of the child's abilities is a matter for lively debate. Braine feels that the method is still too verbal and therefore inadequate.[72] Fleischmann, Gilmore, and Ginsburg have performed studies which indicate otherwise. "The issue is not

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[71]Renner, et al., Teaching Science, p. 79.

[72]Ginsburg and Opper, Intellectual Development, p. 119 [citing] M. D. S. Braine, "Piaget on Reasoning: A Methodological Critique and Alternative Proposals." In W. Kessen and C. Kuhlmann, eds., "Thought in the Young Child," Monographs of the Society for Research in Child Development, 27, No. 2 (1962).

settled yet. Nevertheless, the revised clinical method is less exclusively verbal than Piaget's earlier procedure and attempts to give an accurate assessment of the child's thought processes which may be in a large measure nonverbal."[73]

Lawson statistically analyzed Piaget's tasks for validity. He collected data on the performances on Piagetian Tasks and attempted to gain further insight into the validity of the tasks and the meaningfulness of viewing development as occurring in concrete and formal stages. The technique used was the statistical technique of principal-components analysis. Lawson shared a brief introduction of this technique, how it could be applied to the Piagetian Tasks, and his results when applying the technique to a specific sample.

> Basically, principal-components analysis is a multivariate technique which is often considered a first-stage solution in factor analysis. The technique can be used to determine factorial validity of psychological tests, and that is one way in which it is used here. Generally, the technique attempts to reduce mathematically a set of many measures to a smaller number of factors by extracting weighted sums of the measures which account for a maximum amount of the variance of the total set.
>
> . . . Principal-components analysis, therefore, effects a parsimony of description. To use the technique to validate psychological tests such as the Piagetian Tasks, the procedure is relatively simple. A set of six formal operational Piagetian Tasks, for instance, should be reduced to only one factor through the use of principal components. Since the tasks presumably measure only one thing, only one principal component should be extracted,

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[73]Ibid., [citing] B. Fleischmann, S. Gilmore, and H. Ginsburg, "The Strength of Nonconservation." Journal of Experimental Child Psychology, 1966, 4, pp. 353-68.

> and all six tasks should correlate highly or load heavily on the component. This result would validate the tasks in that they would indeed seem all to be measuring the same thing, namely formal-operational thought. If the technique extracts more than one principal component, or root, then one would conclude that the tasks measure more than one thing. A result such as this would invalidate the tasks.
>
> If a series of both concrete and formal tasks is analyzed, it would be possible to determine the number of psychological factors (components) that underlie success of these tasks. It is necessary to keep in mind that it remains the responsibility of the investigator to determine the "psychological meaningfulness" of the factors.[74]

Lawson concluded the analysis of his particular sample as described below.

> . . . it can be said that on all points the results are as Piagetian theory predicts: (1) only two components, concrete and formal operational thought, are measured by the six tasks; (2) the tasks conservation of solid amount and conservation weight measure essentially one factor; (3) the tasks conservation of volume using cylinders, elimination of contradiction, and exclusion also essentially measure one factor; (4) the conservation of volume using clay, somewhat surprisingly, indicated a certain amount of both formal and concrete thinking, a result that was also anticipated by Piaget.
>
> While these results do not definitely indicate distinct stages in intellectual growth, they suggest that Piaget's tasks measure what they are supposed to measure and that the constructs of formal-operational thought seem viable.[75]

<u>Description of apparatus or materials</u>

The materials needed for such testing were as described by Renner, Stafford, and Ragan below.

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[74]Renner, et al., <u>Piaget Model</u>, p. 130.

[75]Ibid., p. 136.

1. Conservation of number task--6 black checkers, 6 red checkers.

2. Conservation of liquid task--2 containers of equal size, food coloring, water, 1 taller, thinner container.

3. Conservation of solid amounts task--2 pieces of clay containing the same amount of clay.

4. Conservation of area task--2 8½" x 11" sheets of green paper, approximately 16 1" cubes (black will do), 2 toy domestic animals, i.e., horses, cows, sheep, etc.

5. Conservation of length task--One long stick (dowel) 12" long, 4 dowels of the same length each 3" long, 2 identical toy cars.

6. Conservation of weight task--2 balls containing equal amounts of clay, 2 colors, say red and green.[76]

Marianne Frostig Developmental Test of Visual Perception, Third Edition. Ages 3-8; 1961-66 DVTP; by Marianne Frostig in collaboration with Welty Lefever and John Whittlesey, sought to measure five operationally defined perceptual skills, as follows:

Test I

> Eye-Motor Coordination--a test of eye-hand coordination involving the drawing of continuous straight, curved, or angled lines between boundaries of various width, or from point to point without guide lines. (16 items)

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[76] Renner, et al., Teaching Science, p. 400.

Test II

Figure-Ground--a test involving shifts in perception of figures against increasingly complex grounds. Intersecting and "hidden" geometric forms are used. (8 items)

Test III

Constancy of Shape--a test involving the recognition of certain geometric figures presented in a variety of sizes, shadings, textures, and positions in space, and their discrimination from similar geometric figures. Circles, squares, rectangles, ellipses, and parallelograms are used. (17 items)

Test IV

Position in Space--a test involving the discrimination of reversals and rotations of figures presented in series. Schematic drawings representing common objects are used. (8 items)

Test V

Spatial relationships--a test involving the analysis of simple forms and patterns. These consist of lines of various lengths and angles which the child is required to copy, using dots as guide points. (8 items)[77]

The rationale for the subtests evolved from Frostig's own clinical observations, "as well as findings of others . . . that each of the five abilities develop relatively independently of the other and that there should be specific relationships between them and a child's ability to learn and adjust." The authors further note in their manual: "pinpointing the areas of a child's visual perceptual difficulties and measuring their severity is helpful and often necessary in designing the most efficient training program to aid in overcoming the disabilities.

The Developmental Test of Visual Perception can be used either as a screening device for nursery school, kindergarten, and first grade children or as a clinical evaluative instrument for older children who suffer from learning difficulties . . . and adult victims of stroke

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[77]Frostig, et al., Administration and Scoring Manual, Developmental Test of Visual Perception (California: Consulting Psychologists Press, Revised, 1966), p. 5.

> or other brain injury.
>
> The testing materials have not been revised since 1963, but the manual was revised in 1966 . . . . A particular advantage of the Frostig over other tests of perceptual abilities is that it may be administered to groups.
>
> The materials consist of demonstration cards; revised administration and scoring manual (reprint of 13 below); $10 per examiner's kit of 10 tests, scoring keys, demonstration cards, monograph, and manual; $10 per 25 tests; $5 per specimen set; postage extra; (30-35) minutes for individual administration (40-60 minutes for group administration).[78]

The authors cautioned that only experienced persons should administer the test, and explicit criteria were presented for selecting and training administrators. The researcher experienced the instruction process and met all explicit criteria presented with the benefit of being tutored by an already-experienced examiner, a qualified psychometrist of the Oklahoma City Public School System.

Additional pertinent information on this test is as follows:

> The overall usefulness of the DTVP is limited by the standardization sample upon which all of the score conversions are based. The standardization was accomplished prior to 1963, using 2,116 subjects from schools is southern California. Little information is presented about the sample or the sampling procedures. The authors state: "Our present public school standardization sample, therefore, is overwhelmingly middle class in nature." Children from low socio-economic groups and minority groups are poorly represented. In fact, no Negro children were included. Lack of normative information about children of minority groups for which perceptual difficulties are a major problem is not a deficit peculiar to

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[78] Oscar Krisen Buros, ed., Seventh Mental Measurement Yearbook, volume II (New Jersey: The Gryphon Press, 1972), p. 1270.

this test, but the unavailability of such information should be taken into consideration when the DTVP is being used for these children.

The test yields three types of scores: (a) Perceptual Age (PA) for each of the 5 sub-tests, "defined in terms of the performance of the average child in the corresponding age group for each subtest;" (b) Scale Scores, which are "Perceptual Ages divided by Chronological Ages and multiplied by 10, adjusted to the nearest whole number"; and (c) the Perceptual Quotient (PQ), which is a "deviation score obtained from the sum of the subset scale scores after correction for age variation," a normalized score with median 100 and quartile deviation 10.

Although reliability is not high, as is often the case with tests for young children, the information presented is adequate. Test-retest reliability of the perceptual quotient is reported to be .80 for a small group (N-72) of first and second graders tested two weeks apart, with subtest reliabilities ranging from .42 to .80.

Split-half reliability studies carried out for four age groups raise further doubts about the stability of the DTVP's individual subtests. Only Substests 2 and 5 have adequate internal consistency over all the age ranges, with coefficients in the .90's for Subtest 2, and ranging from .64 to .84 for Subtest 5. The coefficients do not go above .60 for Subtest I or above .77 for Subtest 3 and range from .35 to .70 for Subtest 3. The results, again, are better for total scores and global measures, with coefficients from .78 to .89 being reported.

In validity studies, the DTVP scores, particularly the PQ, fare better, for example, DTVP scores do discriminate poor readers from good ones at the first grade level, with modest correlations of .40 to .50 (Correlations in second and third grade are reported as "quite low" but are not cited). The test does discriminate between normal and neurologically impared populations.

Within the area of visual perception, the Frostig test probably yields the best information available today. If a child scores low, it is likely that he will have trouble in the classroom. The converse, however, cannot be assumed. If a child scores high, he may still have trouble in the classroom because of other developmental deficits or because of deficits in other perceptual avenues. Interpreted in such overall context, the Frostig test contributed valuable data to the clinical evaluation.[79]

Research Design and Strategy

Design

According to Campbell and Stanley, the research design for this study was an extension of the simple core design--The pretest-posttest control group design, with an additional delayed posttest. This design is one of Three True Experimental Designs currently recommended in the methodological literature.[80]

Campbell and Stanley further reported that in presenting experimental designs, a uniform code and graphic presentation be employed to epitomize most, if not all, of their distinctive features.

> An X will represent the exposure of a group to an experimental variable or event, the effects of which are to be measured; O will refer to some process of observation or measurement; the Xs and Os in a given row are applied to the same specific persons. The left-to-right dimension indicates the temporal order, and Xs and Os vertical to one another are simultaneous . . . . A symbol R indicating random assignment to separate treatment group, is necessary. This randomization is conceived to be a process occurring at a specific time, and is the all-purpose procedure for achieving pretreatment equality of groups, within known statistical limits. Along with this goes another graphic convention, is that parallel rows unseparated by dashes represent comparison groups

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[79] Ibid., p. 1276.

[80] Donald T. Campbell and Julian C. Stanley, <u>Experimental and Quasi-Experimental Designs for Research</u> (Chicago: Rand McNally College Pub. Co., 1963), p. 27.

equated by randomization.[81]

The design for this study took the following form:

Sample	Pretest	Treatment	Posttest	Delayed Posttest
R (6 yr. olds)	O_1	X	O_2	O_3
R (7 yr. olds)	O_4	X	O_5	O_6
R (8 yr. olds)	O_7	X	O_8	O_9
R (6 yr. olds)	O_{10}		O_{11}	O_{12}
R (7 yr. olds)	O_{13}		O_{14}	O_{15}
R (8 yr. olds)	O_{16}		O_{17}	O_{18}

This design allowed for a random sample of subjects to be divided into six groups of equal size, one experimental group for each age and one control group for each age. Each group was administered a pretest on each of the two instruments used in the study.

Following the treatment of the experimental groups, all subjects were posttested immediately on two instruments. A second posttest was given to all subjects approximately one month later on two instruments.

Control for Internal Validity

Campbell and Stanley defined internal validity and external validity as follows:

> Internal validity is the basic minimum without which any experiment is uninterpretable: Did in fact the experimental treatments make a difference in this specific experiment instance? External validity asks the question of generalizability: To what population, setting, treatment variables can this effect be generalized? Both types of criteria are obviously important, even though they are frequently at odds in that features increasing one may jeopardize the other. While internal validity

[81]Ibid., p. 6.

> is the sine qua non, and while the question of external validity, like the question of inductive inference, is never completely answerable, the selection of designs strong in both types of validity is obviously our ideal.[82]

Kerlinger reported that:

> The control of extraneous variables means that the influence of independent variables extraneous to the purposes of the study are minimized, nullified, or isolated. In other words, the variance of such variables is in effect reduced to zero or near zero, or what amounts to fundamentally the same thing, it is separated from the variance of other independent variables . . . .

Kerlinger further suggested that the best control of extraneous variables is through randomization.

> This is the best way, in the sense that you can have your cake and eat some of it, too. Theoretically, randomization is the only method of controlling all possible extraneous variables. Another way to phrase it is: if randomization has been thoroughly accomplished, then the experimental groups can be considered statistically equal in all possible ways. This does not mean, of course, that the groups are equal in all possible variables. We already know that by chance the groups can be unequal, but the probability of their being equal is greater, with proper randomization, than the probability of their not being equal. For this reason control of extraneous variance by randomization is a powerful method of control. All other methods leave many possibilities of inequality.[83]

In this study the researcher attempted to control the extraneous variables by the method of randomization as suggested by Kerlinger. Randomization was applied: (1) in the selection of 90 subjects and (2) in the formation of experimental and control groups.

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[82] Ibid., p. 5.

[83] Kerlinger, Behavioral Research, p. 309.

Strategy for Data Collection

Following the selection of research site, the random selection of subjects, their random grouping for varied purposes, the description of treatment, the selection of instrumentation, and research design, the strategy for data collection followed. Data were collected considering the phases described below.

Phase I--Pretesting

The Six Piagetian Conservation Tasks

Marianne Frostig Developmental Test of Visual Perception, Test II, Figure-Ground

Phase II--Treatment

Experiences with Three-Dimensional Objects

Figure-Ground Paper and Pencil Exercises

Phase III--Immediate Posttesting

The Six Piagetian Conservation Tasks

Marianne Frostig Developmental Test of Visual Perception, Test II, Figure-Ground

Phase IV--Delayed Posttesting (one month following the end of treatment, Phase II)

The Six Piagetian Conservation Tasks

Marianne Frostig Developmental Test of Visual Perception, Test II, Figure-Ground

A time schedule showing tasks accomplished appears in Appendix G.

Analysis of Data

The most widely used acceptable test for testing statistical significance is to compute for each group pretest posttest gain scores and to compute a t between experimental and control groups on their gain scores.[84] The researcher used this procedure suggested by Campbell and Stanley.

Limitations

Certain limitations were inherent within the study. They were in the areas of theoretical framework, treatment, instrumentation, and research design. These limitations are described as follows:

Theoretical framework

Because Piaget's work deals with theories whose mediating processes are thought to be inside the nervous system, to be inferential, and unconscious, the theories are hard to test.[85]

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[84] Campbell and Stanley, Designs for Research, p. 23.

[85] Gibson, Perceptual Learning and Development, p. 52.

Treatment

"Perceptual training should always be part of a well-rounded program of instruction."[86] In this study is was assumed that the subjects experienced prior to treatment a well-rounded program of instruction.

Instrumentation

Sampling procedures in developing norms for the Frostig DTVP were overwhelmingly middle class in nature. Children from low socio-economic groups and minority groups were poorly represented; in fact, no Negro children were included . . . . Reliability is not high in the Frostig DTVP as is often the case with young children.[87]

"Piaget's revised clinical procedure claiming to give accurate assessment of the child's abilities is a matter for lively debate."[88]

Design

There is the possibility of the memory effect between posttests. Anastasi reported that the effects of sheer repetition, or practice, on test performance are similar to the effects of coaching, but usually less pronounced. "It should be noted that practice, as well as coaching, may

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[86]Frostig and Horne, Visual Perception, Teacher's Guide, p. 15.

[87]Buros, Mental Measurement Yearbook, p. 1276.

[88]Ginsburg and Opper, Intellectual Development, p. 119.

alter the nature of the test since the subjects may employ entirely different work methods in solving the same problems."[89] This, however does not apply to the Piagetian Conservation Tasks.

The above topics and subtopics conclude Chapter I--Background and Theoretical Framework. Below is included an overview of subsequent chapters.

Overview of Subsequent Chapters

Chapter II will be a review of related literature. The treatment, analysis of data, and findings will be presented in Chapter III. Chapter IV will include the summary, conclusion, and recommendations.

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[89]Anne Anastasi, Psychological Testing, 3rd ed. (London: The Macmillan Co., 1972), p. 569.

CHAPTER II

RELATED LITERATURE

This review of related literature is concerned with the following:

(1) Research related to the effect of visual perceptual experiences upon visual perceptual learning.

(2) Research related to the effect of age level and stages of intellectual development upon visual perceptual learning.

The Effect of Visual Perceptual Experiences Upon Visual Perceptual Learning

Hammill investigated the relationship between visual perception and reading comprehension and the effects of visual perceptual training on reading and visual perception. He attended to three basic questions: "How shall visual perception be defined? How are visual perception and school learning related? Can one actually 'train' visual perceptual processes?"[1] He concluded, as did Rosner,[2] that little correlation existed between measures of visual perception and

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[1]Donald Hammill, "Training Visual Perceptual Processes," Journal of Learning Disabilities, vol. 5, Number 10, (November, 1977), p. 40.

[2]Jerome Rosner, "Perceptual Issues in Reading," Paper presented at The Annual Conference on Reading, University of Pittsburgh, (July, 1971).

tests of reading comprehension and that training in visual perceptual skills, using currently available programs has no positive effect on reading and possibly none on visual perception.[3]

Hammill reported that the above conclusion was based upon: (1) surveying correlational studies that met his established criteria for investigating the relationship between visual perception and reading comprehension, and (2) drawing conclusions in the area of determining the effects of perceptual training on reading and visual perception based upon a reading of results of 25 intervention studies which had been completed since 1960.[4]

Hammill was convinced that most, if not all, visual-motor programs were based on the concept which assumed that visual perception was an important factor in the learning process. He was also convinced that justification for such a belief ultimately rested upon the following conditions: (1) a score or more of correlational studies; (2) upon interpretation of developmental theories such as that espoused by Piaget and Inhelder (1967); (3) upon work such as that of Gesell (1940), Gesell et al (1940) and Ilg and Ames (1965); and (4) upon the advocacy of such contributors to the pedagogical literature as Frostig, Getman, Kephart, and Barsch. According to Hammill, many educators adhered to this

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[3]Hammill, "Training Visual Perceptual Processes," p. 39.

[4]Ibid., p. 42.

position--that mastery of visual perceptual skills was a prerequisite for, or at least a primary contributor to, achievement in reading, writing and other school subjects. However, Hammill believed that the teacher should be aware of different points of view.

Hammill proceeded to share these different points of view. He began by summarizing the research of Cohen (1969), Bibace (1969), and Mann (1970).

> Cohen (1969) has recently taken the position that instruction in reading is preferable to training in perception if reading is the goal. In apparent agreement with this, Bibace (1969) questions the assumption that perceptual-motor intactness is a prerequisite for scholastic achievement, while Mann (1970) challenges the theoretical and empirical foundations upon which perceptual training programs rest . . .[5]

Mann's research supported and extended that of Hammill. Mann dealt speculatively with the why's of education's infatuation with perceptual training and offered epistemological and practical grounds for annulling the relationship between the two. His brief speculations of education's infatuation pertained to: (1) the historically negative roles of the school psychologists, who quite recently have become important figures on the education scene; (2) the new wave of teachers equipped with a smattering of physiological psychology accompanied by a feeling of initiation into the society of scientific pedagogy; (3) the physician, who was unequipped to deal with pedagogy; (4) the emergence

[5]Ibid., p. 41.

of special education, looking for its own identity; and finally, (4) educators who were frustrated and wish to avoid full commitments of academically training exceptional children.[6]

After having dealt speculatively with the whys of education's infatuation with perceptual training, Mann considered grounds for annulling the relationship between the two.

> 1. Most perceptual training approaches are based on unwarranted extrapolations or translations of theories and isolated experimental findings into concrete practices, or a consequence of the frenetic seizure and utilization of any and all materials and approaches which at face value appear "perceptual."
>
> 2. Perceptual training approaches are based upon a surprising naivete as to what "perceptual" tests really measure.
>
> 3. The positive results generated by most of the training approaches designed to improve perceptual functioning are not necessarily due to "perceptual" improvements. They are assessed quite often on a before and after basis, through tests similar to the training procedures themselves. Frostig is particularly guilty in this respect.
>
> 4. Many perceptual training practices are self-limited and narrow. By the nature of the positions they espouse, they ignore a variety of other potentially valid perceptual concepts which also might be utilized in establishing programs of instruction.
>
> 5. Perceptual training leads to an emphasis upon the irrelevant . . . . Perceptual activities as a rule have little direct relation to what children are supposed to learn through exposure to educational processes. Their benefits are superficial more often than not, and

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[6] L. Mann, "Perceptual Training: Misdirections and Redirections." American Journal of Ortho-psychiatry, 40, (1970), p. 32.

> obtained at the expense of time and effort diverted from more traditional goal-oriented teaching and training procedures.[7]

Mann concluded that perceptual-motor training has become an educational fad, based upon unwarranted extrapolations from theory and a misreading of the perceptual-motor difficulties manifested by handicapped children.

> What is of value in it can be accomplished through traditional adapted educational and therapeutic approaches directed toward functional and relevant behavioral objectives, rather than toward isolated so-called perceptual improvements.[8]

Rosner agreed with Mann. Rosner, however, discussed more in detail the teacher's involvement. Rosner considered two perceptual systems, the auditory and visual with an extensive list of suggested classroom management accommodations. Examples of some of these suggested accommodations were:

> To assist visual-motor function:
>
> 1. Emphasize the differences in whatever visual information is provided. Ask him to "trace" over the letters and words, "draw" them in the air with a finger, "draw" them with his eyes closed, and--in as many other ways as possible--appreciate the construction of the symbols.
>
> 2. Encourage the child to use his finger as a pointer when he is reading. Allow him to use an oaktag "liner" under each line of print, or to use a "mask" which has been slotted so that only one line of print is exposed at any given time.
>
> 3. Explain what you are doing while you do it, so that

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[7]Ibid., p. 35.

[8]Ibid., p. 30.

the child may hear it and see it at the same time. "Tell" while you "show" . . .[9]

To assist in auditory-motor function:

1. Point out and emphasize the differences in the phonemes of the language. Ask him to "say" the sounds, listen to them and appreciate the way his mouth "feels" as he does. Have him watch your mouth as you form the sounds . . .

2. Avoid sight-method reading programs. This type of program fails to stress the basic individual sounds of the language and leaves it to the child to sort them out.

3. Use such visual mediators as color cues, diacritical marks and underlined letters to aid the child in relating a specific phoneme to visual stimulus . . .[10]

4. In all cases, regardless of his strengths and deficits, provide the child with a learning environment that is patient, predictable, and positive in attitude. A child who manifests perceptual dysfunction need not face continuous frustration and failure. He can learn, but he must be taught.[11]

Elkind's investigations moved in a different direction. His investigations grew out of Piaget's theory of perceptual development. These investigations considered the perceptual regulations of: perceptual reorganization (figure-ground); perceptual schematization (operative wholes); perceptual exploration (scanning); perceptual transport (distance) and perceptual expectation (anticipation). Elkind's findings supported Piaget's view that perception, as well as

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[9]Jerome Rosner, "Perceptual Skills--A Concern of the Classroom Teacher?" Reading Teacher, 24 (March, 1971), p. 547.

[10]Ibid., p. 548.

[11]Ibid., p. 549.

intelligence, is not entirely innate, but is rather progressively constructed through the gradual development of perceptual regulations. Elkind also attempted to demonstrate the applicability of Piaget's theory to practical issues by summarizing some research growing out of an analysis of beginning reading. "Results support the analysis and suggest that beginning reading requires the logic-like process made possible by perceptual regulations."[12]

As stated earlier by Hammill, Frostig is one of many educators who adhered to the position that mastery of visual perceptual skills is a prerequisite for or at least a primary contributor to achievement in reading, writing, and other school subjects.[13] Frostig summarized her position as follows:

> A goal of education is intelligent behavior. Intelligent behavior depends on the undisturbed development of all psychological functions. Integrative abilities and visual perceptual abilities are frequently disturbed in children with learning difficulties. It must be stressed, however, that all psychological functions are interrelated. Although perceptual training may often need to be the focus of a development or remedial program, it cannot be divorced from training in language, sensory-motor functioning, higher thought processes, affective and social behavior, and integrative abilities. In addition, it must be kept in mind that perception needs to be practiced until it becomes automatic, that training in memory and in attention are of great importance, and that any technique which helps the child to direct

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[12]Elkind, "Perceptual Development," p. 541.

[13]Hammill, "Training Visual Perceptual Processes," p. 41.

his attention appropriately is valuable.[14]

Frostig further stated that an adequate theory of transfer of training is not yet available. "Classroom experience, however, indicates that efficient transfer of initial visual perceptual training to academic skills is facilitated in several ways."[15] She offered several skills: (1) verbal labeling; (2) acquisition of perceptual inference habits by observing, discussing, and responding to objects, pictures, and words; (3) rehearsing and over-learning basic concepts until they become automatic; (4) becoming aware of the identical elements in the preparatory perceptual tasks and the perceptual tasks inherent in the scholastic activities in which he engages; (5) abstracting the relevánt features from the immediate visual stimulus; (6) learning that rearrangement of elements may result in a completely different whole or appearance, although the same elements are there; and (7) learning to keep several facts in mind and to synthesize them into a visual image, which then has to be evaluated by remembered auditory and immediately given visual perceptions.

With reference to the Frostig visual perceptual training programme, of which the Frostig Developmental Test of Visual Perception is a part, Smith reported that evidence

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[14]Marianne Frostig, "Visual Perception, Integrative Functions and Academic Learning," Journal of Learning Disabilities, 5, (January, 1972), p. 3.

[15]Ibid., p. 13

to date suggested that the Frostig test may measure fewer than five discrete aspects of perception and that its use as a diagnostic instrument for planning educational remediation and as a predictor of reading achievement has been questioned. The evidence referred to were the following studies: Allen, Haupt, and Jones (1965); Hueftle, (1967); Olsen, (1968); Sprague, (1963); Corah and Powell, (1963); Silverstein, (1965); and Ayres (1964).[16]

With the above evidence in mind, Smith set forth through his study to gather additional information regarding the underlying factor structure of the Frostig test with a group of children of the kind typically referred to the school psychologists for study, and to clarify the relationship of test performance to IQ, age, and reading achievement. The Frostig Developmental Test of Visual Perception, perceptual measure; The Wechsler Intelligence Scale for Children (WISC), an IQ measure; and The Wide Range Achievement Test (WRAT), for an estimate of reading ability, were administered to a sample of 43 elementary school children for educational assessment, and the results were factor analyzed.

> The findings suggest that the Frostig test measures a single general factor of perceptual organization which is weakly related to IQ and unrelated to reading ability . . .[17]

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[16]Phillip A. Smith and Ronald W. Marx, "Some Cautions on the Use of The Frostig Test: A Factor Analytic Study." Journal of Learning Disabilities, 5, 6 (June/July, 1972), p. 358.

[17]Ibid., p. 357.

Becker reported that the Frostig DTVP purported to measure some essentially different underlying processes of the visual perceptual behavioral complex. These processes were: (1) eye-motor coordination, (2) figure-ground perception, (3) form constancy, (4) position in space, and (5) spatial relations.

Becker described the problem as follows:

> Olson (1968) in reviewing several factor analytic studies of the Frostig DTVP, concluded that the five subtests of the DTVP possess a common perceptual function and cannot be assumed to measure separate abilities. Boyd and Randle (1970) factor-analyzed the DTVP subtests for a sample of 94 first grade children using a principal component (unspecified) method. Their findings indicated that the DTVP measures one general visual factor, which is in agreement with Olson's review of the literature. While there appears to be a consensus among several investigators that the DTVP subtests do not measure five different and independent visual perceptual abilities, the degree to which the subtests measure one or more general visual perceptual factors has not been established.[17]

Becker, therefore, purposed by his investigation, to determine (1) the correlations among the Frostig DTVP, the Bender VMGT (1938), and an experimental Visual Discrimination Test of Words (Becker, 1970); (2) the principal components that emerge when the correlation data are treated factorially; and (3) which tests of visual perception load on specified principal components.

The three visual perceptual tests were administered to 154 children from eight kindergarten classes. Becker

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[17]John T. Becker and David Sabatine, "Frostig Revisited." Journal of Learning Disabilities, 6, 3 (March, 1973), p. 180.

reported that the findings in this study indicated that the five DTVP subtests did not measure five different and relatively independent perceptual abilities. The data reported in his investigation failed to support the contention that the DTVP measures a common perceptual function. The orthogonally rotated variables for the present sample disclosed three factors: visual-motor skills, figure-ground perception, and visual discrimination skills.[18]

Harrison reported that there exists no one cure-all for the perceptually handicapped. She, instead, suggested many techniques used according to each child's specific needs. She described a crash program which was a special project of Olive Garfield, psychologist at Dodge Elementary School, Wichita, Kansas. Twenty-thirty children in every hundred were not being reached by usual methods of teaching. Searching for an answer, Garfield turned to various remediation programs. These programs were described as follows:

> Doman-Delacato System. Named for Glenn Doman, a physiotherapist, his brother, Robert J. Doman, J.D., and Carl H. Delacato, Ed.D., a psychologist and educator specializing in remedial reading. The method is highly formalized, with concentrated patterns of exercises designed to stimulate and build up a child's "neurological organization," as they term the developmental processes of the central nervous system.
>
> The Marianne Frostig Program for the Development of Visual Perception. A program based on testing and remedial work in five areas of visual-motor coordination, figure-ground perception, perceptual constancy, perception of position in space, and perception of spatial

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[18]Ibid., p. 181.

relationships.

The Winter Haven Project. An approach based on research done by Dr. Newell Kephart and other psychologists. Templates of basic geometric designs are used in teaching form constancy, walking boards and "jump boards" to teach bilaterality and develop body mechanics.

The Erie and the Fairbanks-Robinson Programs. Originated by the New York Times. These programs are similar to that of Winter Haven. Innovations include such things as "Perceptual Bingo".

Readiness for Learning Program (Lippincott). A workbook for children plus a teacher's guide which uses some of the exercises and pencil work of the Frostig program, but carries them further into the making of marks designed to become letter symbols, and eventually words.

The Illinois Test of Psycholinguistic Abilities. Developed for the purpose of examining the various areas of linguistics, such as the ability to decode both auditorily and visually, to "encode" or express verbally or by motions and to demonstrate automatic and sequential use of language.[19]

From the above, Garfield developed a remediation program with enough flexibility to satisfy her belief that the method must be tailored to the needs of the individual. Some children were, therefore, singled out for intensive practice using the Doman-Delacato System. With others, she used the Kephart methods. Still others used the paper and pencil work from Marianne Frostig Developmental Remedial Series, "Perceptual Bingo" and other games from the Eric and Fairbanks-Robinson Systems. "In all cases, the remediation mix was based on the needs of the individual child."[20]

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[19] Edna L. Harrison, "Real Help for Perceptually Handicapped," Grade Teacher, 86, 8 (April, 1969), p. 73.

[20] Ibid., p. 74.

> What does it all add up to? "A common sense approach to learning disability," Garfield says. "And common sense," she says, "a friendly classroom teacher, a few mother-aides and a consistently operating, workable program of training and guidance will rescue a lot of discouraged, defeated children."[21]

McFarland directed his investigation toward the subject of selected factors in perceptual learning--reward and punishment--for modification of perception. McFarland reported that the work of Schafer and Murphy motivated his investigation.

> Schafer and Murphy (1943) presented halves of a reversible figure separately to their Ss, Ss being given money each time one half-figure (a face) was presented and losing money each time the other face was presented. When the whole reversible figure containing both faces was then presented tachistoscopally for a period of time too short to allow Ss to distinguish both faces, Ss tended to report that they perceived the face that has been associated with reward.[22]

McFarland reported that this Schafer-Murphy effect has not been consistently replicated. Studies of Jackson (1954); Rock and Fleck (1950), Santos and Garvin (1962) differed with respect to type of tachistoscope, age and Ss, the exact figure employed as the stimulus, and the reward and punishment contingencies, it was not possible to state precisely why replication of the Schafer and Murphy (1943) results had been inconsistent.[23]

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[21] Ibid., p. 75.

[22] Richard A. McFarland, "Reinforcement in Figure-Ground Perception." Perceptual Motor Skills, 30 (April, 1970), p. 403.

[23] Ibid., p. 403.

McFarland decided rather than attempting another replication of the Schafer-Murphy paradigm, his study would be designed to investigate whether the effect of reward and punishment on perception of contours can be demonstrated when Ss view of the reversible figure is not limited by tachistocopic presentation. He concluded that changes in figure perception may be influenced by past histories of reward and punishment associated with the figures.

To present McFarland's investigation in isolation seemed, to present an oversimplification of perceptual experience and learning. Gibson offered a comprehensive view of selected factors in perceptual learning which placed McFarland's investigation in its proper perspective.

> It has been argued that what is learned in perceptual learning are distinctive features, invariant relationships, and patterns; that these are available in stimulation; that they must, therefore, be extracted from the total stimulus flux. The processes which are relevant for extraction include orienting responses of the sense organs; abstraction of relations and invariants; and filtering relevant features from irrelevant stimulation.[24]

According to Gibson, perception actively selected and rejected. "The search process is adaptive and I think, it is self-regulatory."[25] Gibson entertained several questions: "If a search process goes on in perception, and if it is adaptive, what directs it and what terminates it? What

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[24]Gibson, Perceptual Learning and Development, p. 119.

[25]Ibid., p. 120.

is the selective mechanism? . . . What reinforces the selective process so that a permanent change results?"[26]

Gibson reported that the direction of the search is determined by the task and by intrinsic cognitive motives, personal attitudes, autistic factors, and cultural bias. Its termination, with resulting perceptual change, can be effected by external reinforcement and knowledge of results, but primarily reinforcement is internal, an is epitomized by the term "reduction of uncertainty."[27]

The Effect of Age Level and Stages of Intellectual Development Upon Visual Perceptual Learning

Elkind provided a brief resumé of educational philosophy--sound pedagogy, based upon a knowledge of child development. He offered this resumé as a reminder that "in trying to adapt educational practice according to the contributions provided by Piaget, we must not forget the lessons that innovators such as Rousseau, Montessori, Dewey, and Freud had to teach. Our zeal to be modern should not blind us to all that is valuable from the past."[28] Following a few historical and cautionary remarks, Elkind proceeded with a discussion of Piaget's work and theory.

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[26]Ibid.

[27]Ibid., p. 144.

[28]David Elkind, "Piaget and Science Education," Science and Children, 10 (November, 1972), p. 9.

He reported that one of the dominant themes of Piaget's developmental psychology of intelligence is that the mind develops in a sequence of stages that is related to age. He stated that while the sequence remains the same for all children, the rate at which particular children pass through the stages will depend upon genetic endowment as well as socio-cultural circumstances.

> Piaget has described four major stages each of which, for heuristic purposes, can be described with regard to the major cognitive task it poses for the child.
>
> The first, or sensori-motor stage, lasts from birth to about the age of two. During this period the infant's principal task is to construct a world of permanent objects so as to arrive at a conception of things which continue to exist even when they are not present to his senses. This stage might be described as dominated by a "search for conservation." At the next (preoperational) stage, usually ages 2 to 6 or 7, the child's major task is to master the symbolic or representational function. It is during this period that the child acquires language, discovers symbolic play, and experiences his first dreams. At this stage the child might be said to be involved in "a search for representation."
>
> At about the age of 6 or 7, the child enters the concrete operational stage, which lasts until about the age of 11 or 12. During this period the young person has to master the interrelationship of classes, relations and members, and he does this with respect to things and with the aid of syllogistic reasoning. The concrete operational stage is, therefore, one in which the young person is engaged in "a search for relations." During the last or final operational stage (usually ages 12 to 15), the young adolescent's major task is to conquer thought. Formal operational structures enable him to take his own thinking as an object and think about thought, about contrary fact conditions, and about ideal situations.[29]

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[29] Ibid., p. 9. [It has been shown that research does not confirm the 12-15 age range for the onset of formal operations.]

Elkind further reported that these stages nicely parallel the stages that characterize the development of any science, namely: observation (sensory-motor period or the search for conservation); naming and labeling (preoperational period or the search for representation); formal classification and quantification (concrete operational period or the search for relations), and controlled experimentation and theory building (formal operational period or the search for comprehension).[30]

Renner also stated that the maturation process influenced the intellectual development of a child.[31] Renner offered the following figure[32] and accompanying explanation which demonstrated how shifting cognitive structures relate to an age continuum.

> As structure modification proceeds along an age continuum, new types of cognitive-structure modifications become possible which greatly enhance the learner's ability to process information. Even though development itself is a continuum, the emergence of these new structures at certain age levels is the basis for Piaget's stages of intellectual development model. One must keep in mind, however, that the model is superimposed on the continuous spectrum of age and that transition from one stage to another is gradual rather than abrupt--new structures do not come into existence spontaneously at a particular age. Even though physiological maturation--increased differentiation and complexity of the nervous system--has opened the possibility for development of new, more powerful structures, the actuation of the new structures by experience through the existing structure is essential. Each new "stage" must be built on fully

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[30]Ibid., p. 10.

[31]Renner, et al., Teaching Science, p. 67.

[32]Ibid., p. 68.

developed existing structures. Children of the same age and in the same class in school, therefore, could be functioning intellectually at completely different stages of development.

The stages-of-development model is most frequently associated with Piaget, but the notion of stages of development is not unique to him. He has, no doubt, been most responsible for popularizing the idea.[33]

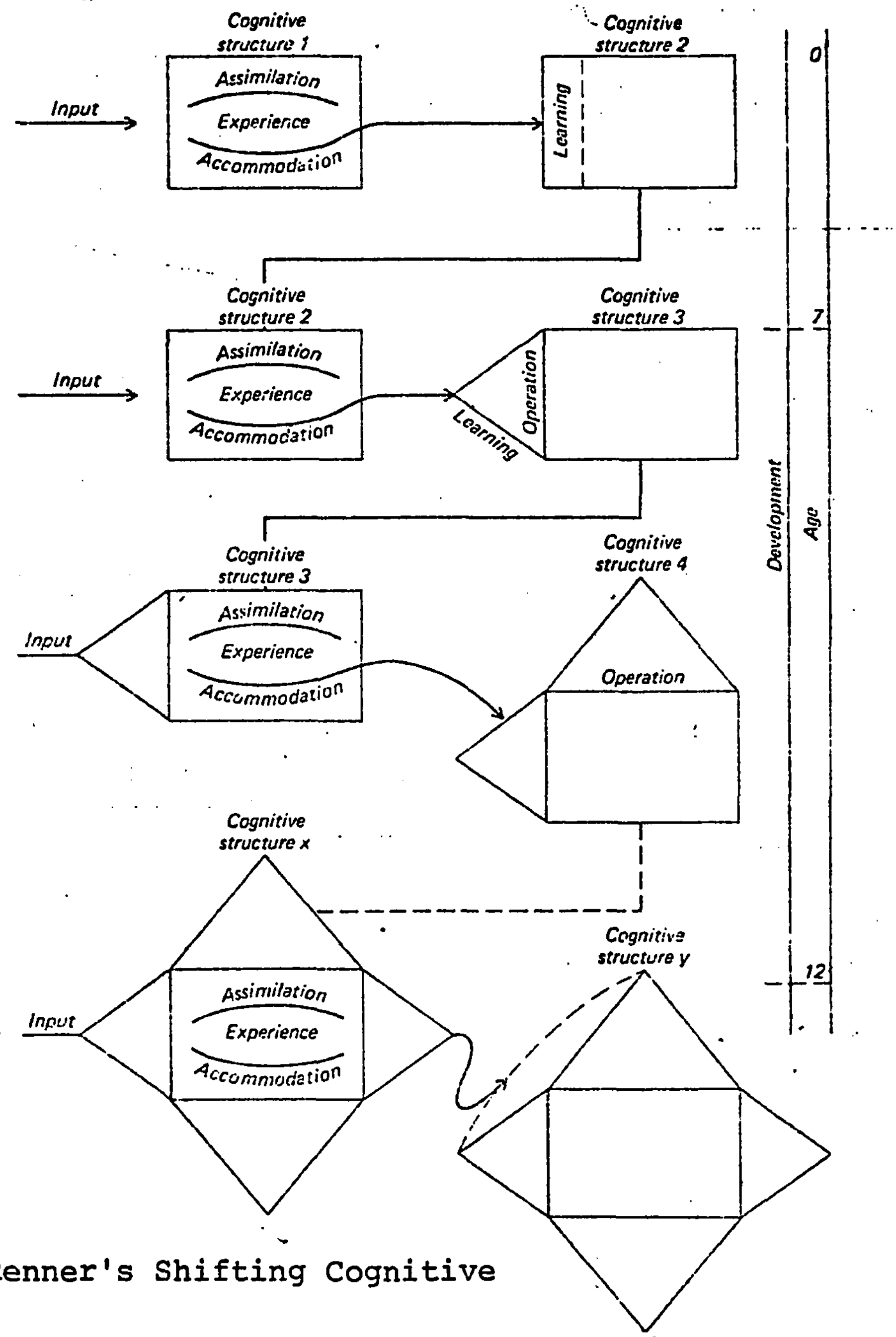

Figure 3. Renner's Shifting Cognitive Model.

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[33]Ibid., p. 67.

Frostig suggested that the stages of maximum perceptual development (ages 3½ to 7½ years) follow the stages of sensory motor development (birth to two years) and maximum speech development (up to 4 years), and preceeds that of higher cognitive processes which occur after age 7 or 8. Perceptual training helps to prepare a child for his development in the cognitive realm of abstractions, thoughts, ideals, and scientific models and systems, but such training does not insure eventual successful performance in the higher cognitive processes.[34]

Elkind investigated the effects of perceptual training at three age levels. The basis of his experiment was numerous investigations of Piaget and his colleagues with children which suggested that many complex perceptual phenomena--such as illusions, size constancy, and figure-ground reversals--are neither entirely innate nor entirely learned, but rather derive from the interaction of maturation and experience. Elkind's design consisted of testing children six, seven, and eight years of age (23 at each age level) for their ability to reverse figure and ground and then giving them special training in this skill. Elkind focused on two questions: (1) "Can children at different age levels profit from training in reversing figure and ground? And if so, (2) Are the initial differences between the age groups

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[34]Frostig and Horne, Visual Perception, Teacher's Guide, p. 15.

affected by special training?"[35]

The materials used consisted of two sets of 8 by 10 inch cards containing ambiguous black and white figures and a set of cardboard shields cut so that when they were placed over the drawings the hidden (reversed) figures were immediately apparent. Each child was pre-tested one set of cards (Form A) immediately prior to training. Immediately after pre-testing, the child was trained on the second set of cards (Form B). Immediately after training the child was again tested with Form A and then retested with the same form a month later.

Elkind reported that the results of the investigation were assessed by means of an analysis of variance for two variables (three age levels and three tests with Form A). All three groups were reported as having made significant ($p < .01$) improvement which was maintained over a month's time. There were also significant differences ($p < .01$) between the age groups both initially and on the subsequent testing.

> Although there was a tendency for the 7-year-old to lose and for the 6- and 8-year-old groups to increase some of their gains over a month, the rank order of the age groups with respect to their level of performance was the same on all tests . . .
>
> In our study the influence of experience was suggested by the findings that all children improved greatly with

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[35]David Elkind, Ronald Koegler, and Elsie Go. "Effects of Perceptual Training at Three Age Levels." Science, 137 (September, 1962), p. 755.

> special training in reversing figure and ground, while the influence of maturation was suggested by the findings that 6- and 7-year-old children required more intense teaching and reached a lower level of performance than did the 8-year-old children.[36]

The major impetus of the investigation of Brooks and Clair was the study of visual figure-ground perception and its relationship to word recognition in an effort to isolate a skill specifically related to the reading process. These researchers reported that other investigators have related various aspects of reading to figure ground perception.

> . . . Silver and Hagan (1964) to reading disability in adults; Elkind, et al (1964) to slow readers; by Olson (1966) to paragraph reading, recognition of reversible words, and word synthesis; by Peterson and Magaro (1969) to reading; by Shepherd (1969) to word recognition; and by Bryan (1964) to reading success and reading comprehension.[37]

These researchers attended to two basic questions: "Does the better reader possess better figure-ground perception ability than does the poorer reader or non-reader? Is figure-ground perception operating independently of IQ and chronological age?"[38]

The subjects in this investigation were all children in the Belleville Area Special Education District in Illinois, aged 7 through 12 years (71 boys and 47 girls). Ayres Test

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[36]Ibid., p. 756.

[37]Clarence R. Brooks and Theodore Nat Clair, "Relationships Among Visual Figure-Ground Perception, Word Recognition, IQ and Chronological Age," Perceptual and Motor Skills, 33 (August, 1971), p. 59.

[38]Ibid.

of Figure-ground Perception (1966) and a test of word-recognition achievement by Botel, et al (1961) were administered to each child by a psychologist; the number correct were used for both tests as data. The WISC IQs were available, having been secured within the past two years.[39]

These researchers reported that the statistical procedure employed indicated a significant relationship between age and visual figure-ground perception. Age differences showed that visual figure-ground perception improved with chronological age. They also concluded that this investigation would support the idea that visual figure-ground perception was related to reading at the readiness and first reader levels. As educable mentally handicapped children mature, visual figure-ground perception ability was not as important to the reading process and would not differentiate reading-ability groups. Also concluded was the fact that this investigation supported other findings that IQ and figure-ground perception was related, suggesting that a figure-ground test may be useful for intellectual screening or differentiation within an educable handicapped group for purposes of instruction.[40]

> Intelligence and figure-ground perception were significantly related (Elkind & Scott, 1962; Olson, 1966; Peterson & Magaro, 1969), but this has not been uniformly observed (Cobrinik, 1959; Corah & Powell, 1963; Shepherd,

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[39]Ibid., p. 60.

[40]Ibid., p. 62.

> 1969). Similarly correlations with chronological age have been noted (Elkind & Scott, 1962; Corah & Powell, 1963; Olson, 1966; Ghent, 1956) with some dissent (Elkind, et al, 1965).[41]

Frostig and Horne supported the statement that the period during which the greatest amount of perceptual development normally takes place is between the ages of 3½ to 7½ years of age.[42] Walsh and D'Angelo, therefore, directed their energies toward attending to perceptual deficiencies in children during the preschool years. Their research sought to determine whether the visual perceptual function of children enrolled in a summer Head Start Program could be improved by a systematic training program in visual perceptual skills.

> Children attending a summer Head Start Center were enrolled in one of two sections of either a morning or afternoon session. One section within each session was randomly selected to receive the Frostig program, the other two sections were controls.
>
> Twenty-four children were administered the Frostig program for the Development of Visual Perception by a team composed of a psychologist who had previous experience with the Frostig program, and an Urban Corps intern. Training was given 30 minutes a day, 4 days a week, for 4 weeks. Eighteen children who were controls received no training but spent an identical amount of time in semi-structured play activities with the two adult trainers who were administering the Frostig program. All children were given the Frostig Developmental Test of Visual Perception twice, prior to and following the

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[41] Ibid.

[42] Frostig and Horne, Visual Perception, Teacher's Guide, p. 15.

Frostig program.[43]

Except for the subtest, Constancy of Space, Walsh and D'Angelo reported that the two groups were basically comparable in performance prior to the administration of the Frostig training program. The control groups' performance was initially higher. Post-training scores were higher than the pre-training scores for both groups on all measures with the group receiving the Frostig program showing the greater gain. The group which received the Frostig training, showed significant improvement on two of the five subtests, Figure-ground perception and Constancy of Shape.[44] Walsh and D'Angelo concluded that the Frostig program did produce some significant gains in visual performance. "Whether the perceptual training provided by the Frostig would transfer to activities required in school has received mixed evaluation."[45]

Beck's research findings corroborated the views of Mann. Mann had stated that one of his five grounds for annulling the relationship between education and perception was:

> The positive results generated by most of the training approaches designed to improve perceptual functioning are not necessarily due to "perceptual" improvements.

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[43] John F. Walsh and Rita D'Angelo, "Effectiveness of The Frostig Program for Visual Perceptual Training with Head Start Children," Perceptual and Motor Skills, 32 (June, 1971), p. 944.

[44] Ibid., p. 945. [45] Ibid., p. 964.

> They are assessed quite often on a before-and-after basis, through tests similar to the training procedures themselves; Frostig is particularly guilty in this respect.[46]

According to Beck, a number of studies have reported positive training effects using the Frostig-Horne (1964) program.

> Populations sampled have included kindergarten Ss (Maslow, Frostig, Lefever, & Whittlesey, 1964), educable level retarded (Allen, Dickman, & Haupt, 1966), neurologically impaired (Tyson, 1963), and severely retarded children (Talkington, 1968). The studies have employed a pre- and posttest procedure comparing treated and control groups space) produced a significant difference ($p < .01$). No significant sex differences were observed on either the FDTVP or PPVT. Marked increases were found between pre- and posttest performance on the PPVT within both groups; however, no between-group differences were observed. In the absence of non-Headstart control groups, one can only speculate that the IQ gains are attributable to the Head-start program; however, no indication was given that such changes were related to having introduced Frostig training.[47]

Beck concluded that even though his study used a modest sized sample, limited support is offered for using the Frostig program with Head Start children. "The question, however, of independent measurement of training benefits remains to be clarified."[48] Reference was made to the integration of training in visual perception with other ability-level teaching for greatest effectiveness.

Buckland and Badlow acknowledged that for the past 50 years, investigators have studied the relationship between

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[46]Mann, "Perceptual Training," <u>American Journal of Ortho-psychiatry</u>, p. 35.

[47]Ibid., p. 522. [48]Ibid.

perceptual skill and reading behavior. They reported that from these investigations most studies found no specific relationship. However, it appeared to them that those few studies of conflicting consequence seemed to motivate more research. They, therefore, designed an experiment to determine the effect of visual perceptual training on perceptual readiness and word recognition skills of low readiness first grade children. The answers to two questions were sought:

> (1) Will low readiness pupils trained in visual perceptual tasks score higher on perceptual readiness, and word recognition tests than pupils who have not had visual perceptual training?
>
> (2) Will initial perceptual skill level differentially affect pupil gain in perceptual skill, reading readiness, or word recognition?[49]

The Marianne Frostig Developmental Test of Visual Perception (DVPT) and the Metropolitan Readiness Test (MRT) were given by the classroom teacher to pupils before and after treatment. The experimental group treatment materials consisted of a workbook devised from the Frostig Program for the Development of Visual Perception which considered the five areas of perceptual skills. The control group listened to and discussed with the teacher stories heard through a headset connected to a tape recorder.

It was reported that each of the groups, experimental and control, spent 15 minutes a day for 50 consecutive school

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[49] Pearl Buckland and Bruce Balow, "Effect of Visual Perception Training on Reading Achievement." Exceptional Children, 39 (January, 1973), p. 299.

days under the close direction of their regular classroom teacher. The experimental group worked on Frostig sheets; the control group listened to and discussed recorded stories.[50]

Results related to question number one, indicated that there were no significant differences between experimental and control groups in perceptual, readiness, or word recognition skills following the two month treatment period. Low readiness pupils did not profit from visual perceptual materials any more than from listening to and discussing stories when the outcome measures were perceptual readiness and word recognition scores. Results related to question number two--Perceptual Skills--indicated that pupils having high pretraining perceptual scores had high perceptual outcome scores, while pupils with low pretreatment scores had low outcome scores on the perception variable. Reading Readiness Skills--results indicated that differences after treatment, not due to chance, indicated that the control children in the lowest perceptual level exposed to a listening experience scored significantly higher on the readiness outcome test than the experimental children who used visual perceptual training materials. It was concluded that visual perception training did not influence the development of readiness skills any more than did the listening exercises.[51]

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[50] Ibid., p. 300.

[51] Ibid., p. 302.

Word recognition skills--results indicated similar results. "The visual perceptual training program did not make any statistical or practical difference in the word recognition skills of low readiness children with different pretreatment perceptual levels."[52]

Cohen reported that it had been demonstrated over a decade ago that disadvantaged populations manifest severe perceptual deficits. He verified this statement by referring to the studies of Pasamanick and Knoblock (1948) and M. Deutsch (1963) and his own recent studies.

After resolving the above condition, he directed his energies toward two questions:

> (1) What behaviors are we really tapping in these tests of visual perception?
>
> (2) Given the high incidence of visual perception dysfunction, what are the practical implications for reading instruction? In other words, so what?[53]

Two studies were carried out. The first study involved children in the first grades of eight poverty area schools. The second study involved high school students. The first study was pertinent to this study and it is, therefore, described below.

Prior to launching the first grade study, Cohen surveyed what he described as typically low achievers in an

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[52]Ibid., p. 303.

[53]S. A. Cohen, "Studies of Visual Perception and Reading in Disadvantaged Children," Journal of Learning Disabilities, 2 (October, 1969), p. 8.

urban school district for perceptual dysfunctions. This was achieved through the use of clinical exams using a Keystone Telebinocular Survey, visual motor checklist, and some standard simple neurological tests of body awareness. At that time the severity of results were astounding. As a result of these observations, Cohen began his investigation. He surveyed for the incidence of perceptual dysfunctions in eight schools offering a representative sample of socially disadvantaged first graders on New York's Lower East Side. Marianne Frostig Developmental Test of Visual Perception (DTVP) was administered by trained and experienced clinicians. Results showed that about 40% of the population in grade one was about two-and-a-half years retarded on the DTVP. Cohen analyzed the population by sex, age level, and ethnicity. He concluded that this first grade study established what he already knew--that urban disadvantaged children were poor on tests of visual perception. As he became involved with a number of subsequent studies which followed involving perceptual training programs as preventative and/or remedial treatments, in general, he did not see significant changes in reading achievement as a result of these perceptual training programs. Cohen stated, "Our findings were essentially the same as Jacob's report of his results using the Frostig Visual-Perceptual Training Program--no real gain in reading."[54]

[54] Ibid., p. 11.

Bishop became concerned over the fact that within recent years there existed children of normal intelligence, who without apparent emotional disturbance or sensory impairment, manifested severe learning disabilities. This condition motivated him to investigate, to establish means of identifying and treating the perceptually handicapped child within the regular school frameword. His study had three major emphases:

> (1) to identify and treat the perceptually handicapped child as early as possible in the educational process;
>
> (2) to determine the feasibility of conducting the identification and treatment procedures within the regular school framework; and
>
> (3) to investigate the efficacy of one program designed for the remediation of perceptual motor deficit.[55]

Bishop made the decision to use the Frostig Program for the Development of Visual Perception. His stated reasons were: (1) "This test had demonstrated positive training effects with mentally retarded and neurologically impaired children; and (2) It also appeared to be one of the better standardized programs available with norms extending down to the younger age group."[56]

The investigation consisted of five phases. Phase I was a training institute in which the teachers of each of the 22 classes to be utilized in the investigation were

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[55]John S. Bishop, "An Investigation of the Efficacy of the Frostig Program for the Development of Visual Perception," Pediatrics, 50 (July, 1972), p. 154.

[56]Ibid.

trained in the use of the Frostig materials. Phase II involved the administration of the Frostig Test by the first grade teachers to all first grade students. Phase III involved analyzing the total perceptual quotients so that mean score and standard deviations for the group could be obtained. Phase IV focused upon visual perceptual training for the experimental group through the use of The Frostig Program for the Development of Visual Perception. Phase V involved the readministration of the Frostig Test to all of the students in both the experimental and the control groups.[57]

Bishop reported that the results were examined by comparing the amount of change each group underwent from pre- to posttest. The experimental group showed significantly more improvement from pretest to posttest on all measures. In terms of total perceptual quotient they showed three times as much improvement as the control group. Another important finding was that none of the children in the experimental group showed a decline in performance from pretest to posttest, while 25.4 per cent (n - 15) of the control group manifested such decline.[58]

Bishop stated that these results suggested: (1) It is possible to identify and treat the perceptually handicapped child early in his educational career; (2) It is

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[57]Ibid., p. 155.

[58]Ibid., p. 156.

quite feasible to conduct the identification and treatment procedures within the regular school framework; (3) The Frostig Program for the Development of Visual Perception is an effective program in raising the visual-perceptual abilities of children identified as perceptually handicapped. (4) The remediation program is effective in a very general sense in that all subtests as well as the total perceptual quotient showed the hypothesized increase. Bishop, however, did point out an important observation. Further research will be needed before definitive statements can be made regarding the validity of the Frostig Program. "One question which could be raised concerning this study is to what extent the improvement shown on the Marianne Frostig Developmental Test of Visual Perception is a result of practice on test-like items contained in the Frostig Program for the Development of Visual Perception.[59]

A study of kindergarten perception was made by Faustman to determine if a formal program in perception in kindergarten would contribute to the growth of perception in children at the end of the kindergarten year and to success at the first grade level. Fourteen kindergarten classes were chosen at random for a control group, and fourteen classes were chosen at random for an experimental group. The children, from a large school district in northern California, were randomly assigned to all classes. Each subject was

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[59]Ibid., p. 157.

given the Winterhaven Perception Ability Forms Test in September and May of the kindergarten year to determine growth in perception and was tested with the Gates Word Recognition Test in November and May of the first grade to determine growth in reading ability. The teachers were chosen at random for the classes and were matched on years of experience and teaching competence. Each of the kindergarten control and experimental group teachers received in-service training on the use of kindergarten guides from both county and district. The experimental group of teachers received additional training in teaching perception skills. Materials used represented that of Frostig, Strauss, and Kephart, as well as materials and methods suggested by the author. The Winterhaven program for perception was added. Data were analyzed by means of Chi Square and indicated significantly greater growth in the experimental group in both perception and word recognition achievement when compared to the control group.[60]

According to Bibace, major developmental theorists, applied developmental psychologists, neurologists, and specialists in education assumed mastery of lower (perceptual-motor) processes as necessarily prior to higher cognitive

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[60]Marion Neal Faustman, "Some Effects of Perception Training in Kindergarten on First Grade Success in Reading," International Reading Association Conference (Seattle, May 4-6, 1967).

processes and, hence, scholastic achievement.[61] Bibace reported that:

> This theoretical assumption is important because it has shaped both methodological assumptions guiding research in the field and the clinical pedagogical efforts of various specialists who attempt to offer remedial or therapeutic programs for children with learning disabilities.[62]

Bibace stated that the justification for this assumption rested upon names such as Piaget, Gesell, Kephart, and Werner.[63] However, there existed perplexing clinical observations shared by many workers in the field who have not agreed with this assumption. These perplexing clinical observations were described by Bibace as follows:

> . . . a large number of individuals have noted that some children who are given extensive training in perceptual and motor tasks are: (a) able to show an improvement in tasks involving identical cognitive processes (e.g. left-right discriminations in perceptual forms such as Frostig training procedures) and (b) show no significant increase in their school achievement.[64]

This disparity between observations and the theoretical assumption led Bibace to undertake a pilot project using an experimental design allowing variation in perceptual-motor functioning and scholastic ability to test the assumption. The experimental design employed by Bibace consisted of three

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[61]Roger Bibace, "Relationships Between Perceptual and Conceptual Cognitive Processes," <u>Journal of Learning Disabilities</u>, 2 (January, 1969), p. 17.

[62]Ibid., p. 18.

[63]Ibid., p. 17.

[64]Ibid., p. 18.

variables: (1) age of subject; (2) level of scholastic achievement; and (3) perceptual-motor achievement.

Boys aged 7-8 and 12-13 were selected in order that the assumption could be investigated for both those who had only recently acquired the higher cognitive processes and those in whom such processes should have been well established. The levels of scholastic achievement and perceptual-motor achievement allowed Bibace to establish the following four-cell design:

high perceptual-motor, high scholastic
low perceptual-motor, low scholastic
high perceptual-motor, low scholastic
low perceptual-motor, high scholastic[65]

In order to differentiate levels of scholastic achievement for the experimental design, the child's most recent report card and any pertinent information about his academic record were examined. Subjects were regarded as high scholastic achievers who received grades of A or B in most subjects. Low scholastic achievement was indicated by a predominance of D's and F's.

Two testing situations were a part of this experimental design. The Kephart Perceptual-Motor Survey was administered and served to insure the level of perceptual-motor achievement. Since the Perceptual-Motor Survey allowed one to assess the child's abilities in various areas, it did

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[65]Ibid., p. 19.

not indicate how the child would perform on learning tasks involving specifiable cognitive means for solving a task. Bibace, therefore, administered three learning tasks, each of which was developmentally organized in the performance. It was reported that all three tasks had previously been found by other authors to validly discriminate among groups differing in their levels of cognitive functioning. These tasks were developed by Janet Switzer, Blum and Broverman, and Frank Clarkson. These were described.[66]

Results of this study led Bibace to conclude that:

> . . . there are cases which are contrary to the theoretical assumption. Both younger and older children can be found who show gross deficits in perceptual-motor abilities and who, despite their deficits, are able to function very well in school and who do reveal reliance on conceptual means in our experimental tasks. We suspect that such children do not often, if ever, come to the attention of clinicians and special educators. In conclusion, our study indicates both that the theoretical assumption must at least be qualified and that the clinical pedagogical practices based on the assumptions need to be re-examined.[67]

According to Elkind, Piaget's views are based upon a knowledge of child development which can be traced historically to past innovators as Rousseau, Montessori, Dewey and Freud.[68] Piaget's developmental theory suggested that the four stages of intellectual development paralleled the

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[66] Ibid., p. 21.

[67] Ibid., p. 22.

[68] Elkind, "Piaget and Science Education," Science and Children, 10 (October, 1971), p. 9.

stages that characterize the development of any science, namely: observation (sensori-motor period or the search for conservation); naming and labeling (pre-operational period or the search for representation); formal classification and quantification (concrete operational period or the search for relations) and controlled experimentation and theory building (formal operational period or the search for comprehension).[69]

Renner et al., motivated by the interest in employing Piagetian theory in the elementary classroom, conducted an inquiry by administering the six Piagetian Conservation Tasks to 252 children in the Norman, Oklahoma Public Schools. Using Piaget's 75 per cent rule of thumb, they shared the results of this inquiry.

> If Piaget's procedure is followed, the children in the sample all conserved number by the age of 84 months (seven years) . . . . The children in the sample exercised conservation reasoning on solid amount and liquid amount by the age of 88 months (7 years, 4 months).
>
> . . . The data . . . show that the children in the sample were not consistent (even using Piaget's 75 per cent rule) in their development of the ability to conserve length until 128 months (10 years, 8 months) of age, area until 132 months (11 years), and weight until 120 months (10 years).[70]

Stafford and Renner then discussed these findings in light of their implications for sequencing the curriculum for the elementary school child.[71] Following the above

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[69]Ibid. [70]Ibid.

[71]John W. Renner, et al., "Piaget is Practical," Science and Children, (October, 1971), p.

inquiry, which provided evidence of the level of conservation reasoning in elementary school children, Stafford and Renner investigated the following questions: "Can the attainment of the conservation reasoning be significantly accelerated by experiences, especially, classroom experiences? If so, what kinds of experiences are needed?"[72] Renner extended credit to the suggestions of Almy and Wohlwill, researchers in the area of intellectual development, for setting the stage for an investigation to determine whether the first grade program of the Science Curriculum Improvement Study (SCIS) would accelerate the ability to conserve. Stafford and Renner reported that the following ideas from Wohlwill and Almy served as the basic hypothesis for their research.

> Our findings that children's scores (on conservation related tasks) could be raised by intensive experience suggests a profitable focus for instruction in the primary grades when little attention is usually given to cultivating the child's measuring and classifying skills. Our guess is that concerted efforts to encourage and guide children's activities in this area might pay handsome dividends.[73]

Almy offered the following opinion which concurs with Wohlwill.

> . . . it is interesting to note that most studies reported in the literature to date have worked with what seem to be the elements immediately involved in the conservation task, such as addition and subtraction or reversibility, rather than with what may well be the

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[72] Renner, et al., Piaget Model, p. 46. [Citing] Donald G. Stafford and John W. Renner, "Development of Conservation Reasoning Through Experience."

[73] Ibid.

> developmentally, prior abilities of classifying and ordering . . . . Piaget's work would suggest that children who have had many opportunities to classify objects on the basis of similar properties, to order along dimensions of difference, or better opportunities of both kinds might arrive at level of operational thought represented in conservation sooner than children who have not had such opportunities.[74]

The design for this research consisted of an experimental group that used the SCIS program and a control group that used a traditional science program. The Six Piagetian Conservation Tasks were administered to each group at the pretest and posttest phase. Gains in conservation reasoning were compared. Information was available on this sample in the areas of IQ and readiness. Stafford and Renner reported that the average scores on both IQ and readiness favored the control group.[75]

Pretest results revealed very little difference in the scores on each separate conservation task with the exception of area. "On the pretest the control-group scores were slightly higher in two categories (area and numbers), the experimental group were slightly higher in two areas (weight and length), and the two groups scored equally on the remaining two areas."[76]

Posttest results revealed that the experimental group outscored the control group on every conservation task

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[74]Ibid., p. 46.

[75]Ibid., p. 47.

[76]Ibid., p. 50.

except area. "Even on that task . . . the experimental group far outgained the control groups."[77]

Stafford and Renner reported that the results of this study showed that the first grade program did indeed enhance conservation reasoning.

> Since the acceleration of the acquisition of conservation skills was achieved through educational experiences that were a part of normal curriculum, rather than a training exercise designed specially to result in a conservation skill, it can be assumed that the acceleration was produced because the SCIS program provided a richer experimental educational environment than did the text book program. The children apparently had prerequisite maturation and simply lacked the experiences needed to actuate the thought processes essential to conservation and logical thought. The experiences provided in the first grade program of the SCIS are the kinds needed to initiate the movement toward the stated Goals of the Educational Policies Commission, "the ability to think."[78]

Following this study, the first grade program of the SCIS, Kellog concluded that since these investigators had a vehicle that nurtured logical thinking, it should also serve as a reading-readiness program that is superior to a readiness program not specifically designed to nurture such thinking. The hypothesis for this new study was: the SCIS first year program is superior to the usual commercial program in producing readiness for reading in first grade children.[79]

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[77]Ibid.

[78]Ibid., p. 48.

[79]Ibid., p. 57.

The design for this experiment consisted of a control group which experienced a commercial reading readiness program and the experimental group which experienced the Material Objects unit and experienced no reading readiness program. A pretest experience for both groups consisted of the Metropolitan Reading Readiness Test.

The results of the pretesting and posttesting for both the experimental and control groups showed that the experimental group numerically outgained the control group on all the subtests except copying. The gains in word meaning, matching, numbers, and total scores were substantially significant.[80]

Kellogg added to these results the following comments:

> We believe that the experimental group outperformed the control group in the areas of word meaning, listening, matching, and numbers because the members of the experimental group, through the use of the "Material Objects" units, were allowed to have concrete experiences in each of these areas to the limit of their interest and ability. The children learned to match because they were allowed to match properties to objects, using objects that they could grasp, manipulate, and even alter. They developed skills in listening because they listened to the teacher and to their fellow students describing, classifying, and discussing experiences. They learned word meaning when words were invented by the teacher (or by themselves) as needed to describe experiences with objects. A number of skills were gained as they serial ordered objects or groups of objects. They were outgained on the copying subtest because they did not do much copying, but instead were allowed and encouraged to think.[81]

The above inquiries of Stafford and Renner and that of Kellogg are examples of teaching for thinking. Lawson

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[80]Ibid., p. 62. [81]Ibid., p. 62.

and Renner elaborated further. They focused on two questions. (1) "How do children acquire knowledge? (2) How can awareness of children's thinking abilities and learning processes help teachers?"[82] They also introduced three key aspects of Piaget's theory concerning the development of reasoning: (1) "the idea of mental structures, (2) the process of self regulations, and (3) the stages of reasoning patterns."[83] Also offered were some practical suggestions for teaching for self-regulation. These authors summarized their view points as follows:

> The Idea of Mental Structures.
>
> . . . In the course of intellectual development from infancy to adulthood, mental structures are constructed and reconstructed within the brain. At birth, the infant has few structures with which to begin the process of constructing more useful and adaptive mental structures.
>
> . . . The construction of mental structures is a fundamental process in intellectual development. Mental structures provide the basis for our patterns of reasoning, which in turn, determine how and what we think and how we interact with our environment. In a very real sense, our mental reasoning patterns represent our knowledge about both the physical world and the world of ideas.
>
> Constructing Mental Structures:
> The Process of Self-Regulation.
>
> . . . A contradiction to present behaviors, or at least an awareness that they are not entirely adequate, is the first step toward the construction of new mental structures. Piaget calls the process of constructing new mental structures self-regulation.

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[82]Anton E. Lawson, and John W. Renner, "Teaching for Thinking: A Piagetian Perspective," Today's Education, 65, 3 (September-October, 1976), p. 38.

[83]Ibid.

This process is described as unfolding in alternating phases, beginning with an assimilation phase. An individual's mental structures assimilate a situation, that is, they give it meaning and initiate a behavior consistent with that meaning. The meaning is determined by present mental structures . . . . Inappropriateness produces what is variously called "disequilibrium," "cognitive conflict," or "contradiction." It is, according to Piaget, the prime mover in initiating the second phase--Accommodation.

According to Piaget, the process of self-regulation underlies all intellectual development. The emphasis in this process is on the self, because the process is by its very nature an internal regulation that cannot be circumvented using external agents . . . .

Stages in Reasoning Patterns.

. . . In general, reasoning patterns are described by Piaget as falling into two major categories, concrete operational and formal operational, depending upon their breadth of applicability and their usefulness in organizing information and solving problems.

Reasoning patterns are called concrete if they can be applied only to familiar objects, events and situations in the child's experience. Classifying objects into groups such as plants and animals, boys and girls, or odd numbers and even numbers involves a concrete reasoning pattern. Serial ordering--that is, arranging things in order from smallest to largest, lightest to heaviest, or youngest to oldest--is another concrete reasoning pattern. These patterns are certainly basic to organizing experience. We cannot deal with it effectively without them, but their usefulness is limited.

Reasoning patterns with greater breadth of applicability--that is those used to deal with abstract relationships, hypothesized objects, indirect ideas--are called formal. In terms of the theory and of school learning, Piaget believes that concrete reasoning patterns are prerequisite for the development of formal reasoning patterns. An individual is not meaningfully able to deal on a formal level with any topic without first acquiring a sound experiential base, i.e., without being able to classify and to serially order the phenomena under consideration. Basic to formal thought are reasoning patterns guiding a systematic isolation and analysis of all possible combinations of variables, the control of variables, proportional reasoning, probabilistic reasoning, and hypothetico deductive reasoning.[84]

Lawson and Renner concluded their perspective on thinking with a lengthy list of practical suggestions directed toward teaching for self-regulation.[85]

Perceptual learning has been considered in terms of visual perceptual experiences, age levels, and Piaget's stages of intellectual development. The researcher felt it appropriate to end this comprehensive work with a summary of interrelations of perceptual learning and the total cognitive process as viewed by Gibson. Gibson offered the following figure and accompanying explanation.

Total Cognitive Process

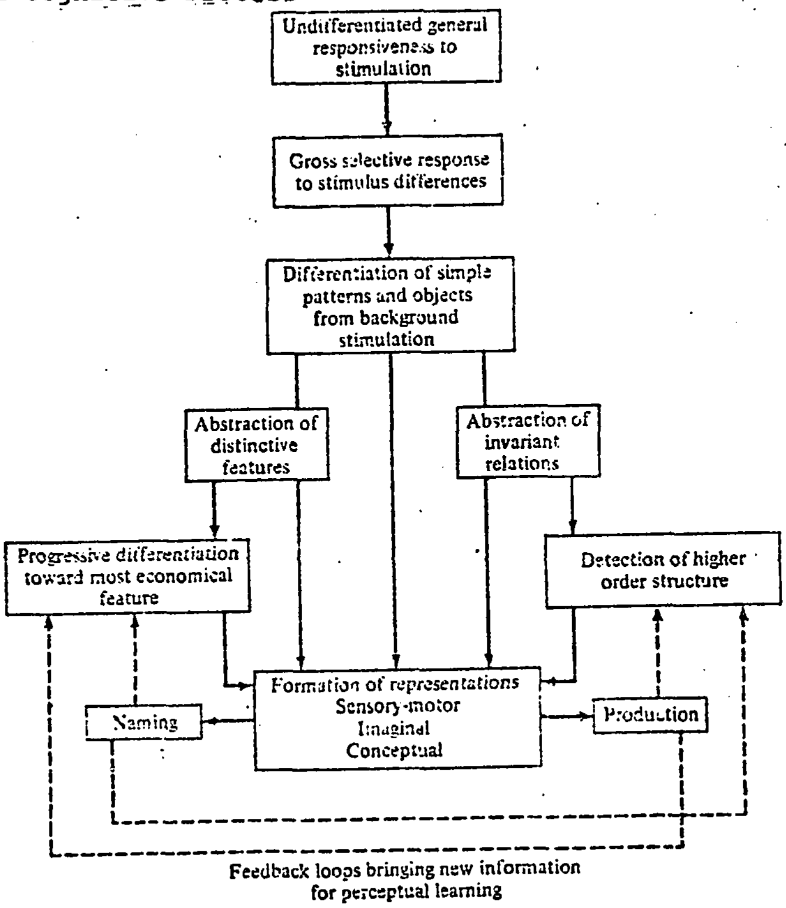

Figure 4. Gibson's Developmental Interrelations of Cognitive Processes.

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[84]Ibid., p. 39. [85]Ibid., p. 40.

The developmental interrelationships of the cognitive processes . . . are summarized . . . , which shows a developmental progression from one cognitive achievement to another, and feedback loops from processes achieved later to processes that began earlier. These loops (dotted lines) indicate potential subsequent refinement and faciliation of the processes available earlier by those achieved later. That is, while the chart suggests a developmental progression reading from the top down, it also contains the implication that later appearing processes, such as naming, may react on and contribute to future perceptual learning once they have become part of the organism's repertory of activities . . . .

At the top of the chart is undifferentiated general responsiveness to stimulation, present to a limited extent in the unborn foetus. Following this step is gross selective response to stimulus differences, present in the neonate, and demonstrable by techniques such as habituation and presentation of novel stimuli . . . . Up to this point, we see no evidence of learning, but from birth on, learning and growth can proceed together. A few weeks after birth, it can be demonstrated that certain sounds and objects are differentiated from the background stimulation and attended to selectively (for instance, faces).

Following primitive separation of an object or event from the stimulus flow, perception differentiates in two ways. One, features which distinguish an object or event from others are abstracted (e.g., properties distinguishing one face from another, one voice from another, and so on) and progressively more economical processing features is achieved. The second path of perceptual learning is the extraction of invariants of events and progressive pick up of higher order structure. Differentiation of sequential stimulus information, such as speech and writing, prominently embodies both.

Perceptual learning begins before permanent representations of things, patterns, and sequences can be developed. Some kinds of representation may be prior to others; for instance, a sensory-motor schema, in Piaget's sense, and a concrete image would be prior to an abstract concept. The representation, in turn, preceeds the ability to produce a copy and to attach verbal labels. But when production and naming are possible, these activities can speed up further perceptual learning by providing distinctive features and higher order relations. They help especially in the learning of distinctive features and structure of very complex sets of objects and coded stimuli such as speech and writing.[86]

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[86]Gibson, _Perceptual Learning and Development_, p. 161.

CHAPTER III

TREATMENT AND ANALYSIS OF DATA

Necessary to accurate and clear analysis of raw data was knowledge of the amount of figure-ground skills and the stages of intellectual development possessed by subjects within each of the 18 groups considered in the research design for testing the specific null-hypotheses. This knowledge was obtained from raw data, Appendix H, page 163 using the following instrumentation: (1) Marianne Frostig Developmental Test of Visual Perception, Test # II, Figure-Ground, and (2) The Six Piagetian Conservation Tasks. The analysis procedures were divided into the following phases: (1) Preliminary Procedures and (2) Methods of Statistical Analysis Procedures.

Preliminary Procedures

These procedures began as soon as the raw data (Appendix H) were collected according to The Strategy for Data Collection (see page 42). The first phase of raw data analysis procedures was to organize raw data from each instrumentation into manageable forms, Appendix I, page 172. Means and standard deviations were calculated, Appendix J, page 190.

Methods of Statistical Analysis Procedures

The second phase of data analysis procedures was the statistical calculations needed to test the specific null-hypotheses. In very broad and general terms Campbell and Stanley[1] reported that the most widely used acceptable test of significance for the design used in this study was to compute for each group, pretest, posttest, and delayed posttest gain scores and to compute a t between the experimental and control groups on their gain scores. More specifically, Ary and Jacobs made a distinction between independent and dependent samples because there were two different procedures for testing the significance of the difference between means--one procedure for independent samples and another used for dependent samples.

> Independent samples are those in which the selection of cases is not influenced by the selection of cases in the second sample. As the name implies, they are completely independent of each other; there is no logical paring in the two groups or any reason to connect any given measure in one sample with measures in the other.[2]

A two-tailed test of significance with an alpha of .05 was used.[3] The results of these calculations are in the following paragraphs.

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[1]Campbell and Stanley, Designs for Research, p. 23.

[2]Donald Ary and Lucy Cheser Jacobs, Introduction to Statistics (New York: Holt, Rinehart and Winston), p. 331.

[3]Types of statistical errors are not discussed here. For that discussion see Chapter IV, Summary, Conclusions, and Recommendations, page 134.

Discussion of Findings

The discussion of findings begins with the results of testing the null-hypotheses. The null-hypothesis/es is/are stated. This is followed by a short explanation of the procedures used for testing the hypothesis/es, the tabled results, and a brief explanation of results. This discussion is followed by a visual comparison of the effects of visual perceptual experiences upon visual perceptual learning at three age levels using the same results. This section--discussion of findings is completed with a discussion of findings in terms of The Six Piagetian Conservation Tasks.

Null-Hypothesis Number One (H_{01})

The exact form of the null-hypothesis tested in hypothesis number one was as follows:

> H_{01} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects (on pretests, posttests, or delayed posttests) between the experimental and control groups.

The first null-hypothesis was tested by specific statistical calculations for testing hypotheses: Tests Related to Means for Uncorrelated Data (Independent Data) as suggested by Downie and Heath.[3] The results of these statistical calculations are presented in Table 1 (page 92).

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[3] N. M. Downie and R. W. Heath, Basic Statistical Methods, 4th ed. (New York: Harper and Row, 1974), pp. 169-176.

TABLE 1

t-TEST RESULTS OF SIX, SEVEN, AND EIGHT-YEAR-OLDS ON FIGURE-GROUND PRE, POST AND DELAYED POST-TESTS FOR EXPERIMENTAL AND CONTROL GROUPS

Age	Test	Comparison	df	t	Critical t @ .05
6	Pre	Experimental/Control	28	1.23	2.048
6	Post	Experimental/Control	27	.11	2.052
6	Delayed Post	Experimental/Control	27	1.94	2.052
7	Pre	Experimental/Control	28	1.83	2.048
7	Post	Experimental/Control	27	1.31	2.052
7	Delayed Post	Experimental/Control	27	.65	2.052
8	Pre	Experimental/Control	28	0.00	2.048
8	Post	Experimental/Control	28	.74	2.048
8	Delayed Post	Experimental/Control	28	-1.09	2.048

The results of testing the first null-hypothesis present in Table 1 showed that the differences were not statistically significant. These statistical results would not allow the researcher to reject the first null-hypothesis and it was concluded that there were no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects on pretests, posttest, or delayed posttests between the experimental and control groups.

<u>Null-Hypotheses Number Two (H_{02}) Three (H_{03}), and Four (H_{04})</u>

The exact form the null-hypotheses tested in hypotheses number two, three, and four were as follows:

H_{02} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and posttests.

H_{03} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on post and delayed posttests.

H_{04} - There are no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and delayed posttests.

The second, third and fourth null-hypotheses were tested by specific statistical calculations for testing hypotheses: Tests Related to Means for Correlated Data

(Dependent Data) as suggested by Downie and Heath.[4]

The results of testing these three null-hypotheses present in Table 2 showed that: (1) for hypothesis number two (H_{02}), the differences were not statistically significant. These statistical results would not allow the researcher to reject null-hypothesis number two and it was concluded that there were no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and posttests; (2) for hypothesis number three (H_{03}), there were statistically significant differences for the seven year old experimental group at the delayed posttest phase and the seven year old control group at the delayed posttest phase. Other comparisons were not significant. These statistical results allowed the researcher to reject null hypothesis number three (H_{03}) and it was concluded that there were statistically significant differences in the mean scale scores (figure-ground) of seven year old subjects in the experimental and control groups on post and delay posttests; and (3) for hypothesis number four (H_{04}) there were no statistically significant differences in the mean scale scores (figure-ground) of six, seven, or eight year old subjects in the experimental and control groups on pre and delayed posttests.

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[4]Ibid., pp. 176-8.

TABLE 2

t-TEST RESULTS OF SIX, SEVEN, AND EIGHT-YEAR-OLDS IN EXPERIMENTAL AND CONTROL GROUPS FOR FIGURE-GROUND PRE AND POSTTESTS, PRE AND DELAYED POSTTESTS, AND POST AND DELAYED POSTTESTS

Age	Group	Comparison	df	t	Critical t @ .05
6	Experimental	Pre/Post	13	1.82	2.160
7	Experimental	Pre/Post	13	1.54	2.160
8	Experimental	Pre/Post	14	- .79	2.145
6	Control	Pre/Post	14	.26	2.145
7	Control	Pre/Post	14	- .12	2.145
8	Control	Pre/Post	14	.16	2.145
6	Experimental	Post/Delayed Post	13	- .97	2.160
7	Experimental	Post/Delayed Post	13	-2.22*	2.160
8	Experimental	Post/Delayed Post	14	.38	2.145
6	Control	Post/Delayed Post	14	.96	2.145
7	Control	Post/Delayed Post	14	-2.79*	2.145
8	Control	Post/Delayed Post	14	-1.49	2.145
6	Experimental	Pre/Delayed Post	13	.76	2.160
7	Experimental	Pre/Delayed Post	13	- .27	2.160
8	Experimental	Pre/Delayed Post	14	- .25	2.145
6	Control	Pre/Delayed Post	14	- .19	2.145
7	Control	Pre/Delayed Post	14	-2.09	2.145
8	Control	Pre/Delayed Post	14	-1.76	2.145

* - Significant at the .05 level.

Null-Hypotheses Five ($H_{0}5$), Six ($H_{0}6$), and Seven ($H_{0}7$)

The exact form the null-hypotheses tested in hypotheses number five, six and seven were as follows:

H_{05} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages six and seven.

H_{06} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages six and eight.

H_{07} - There are no statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages seven and eight.

The fifth, sixth, and seventh null-hypotheses were tested by specific statistical calculations for testing hypotheses: Tests Related to Means for Uncorrelated Data (Independent Data) as suggested by Downie and Heath.[5] The results of these statistical calculations are presented in Table 3.

The results of testing these null hypotheses presented in Table 3 showed: (1) that there were significant differences for hypothesis number five (H_{05}) for the experimental group at the delayed posttest phase for six/seven year old subjects and for the control group at the delayed posttest phase for six/seven year old subjects. Other

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[5]Ibid., pp. 169-76.

TABLE 3

t-TEST RESULTS OF FIGURE-GROUND PRE, POST, AND DELAYED POSTTESTS IN EXPERIMENTAL AND CONTROL GROUPS FOR SIX AND SEVEN-YEAR-OLDS, SIX AND EIGHT-YEAR-OLDS, AND SEVEN AND EIGHT-YEAR-OLDS

Group	Test	Comparison	df	t	Critical t @ .05
Experimental	Pre	6/7	28	- .75	2.048
Control	Pre	6/7	28	.09	2.048
Experimental	Post	6/7	26	-1.41	2.056
Control	Post	6/7	28	- .13	2.048
Experimental	Delayed Post	6/7	26	-2.63*	2.056
Control	Delayed Post	6/7	28	-3.41*	2.048
Experimental	Pre	6/8	28	-1.69	2.048
Control	Pre	6/8	28	.09	2.048
Experimental	Post	6/8	27	- .29	2.052
Control	Post	6/8	28	.42	2.048
Experimental	Delayed Post	6/8	27	.92	2.052
Control	Delayed Post	6/8	28	-2.15*	2.048
Experimental	Pre	7/8	27	2.70*	2.052
Control	Pre	7/8	28	.30	2.048
Experimental	Post	7/8	27	.98	2.052
Control	Post	7/8	28	.50	2.048
Experimental	Delayed Post	7/8	27	3.62*	2.052
Control	Delayed Post	7/8	28	1.46	2.048

* - Significant at the .05 level.

comparisons were not statistically significant. These results allowed the researcher to reject null-hypothesis number five (H_{05}) and it was concluded that there were statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post or delayed posttests at ages six and seven; (2) that there were significant differences for null-hypothesis number six (H_{06}) for the control group at the delayed posttest phase for six/eight year old subjects. Other comparisons were not statistically significant. These results allowed the researcher to reject null-hypothesis number six (H_{06}) and it was concluded that there were statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delay posttests at ages six and eight; and (3) that there were statistically significant differences for hypothesis seven (H_{07}) for the experimental group at the pre test phase for seven/eight year old subjects and for the experimental group at the delayed posttest phase for seven/eight. Other comparisons were not statistically significant. These statistical results allowed the researcher to reject hypothesis number seven (H_{07}), and it was concluded that there were statistically significant differences in the mean scale scores (figure-ground) between the experimental and control groups on pre, post, or delayed posttests at ages seven and eight.

Visual Comparisons

A visual comparison of the effect of visual perceptual experiences upon visual perceptual learning at three age levels shown in Figure 5, revealed for:

The Eight-Year-Old-Experimental/ Control Groups That:

A. At Phase I, pretesting, the experimental/control groups were identical;

B. At Phase III, posttesting, the experimental group out-scored the control group, while the control group remained constant, however;

C. At Phase IV, delayed posttesting, the experimental group displayed a loss of figure-ground scores, while the control group out-scored the experimental group.

D. Between age-level-comparison, 6/8, significant differences, (8 out-scored the 6) within the control group at the delayed posttest phase and 7/8, significant differences (7 out-scored the 8) within the experimental group at the pre-testing phase and significant differences (7 out-scored the 8) within the experimental group at the delayed posttesting phase.

The Seven-Year-Old-Experimental/ Control Groups That:

A. At Phase I, pretesting, the experimental/control groups were not identical. The experimental group was favored. This group not only outscored the control group

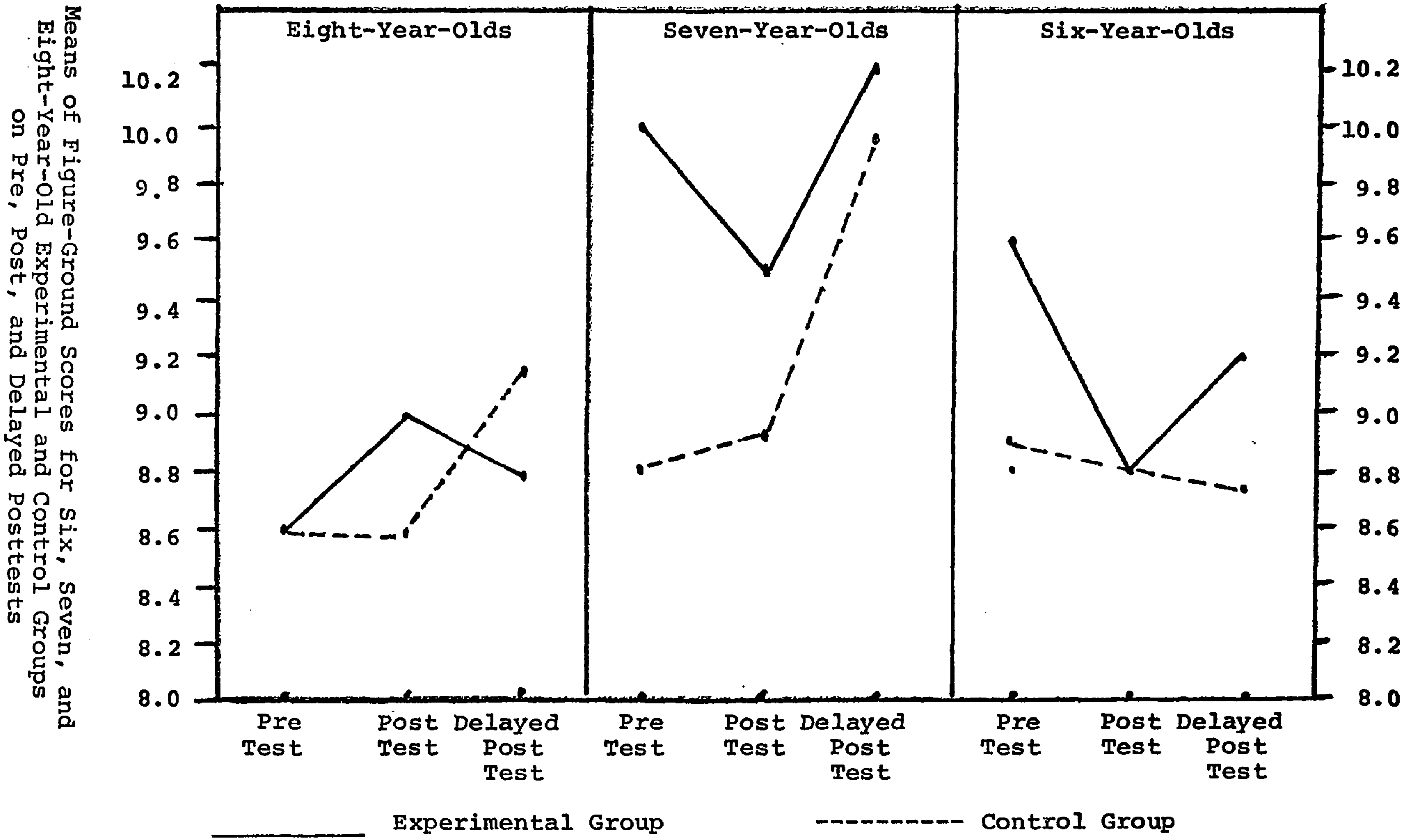

Figure 5. Effects of Visual Perceptual Experiences Upon Visual Perceptual Learning (Figure-Ground Skills) at Three Age Levels.

within this age level, but out-scored groups among all levels.

B. At Phase III, posttesting, the experimental group continued to remain the favored group, yet displayed a loss of figure-ground scores, while the control group, displayed continued figure-ground score gains.

C. At Phase IV, delayed posttesting, the experimental group continued to remain the favored group, yet displayed a significant gain in figure-ground scores and continued to out-score the control group. The control group, however, displayed throughout all phases of this age level, constant figure-ground score gains.

D. Between age-level-comparisons, 6/7, displayed significant differences, (7 out-scored the 6) within the experimental group at the delayed posttest phase and the control group, 6/7, displayed significant differences, (7 out-scored the 6) at the delayed posttest phase; also, the experimental group 7/8, displayed significant differences, (7 out-scored the 8) at the pretest phase, and the experimental group, 7/8, displayed significant differences, (7 out-scored the 8) at the delayed posttest phase.

<u>The Six-Year-Old Experimental/
Control Groups That</u>:

A. At Phase I, pretesting, the experimental group out-scored the control group.

B. At Phase III, posttesting, the experimental group continued to remain the favored group, yet displayed a loss of figure-ground scores, while the control group displayed a slight loss of figure-ground scores.

C. At Phase IV, delayed posttesting, the experimental group continued to remain the favored group. This group out-scored the control group and the control group again displayed a slight loss of figure-ground scores.

D. Between age-level-comparisons, 6/7, displayed significant differences, (7 out-scored the 6) within the experimental group at the delayed posttest phase and the control group, 6/7, significant differences, (7 out-scored the 6) at the delayed posttest phase; also, 6/8, significant differences, (8 out-scored the 6) within the control group at the delayed posttest phase.

It seemed obvious from the above results that: (1) Learning, as defined by Piaget, was not an effect of the provided visual perceptual experiences at age level eight in the experimental group; and (2) ". . . the development of regulations and the resulting figure-ground reversal, schematization, and so on are constructed by most children on their own and without specific tutelage"[6] at age level eight in the control group.

At the seven-year-old level, results indicated that this age level possessed the potential for having been the

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[6]Elkind, "Perceptual Development," p. 539.

optimum age for visual perceptual learning of figure-ground skills if viable visual perceptual experiences were provided. The researcher based this statement upon results indicating that: (1) the subjects at this age level within the experimental group, initially, out-scored all age level groups included in this study; however, after treatment, there was displayed a loss of figure-ground scores; yet, at the delayed posttesting phase, there was displayed a significant gain in figure-ground scores, indicating that the lack of learning as described by Piaget could be attributed to the lack of quality of the provided visual perceptual experience; (2) the subjects at this age level within the control group displayed a constant gain in visual perceptual scores at all phases. This constant gain at all phases, plus the significant gain of the experimental group at the delayed posttesting phase, again reinforced Piaget's viewpoint just stated above.

At the six-year-old-level, results indicated that the provided visual perceptual experiences had a negative effect following treatment within the experimental group. This condition again, could have been attributed to the lack of quality of the provided visual perceptual experiences. Repeated at the delayed posttesting phase within the experimental group at the delayed post phase was a gain in figure-ground scores. These results possibly reinforced Piaget's viewpoint that, "figure-ground reversal is mediated by logic-like processes that do not emerge until about the age six or seven."[7] The control group displayed a constant loss of figure-ground scores.

The Six Piagetian Conservation Tasks

The literature indicated that the order and approximate levels of conservation reasoning in children had been established, i.e., there existed a relationship between the stages of intellectual development within the Piagetian model and age.

> There is only one stage in Piaget's model whose starting point can be precisely stated--the sensory-motor stage. It begins at birth and ends around 2-and-a-half-years of age. A 2-and-a-half-year-old child begins to enter the preoperational stage, and his exit from that type of thinking begins around 7 years of age. In other words, in the model, exact, precise ages at which a learner will progress from stage to stage cannot be stated. The child himself determines his progress through the stages. In his model Piaget describes the relationship of the stages and age thus: "although the order of succession is constant, the chronological ages of these stages varies a great deal" . . . keep in mind that a child does not move completely from one stage to another. The evidence available suggests that a learner can easily be in the sensory-motor phase on some traits and preoperational on others. Rather than thinking about a child as moving from one stage into another, think of him as moving into a particular stage on certain traits. As his development progresses, he moves into the stage on other traits. There is not, in other words, a chronological line and as he passes it he has moved from one stage to another, as much as he is permitted to vote when he reaches 18 years of age.[8]

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[7]Ibid., p. 534.

[8]Renner, Stafford, and Ragan, Teaching Science in the Elementary School, p. 70.

Table 4 (page 111) shows the results of administering to each of the 90 subjects <u>The Six Piagetian Conservation Tasks</u>. This table revealed several types of information: (1) General information showing the relationship between approximate age levels and stages of intellectual development which corroborated the research of Piaget and Renner; (2) More specific information related to this study showing the relationship that existed between approximate age levels and stages of intellectual development which did not of necessity corroborate the research of Piaget and Renner; and (3) Possible effects treatment and time had upon conservations (gains and losses) at three data collection phases (pretest, posttest, and delayed posttest).

These data are informative when the following references for studying them are considered. Conservation of reasoning was achieved in this study when approximately 11.25 children (in this 15 subject sample) responded satisfactorily, i.e., conservation was achieved at approximately 73-75 per cent rule of thumb.

<u>General Information Showing the Relationship Between Approximate Age Levels and Stages of Intellectual Development</u>

The percentages on Table 4 corroborated the statements of Renner.

> 1. . . . although the order of succession is constant, the chronological ages of these stages varies a great deal.

2. . . . a child does not move completely from one stage to another.

3. . . . think of him as moving into a particular stage on certain traits. As his development progresses, he moves deeper and deeper into a particular stage on some traits as he moves into the stage on other traits.[9]

4. . . . "knowing is a process; not a product." Learning, therefore, proceeds by the interaction of the learner with something and his construction of mental structures from and to accommodate the results of these interactions.[10]

5. The maturation process also influences the intellectual development of the child.[11]

6. . . . experience . . . has an influence upon cognitive structure development.[12]

7. Egocentrism, irreversibility, centering, states in a transformation, transductive reasoning are characteristics of the preoperational child.[13]

8. Conservation is an overt manifestation of whether or not a child is a preoperational thinker.[14]

9. The beginnings of the child's entry into the third stage in the Piagetian model (concrete operations) occur, then, in the late first or second grade.[15]

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[9]Ibid., p. 70.

[10]Jerome S. Bruner, Toward A Theory of Instruction (Cambridge, Mass.: Harvard University Press, 1966), p. 72.

[11]Renner, Stafford, and Ragan, Teaching Science in the Elementary School, p. 62.

[12]Ibid., p. 63

[13]Ibid., p. 72.

[14]Ibid., p. 78.

[15]Ibid., p. 79.

10. The first conservation task usually is number and the second and third are liquid and solid and other three achievement shows no definite pattern.[16]

11. The gross way to think about the concrete operational child is he is what a preoperational thinker is not.[17]

12. This stage of intellectual development begins somewhere between 6½ years and 7 years 8 months and continues, according to Piaget until 11 to 12 years of age. Friot and Renner corroborated this age range and suggested that it might be extended . . . .[18]

<u>More Specific Information Showing the Relationship That Existed Between Approximate Age Levels and Stages of Intellectual Development</u>

A. The first conservation made was the conservation area of number. Table 4 (page 111) clearly showed the beginnings of the conservation area of number at age six (83-72 months), and the conservation area of number achieved for all groups, pretesting (experimental/control); posttesting (experimental/control); and delayed posttesting (experimental/control) at age level seven (95-84 months). These data corroborated Renner's findings. Renner stated that "conservation of number, for example, is not achieved until 84 months of age (seven years)."[19]

B. The second and third conservation achieved were

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[16]Ibid., p. 83.

[17]Ibid., p. 90.

[18]Ibid., p. 91.

[19]Ibid., p. 85.

TABLE 4

PRETEST, POSTTEST, AND DELAYED POSTTEST PERCENTAGES FOR EXPERIMENTAL AND CONTROL GROUPS ON THE SIX PIAGETIAN CONSERVATION TASKS - AGES SIX, SEVEN, AND EIGHT

Age Group	Conservation Area	Pretest		Posttest		Delayed Posttest	
		Experimental	Control	Experimental	Control	Experimental	Control
Eight-Year-Olds (107-96 Mos.)	Number	100%*	93%*	100%*	93%*	100%*	93%*
	Liquid Amount	93%*	100%*	87%*	100%*	93%*	93%*
	Solid Amount	100%*	87%*	93%*	93%*	93%*	93%*
	Area	73%*	67%	93%*	73%*	80%*	93%*
	Length	67%	54%	40%	60%	47%	54%
	Weight	100%*	93%*	93%*	93%*	87%*	87%*
Seven-Year-Olds (95-84 Mos.)	Number	100%*	87%*	93%*	93%*	93%*	87%*
	Liquid Amount	60%	60%	87%*	73%*	87%*	60%
	Solid Amount	87%*	67%	73%*	54%	93%	47%
	Area	60%	47%	87%*	33%	73%*	47%
	Length	40%	20%	60%	7%	67%	20%
	Weight	87%*	67%	87%*	60%	87%*	54%
Six-Year-Olds (83-72 Mos.)	Number	67%	73%*	60%	73%*	73%*	60%
	Liquid Amount	40%	33%	53%	54%	47%	54%
	Solid Amount	60%	54%	47%	54%	40%	54%
	Area	20%	47%	47%	33%	27%	40%
	Length	0%	7%	0%	7%	7%	13%
	Weight	60%	67%	40%	54%	40%	67%

*Criteria for determining conservation is 73% and above.

liquid amount and solid amount. Table 4 (page 111) clearly showed the beginnings of liquid and solid amount conservation at age level seven (97-84 months) and liquid amount and solid amount conservation achieved by all groups, pretesting (experimental/control); posttesting (experimental/control); and delayed posttesting (experimental/control) at age level eight (107-96 months). Renner suggested that the conservation of liquid task is achieved between eight and nine years old (105-108 months).[20] This sample conserved earlier. Renner also stated that, ". . . the conservation of solid amount is accomplished, according to Piaget, between seven and eight years of age."[21] In the conservation area of solid amount, this sample corroborated the findings of Piaget.

C. The following pattern for the remaining three conservation areas were: the conservation area of weight, the conservation area of area, and the conservation area of length. Renner recorded that . . . "our results on the order in which conservation on the other three is achieved show no definite pattern."[22]

D. Table 4 (page 111) clearly showed the beginnings of the conservation area of area at age level seven (95-84 months) and the conservation of area was achieved within

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[20]Ibid.

[21]Renner, et al., Piaget Model, p. 44.

[22]Renner, et al., Teaching Science, p. 83.

five of the six groups, pretesting (experimental/control); posttesting (experimental/control); and delayed posttesting (experimental/control) at age eight (107-96 months). Renner stated that "Piaget has also stated that length and area are conserved between seven and eight years of age."[23] The subjects in this study corroborated Piaget's and Renner's findings for the conservation of area.

E. The conservation area of length was not conserved by this sample of subjects, indicating a much later age level for this sample. "Piaget has also stated that length and area are conserved between seven and eight years of age."[24]

F. The conservation area of weight began at age seven and was achieved by all groups, pretesting (experimental/control); posttesting (experimental/control); and delayed posttesting (experimental/control) at age level eight (107-96 months). Renner reported, "Piaget has stated that the weight is not conserved until about ten years of age, and our data support his conclusions."[25] The subjects in this study conserved in this area of conservation earlier.

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[23]Renner, et al., Piaget Model, p. 46.

[24]Ibid.

[25]Ibid., p. 44.

<u>More Specific Information Showing the Possible Effects of Treatment and Time Upon Conservation at Three Data Collection Phases</u>

The results of the pretest, posttest, and delayed posttest percentages for experimental and control groups on <u>The Six Piagetian Conservation Tasks</u>, ages six, seven, and eight, showed in Table 4 (page 111) revealed for:

<u>The Eight-Year-Old Experimental/Control Groups That:</u>

A. At Phase I, pretesting, intellectually, the experimental group conserved at the 73 per cent level in all areas of conservation except one, length; and conserved at a higher percentage than the control group in all areas of conservation except liquid. The control group conserved in all areas of conservation except two, length and area.

B. At Phase III, posttesting, the experimental group continued to conserve at the 73 per cent level in all areas of conservation but one, length; however, there was displayed a loss of percentages of conservation in all areas of conservation except the conservation of area, which displayed a gain, and a constant holding for the conservation area of number. The control group continued to conserve in all areas of conservation except length; however, this group conserved at a higher percentage than the experimental group percentage in three areas of conservation, solid amount, area and length than at the pretest phase; and displayed a constant holding in three areas of conservation, number, liquid amount, and weight.

C. At Phase IV, the delayed posttesting, the experimental group conserved in all areas of conservation except length; however, there was displayed a percentage loss in two areas of conservation, length and weight and in the area of conservation of solid amount remained constant. The control group conserved in all areas of conservation except length and displayed a constant percentage holding in two areas of conservation, number and solid amount. This group also displayed a percentage loss in two areas of conservation, liquid amount and weight.

The Seven-Year-Old Experimental/Control Groups That:

A. At Phase I, pretesting, intellectually, the experimental group conserved at the 73 per cent level in three areas of conservation, number, solid amount, and weight; and conserved at a higher percentage than the control group in all areas of conservation except liquid amount, which was constant. The control group conserved in one area of conservation, the conservation area of number.

B. At Phase III, posttesting, the experimental group conserved in five areas of conservation, number, liquid amount, solid amount, area, and weight; however, compared to Phase I, the percentage of conservation was lower in the conservation areas of number, solid amount, and remained constant in the conservation area of weight. At the Phase II a higher percentage of conservation was displayed in the conservation areas of length and area. The control group conserved in two areas of conservation, number and liquid amount. Compared to Phase I, this represented a gain in one more area of conservation.

There was also displayed a percentage increase in the areas of conservation of number and liquid amount; and a depressed percentage in four areas of conservation, solid amount, area, length, and weight.

C. At Phase IV, delayed posttesting, the experimental group conserved in five areas of conservation, number, liquid amount, solid amount, area, and weight. This displayed an increase in two conservation areas, since Phase I and displayed conservation holding in two areas of conservation, liquid amount and weight, since Phase III. There was also displayed compared to Phase I, pretesting, a gain in percentage in four areas of conservation, liquid amount, solid amount, area, length; and a percentage holding in one area of conservation, weight, and depressed percentage in the conservation area of number. The control group conserved in one area of conservation, number. This represented a loss in one area of conservation holding since Phase I. Compared to Phase I, displayed was depressed percentage in all areas of conservation except liquid amount, which showed a constant conservation holding.

<u>The Six-Year-Old Experimental/Control Groups That</u>:

A. At Phase I, pretesting, intellectually, the experimental group did not conserve at the 73 per cent level in any of the six areas of conservation. The percentage figures for these conservations were: number, 67 per cent; solid amount, 60 per cent; and weight, 60 per cent. The control group conserved in one area, number. The percentage figures of these conservations were solid amount, 54 per cent and weight, 67 per cent.

B. At Phase III, posttesting, the experimental group did not conserve in any of the six areas of conservation. Displayed was evidence of percentage gain in one area of conservation, liquid amount. The control group continued to conserve in one area of conservation, number. Also displayed was a percentage increase of conservation in liquid amount; percentage loss in the area of conservation of weight and area and percentage holding in the areas of conservation in solid amount and number.

C. At Phase IV, delayed posttesting, the experimental group conserved in one area of conservation, number. Displayed was a gain in percentage in two areas of conservation, length and number, and a loss of percentage in three areas of conservation, liquid amount, solid amount, and area. Also displayed was percentage holding in the conservation area of weight. The control group displayed a loss of one conservation area of number; gains in three areas of conservation, length, weight, and area.

It seemed obvious from the above results that at age level eight years, the effect of Piaget's stages of intellectual development upon visual perceptual learning was initially most perplexing! It seemed logical to the researcher that: (1) the chronologically older the subjects, the greater the degree of conservation achievement, therefore, a greater degree of visual perceptual learning was expected; and (2) the greater the quality of the provided visual perceptual experiences, the greater the increase of the percentages of conservations, therefore, the greater the amount of visual perceptual learning expected. In terms of the results displayed, the assumed positive effect was not evident. However, since the researcher had concluded earlier in this study, relative to questions one and two, that the lack of quality of the provided visual perceptual experience seemed to overpower any positive effect that the variables of age level and the stages of intellectual development might have upon visual perceptual learning; then, the following results further corroborated this conclusion stated earlier.

For the experimental group at this age level, results indicated that the provided visual perceptual experiences did not develop cognitive structures in positive ways, nor did the stage of intellectual development effect visual perceptual learning in positive ways. This state--highest yet depressed stage of intellectual development for this study and a lack of visual perceptual mastery, not only corroborated the researcher's earlier findings, but seemed to also support the research of Bibace. Bibace reported that major developmental theorists, applied developmental psychologists, neurologists, and specialists in education assume mastery of lower (perceptual-motor) processes as necessarily prior to higher cognitive processes and hence, scholastic achievement. Bibace reported:

> This theoretical assumption is important because it has shaped both methodological assumptions guiding research in the field and the clinical pedagogical efforts of various specialists who attempt to offer remedial or therapeutic programs for children with learning disabilities.[6]

Bibace also stated that the justification for this assumption rests upon such names as Piaget, Gesell, Kephart and Werner.[7] However, there exist perplexing clinical observations shared by many workers in the field who do not agree with this assumption.[8] This disparity between observations and the theoretical assumption led Bibace to undertake a pilot project using an experimental design allowing variation in perceptual-motor functioning and scholastic ability to test the assumption. Results indicated that there were cases which are contrary to the theoretical assumption and

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[6]Bibace, "Perceptual and Conceptual Cognitive Processes," p. 17.

[7]Ibid.

[8]Ibid., p. 18.

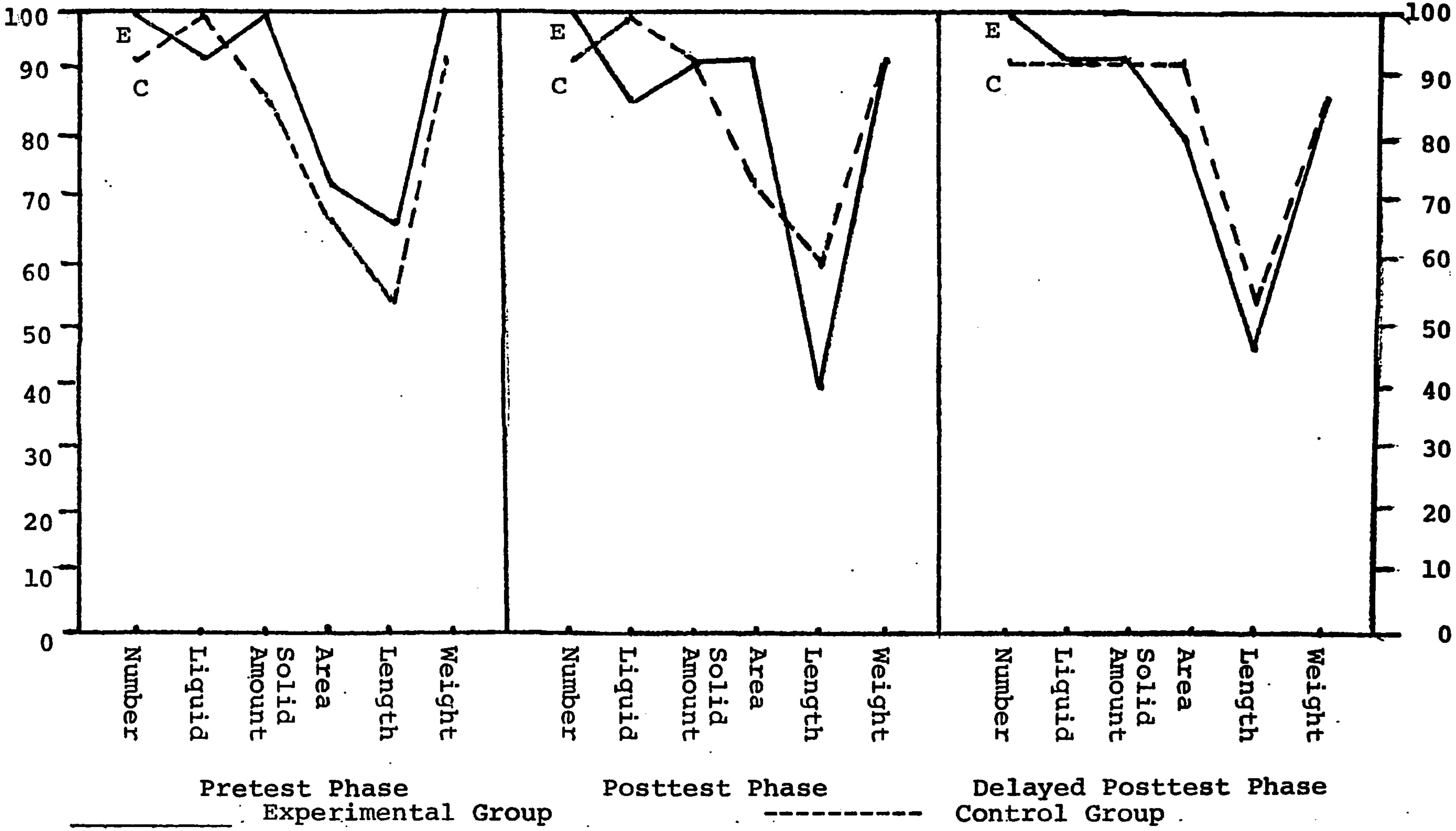

Figure 6. Pretest, Posttest, and Delayed Posttest Percentages for Experimental and Control Groups on The Six Piagetian Conservation Tasks - Age Eight.

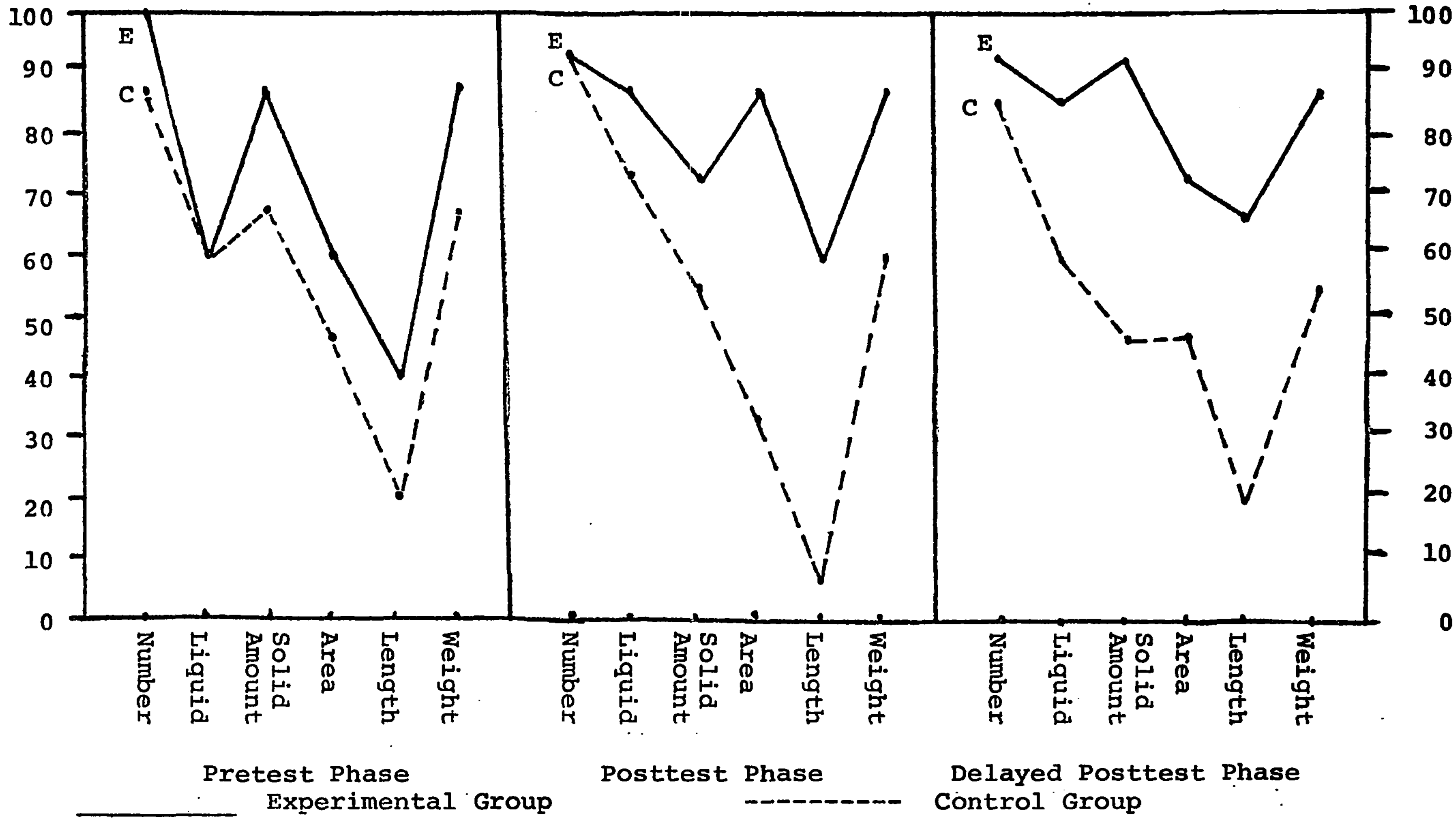

Figure 7. Pretest, Posttest, and Delayed Posttest Percentages for Experimental and Control Groups on <u>The Six Piagetian Conservation Tasks</u> - Age Seven.

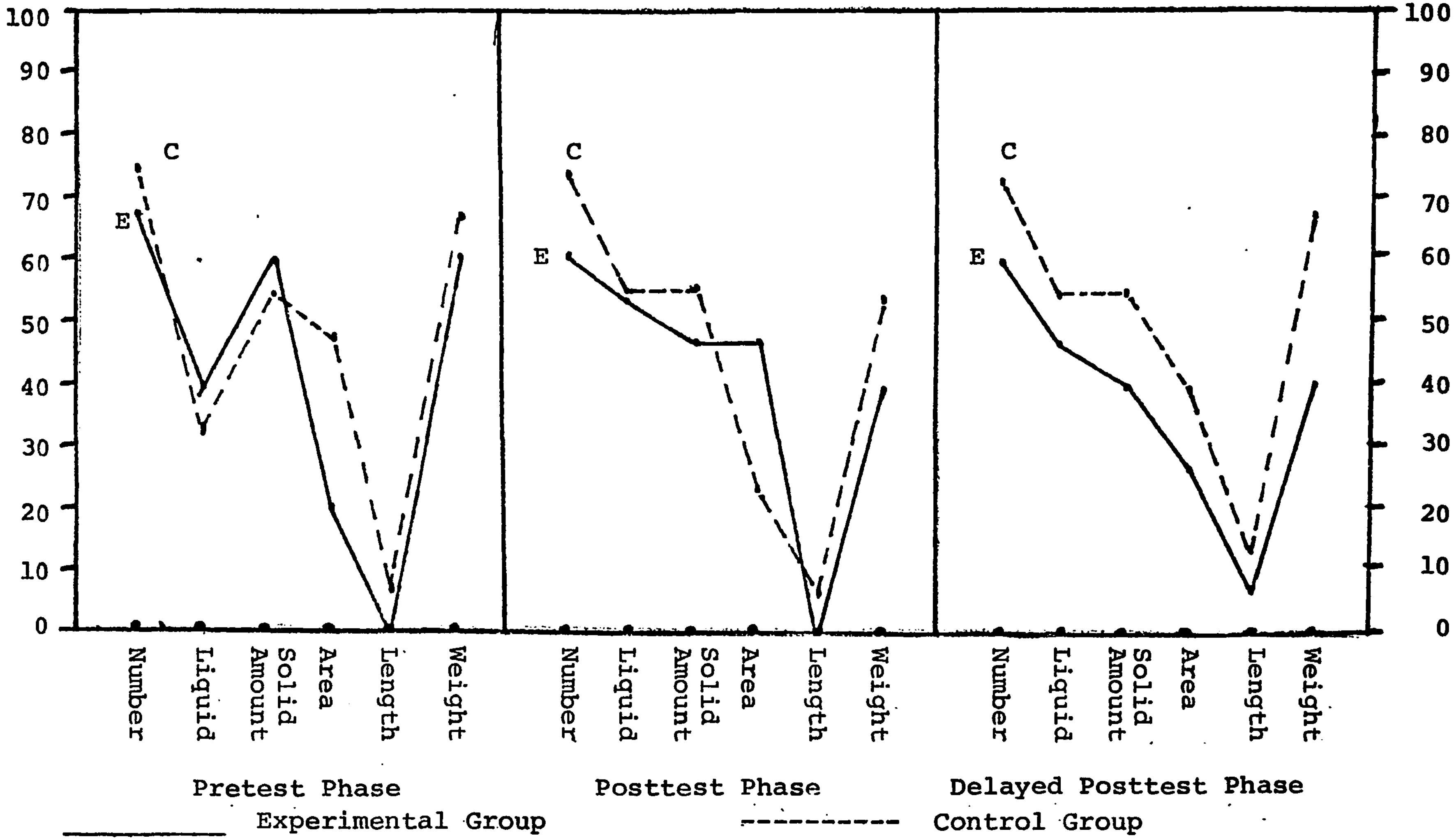

Figure 8. Pretest, Posttest, and Delayed Posttest Percentages for Experimental and Control Groups on The Six Piagetian Conservation Tasks - Age Six.

that the theoretical assumption must at least be qualified and that the clinical-pedagogical practices based on this assumption need to be examined.[9]

For the control group at this age level, results seemed to reinforce Piaget's viewpoint:

> . . . that perception, like intelligence, is not performed or learned; rather, it is constructed with the aid of semi-logical regulations. It is important, to emphasize, however, that the development of regulations and the resulting figure-ground reversal schematization, and so on are constructed by most children on their own and without specific tutelage. This happens because such constructions are necessary to survival; the child is forced to construct them as he interacts with the physical world. The same is true for the many "conservation" concepts that, as Piaget (1950) has demonstrated develop during the elementary school years.[10]

Initially, in the area of visual perceptual learning, the control group maintained a neutral position and was the unfavored group; then eventually, out-scored the experimental group. The experimental group was the more favored initially then displayed a loss of visual perceptual scores which was not regained. In the area of conservation, the control group, initially, was unfavored in all areas except liquid amount, and finally became favored in all areas except one area of conservation. The experimental group, initially was the favored group except in one area liquid and eventually became unfavored in all areas except number.

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[9]Ibid., p. 22.

[10]Elkind, "Perceptual Development in Children," p. 539.

At age level seven for the experimental group, results indicated that the provided visual perceptual experiences did not develop cognitive structures in positive ways, nor did the stage of intellectual development effect visual perceptual learning in positive ways. These results again reinforced Piaget's viewpoint just stated for the control group at age level, eight. Initially, in the area of visual perceptual learning, the control group was the unfavored group, then, constantly showed a gain in visual perceptual scores. Had the learning curve been extended, it would seem logical that one might predict that the control group would eventually out-gain the experimental group. The experimental group was the more favored and remained in that position. This group, however, displayed a loss of visual perceptual scores at the posttest phase; then, after treatment was withdrawn, continued to gain in visual perceptual scores. In the area of conservation, the control group was unfavored in all areas of conservation except liquid, which was equal to the experimental group and remained in that unfavored position throughout the study. It should be noted that the control group displayed more conservation losses than gains at later testing phases. These results possibly indicated some negative effect within the environment which could not be explained by the researcher. This aspect of the results for this age level was perplexing!

At age level six for the experimental group, results indicated that visual perceptual experiences did not develop cognitive structures in positive ways, nor did the stage of intellectual development effect visual perceptual learning in positive ways. These results again reinforced Piaget's view for the control group at age level eight and the experimental group age level seven. Initially, in the area of visual perceptual learning, the experimental group was favored, then, displayed a loss which resulted in an equal degree of visual perceptual skills at the posttesting phase as the control group. After treatment was removed, the experimental group displayed a gain in visual perceptual scores. Initially, the control group was unfavored and maintained this position throughout all phases. Also displayed was a constant loss of visual perceptual scores at all phases. These results seem to reinforce Piaget's viewpoint that, "figure-ground reversal is mediated by logic-like processes that do not emerge until about the age six or seven."

In the area of conservation, the experimental group, initially was the unfavored group, displaying a higher percentage of conservation in two areas; while the control group was favored, displaying a higher percentage of conservation in four areas. The experimental group remained unfavored at the posttesting phase, displaying a higher percentage of conservation in one area and, eventually, becoming unfavored in all areas at the delayed posttesting phase. The control group, at each phase of testing, displayed a constant gain in conservation. This state of affair within the control group, higher cognitive stage of development, lower degree of visual perceptual skills, seemed to reinforce the research of Bibace previously stated for the eight-year-old experimental group.

In view of the above discussion, the statistical results of Table I (page 95), Table 2 (page 98), Table 3 (page 100), Figure 5 (page 103), Table 4 (page 111), Figure 6 (page 120), Figure 7 (page 121), and Figure 8 (page 122), it became evident, upon close inspection, that there existed differences between Piaget's stages of intellectual development and visual perceptual learning. Perhaps an extension of this study, using a larger sample size, might be in order so that a statistical testing of these differences might be precisely obtained.

The above topics and sub-topics conclude Chapter III--Treatment, Analysis of Raw Data and Findings. Following is Chapter IV which includes The Summary, Discussion, and Recommendations.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The problem of this study was: What effects do visual perceptual experiences, chronological age level, and Piaget's stages of intellectual development have upon visual perceptual learning? Specifically, the following questions were investigated.

1. What was the effect of visual perceptual experiences upon visual perceptual learning?

2. What was the effect of chronological age level upon visual perceptual learning?

3. What was the effect of Piaget's stages of intellectual development upon visual perceptual learning?

Ninety (n = 90) kindergarten, first, second, and third grade pupils; at age levels six, seven, and eight were randomly selected to participate in the study. These pupils were enrolled in the Oklahoma City, Oklahoma Public School System. The building site selected was Southern Hills Elementary School.

During the second semester of the academic school year 1976-77, the researcher administered <u>The Six Piagetian Conservation Tasks</u> and <u>Marianne Frostig Developmental Test</u>

<u>of Visual Perception, Test II, Figure-Ground</u> and executed an experimental treatment (see page 27) as described in Strategy for Data Collection (see page 42).

Analysis of raw data followed. The analysis procedures were divided into two phases. (1) Preliminary procedures dealt with the organization of raw data into manageable forms and (2) Methods of Statistical Analysis Procedures dealt with the testing for significant differences of seven null-hypotheses (stated in Chapter I) by computing for each group in the experimental design (see page 40) gain scores and computing a t between the experimental and control groups on their gain scores. A discussion of these findings is located in Chapter III (see page 94).

Conclusions

The approach consisted of: (1) A referral to Piagetian theory relevant to this study; and (2) statements of possible corroboration or possible rejection of Piagetian theory based upon findings and discussions in reference to the three questions investigated .

> In general learning is provoked by a psychological experimenter, or by a teacher, with respect to some didactic point, or by an external situation. It is provoked, in general, as opposed to spontaneous. In addition it is a limited process limited to a single problem, or to a single structure.
>
> So I think that development explains learning, and this opinion is contrary to widely held opinion that development is a sum of discrete learning experience . . . . In reality, development is the essential process and each element of learning occurs as a function of total,

> rather than being an element which explains development.[1]
>
> . . . it might be helpful to briefly introduce and describe three ideas which are central to the Piagetian approach to learning. These ideas are that (a) learning is creating, (b) learning is developmental, and (c) learning is living and growing.[2]

The effect of visual perceptual experiences upon visual perceptual learning as designed by Frostig, interpreted and implemented by the researcher did not seem to represent learning as defined by Piagetian theory, nor did the effect appear to justify the expense of time, money and effort. The effect of these visual perceptual experiences upon visual perceptual learning, as designed by Frostig, interpreted and implemented by the researcher, ranged from a temporary non-significant gain of figure-ground scores, accompanied by a lack of retention of that non-significant gain, to a non-significant loss of figure-ground scores. In this study, perhaps a lack of quality in the visual perceptual experiences may have overpowered any positive effect that the variables of age level and the stage of intellectual development might have upon visual perceptual learning.

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[1] Jean Piaget, "Development and Learning," Journal of Research in Science Teaching, 2 (Issue 3, 1964), pp. 176-86.

[2] David Elkind, "Learning--The Continuing Influence of Jean Piaget." Grade Teacher, vol. 63, No. 9 (May/June, 1971) p. 7.

The Quality of the Visual Perceptual Experience

The researcher is convinced that although Frostig endorsed an integrated approach to academic learning,[3] the visual perceptual experiences incorporated within the Frostig program focused upon paper and pencil exercises. Those experiences, strategies, or stages that characterize the development of any discipline were minimized. The researcher supported the viewpoint of Elkind in that the intellectual stages of development parallel nicely the stages that characterize the development of any discipline and that this parallel condition is namely: observation (sensory-motor period or the search for conservation); naming and labeling (pre-operational or the search for representation); formal classification and quantification (concrete operational period or the search for relations) and controlled experimentation and theory building (formal operational period or the search for comprehension).[4] According to Piaget, Elkind, Renner, Taba, Spodek, Hirsch, McGill, Rogers, Gibson, just to mention a few, such experiences strategies, or stages, assist the child in the development of his cognitive structures, which effect learning in significantly positive ways.

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[3] Frostig, "Visual Perception," 5, Journal of Learning Disabilities, p. 1.

[4] Elkind, "Piaget and Science," 10, Science and Children, p. 10.

This limitation, as observed by the researcher, of the Frostig visual perceptual experiences, supported the findings of Evans. She reported after her recent study, which assessed the patterns of school programs in traditional American and British American open classrooms, that in these traditional classrooms, students were observed engaging in reading activities 65.9% of the time, in mathematics activities 12.6% of the time and in unspecified books and worksheets 14.5% of the time. Science activities were engaged in 0.4% of the time. While there was no social studies categorized by the observers, the other category (which might include social studies) included only 4.1% of the student's time. Patterns in the open classrooms observed in England and the United States were significantly different. Evans also reported that the traditional American classrooms were identified as exemplary ones.[5]

Since research has proven that there existed a relationship between chronological age levels and Piaget's stages of intellectual development, questions two and three were combined as conclusions were drawn. Within Piaget's theory of intelligence and perception Piaget assumes that,

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[5]Bernard Spodek, "Social Studies for Young Children: Identifying Intellectual Goals," Social Education, 38 (January, 1974), p. 42 [citing] Judith E. Evans, "An Activity Analysis of U.S. Traditional, U.S. Open, and British Open Classrooms." Paper presented at AETA Meeting, Chicago, April, 1972.

(1) . . . intelligence is an extension of biological adaptation and that it results in the formation of new mental structures. These mental structures, however, are not performed, or acquired; rather they are constructed in the course of development. Piaget's interest in perception thus grew out of his desire to demonstrate that perception, no less than intelligence, is neither entirely performed (as Gestalt psychology claimed) or simply acquired (as some contemporary theorists, such as Gibson (1969) contend).[6]

(2) . . . the perception of the young child is centered in the sense that it is caught and held by one or another dominant aspect of the perceptual field. In each case the dominant feature of the perceptual field is determined by organizational characteristics that the Gestalt psychologists describe as continuity, closure, good form, and so on. A closed line drawing shows both continuity of line and closure of form and hence is a more dominant figure than an unclosed or incomplete line drawing. These organizational characteristics of the stimulus are what Piaget calls field effects. This liberation comes about because of the development of new perceptual abilities that Piaget speaks of as perceptual regulations; semi-logical processes that enable the child to act mentally on the visual material. They enable the child to reverse figure and ground, to coordinate parts and wholes, to explore systematically, to make comparisons at a distance, and to integrate the spatial and temporal features of a visual presentation.[7]

(3) . . . figure-ground reversal is mediated by logic-like processes that do not emerge until about the age of six or seven.[8]

(4) . . . perceptual activities involved in perceptual learning are not themselves autonomous, but are increasingly directed by the active operation of intelligence.[9]

(5) . . . development of regulations and the resulting figure-ground reversal, schematization and so on are

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[6]David Elkind, "Perceptual Development in Children," American Scientific, 63 (September-October, 1975) p. 533.

[7]Ibid.

[8]Elkind, "Perceptual Development," p. 533.

[9]Gibson, Perceptual Learning and Development, p. 51.

constructed by most children on their own and without specific tutelage.[10]

(7) As structure modification proceeds along an age continuum, new types of cognitive-structure modifications become possible which greatly enhance the learner's ability to process information. Even though development itself is a continuum, the emergence of these new structures at certain age levels is the basis for Piaget's stages of intellectual development model. One must keep in mind, however, that the model is superimposed on the continuous spectrum of age and that transition from one state to another is gradual rather than abrupt--new structures do not come into existence spontaneously at a particular age. Even though physiological maturation--increased differentiation and complexity of the nervous system--has opened the possibility for development of new, more powerful structures, the actuation of the new structures by experience through the existing structure is essential. Each new "stage" must be built on fully developed existing structures. Children of the same age and in the same class in school, therefore, could be functioning intellectually at completely different stages of development.

The stages-of-development model is most frequently associated with Piaget, but the notion of stages of development is not unique to him. He has, no doubt, been most responsible for popularizing the idea.[11]

In light of the above conclusions, the effect of visual perceptual experiences upon visual perceptual learning and the results of findings and discussions focusing upon the effect of chronological age level and Piaget's stages of intellectual development, it was strongly suspected that there might exist possible interaction between the three variables--visual perceptual experiences, chronological age level and Piaget's stages of intellectual

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[10]Elkind, "Perceptual Development," p. 539.

[11]Renner, et al., <u>Teaching Science</u>, p. 67.

development. Specifically, the suspected lack of quality of the visual perceptual experiences may have over-powered any positive effect that the variables chronological age level and the stages of intellectual development might have had upon visual perceptual learning.

In this study the effect of chronological age level and Piaget's stage of intellectual development indicated that the chronologically older subjects (age eight) in both the experimental and control groups possessed fewer figure-ground scores than did the chronologically younger subjects (ages seven and six). At a glance, this observation seemed to support the Gestalt psychologists Köhler and Wallach, figure-ground reversal should be more prominent in younger than older children.[12] However, this assumption became questionable since the chronologically youngest of the three age levels (age 6) displayed evidences of possessing fewer figure-ground scores than did the age seven level.

Since the chronologically older subjects (age eight) displayed evidences of a higher percentage of conservation than the chronologically younger subjects (age seven and six), this observation seemed to support the assumption of Bibace--mastery of lower (perceptual-motor) processes are not of necessity prior to higher cognitive processes[13] and that

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[12] Elkind, "Perceptual Development," p. 533.

[13] Bibace, "Perceptual and Conceptual Cognitive Processes," p. 17.

younger and older children can be found who show gross deficits in perceptual-motor abilities who, despite their deficits, were able to function very well in school.[14]

Another important observation noted was the increase of visual perceptual scores within the control groups of the older subjects (ages eight and seven) and the increase of visual perceptual scores within the experimental groups of the younger subjects (ages seven and six) after experimental treatment was discontinued. These observations seemed to support the assumption of Piaget, that the development of regulations and the resulting figure-ground reversal, schematization and so on are constructed by most children on their own and without specific tutelage.[15]

It appeared clear that the stages of development model be corroborated. All observations led to that conclusion. These observations were quite extensive and were recorded and discussed in Chapter III, <u>General Information Showing the Relationship Between Approximate Age Levels and Stages of Intellectual Development</u> (page 108) and <u>More Specific Information Showing the Relationship That Existed Between Approximate Age Levels and Stages of Intellectual Development</u> (page 110).

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[14]Ibid., p. 22.

[15]Elkind, "Perceptual Development," p. 539.

Recommendations

Based upon the findings, discussions, and conclusions of this study, the following specific and general recommendations are offered:

Specific Recommendations

Further study under the following conditions:

1. Use the entire Marianne Frostig Developmental Test of Visual Perception. Test-fragmentation--the use of only one sub-test instead of all five tests--could influence the effect of this variable.

2. Incorporate within the experimental treatment experiences, strategies, or stages that (a) characterize the development of any discipline and that (b) are appropriate to the developmental stage of the subjects.

3. Use more precise tests of significance with research design. Campbell and Stanley suggested that, randomized "blocking" or "leveling" on pretest scores and the analysis of covariance are usually preferable to single gain-score comparison.[16]

4. Use a more appropriate level of statistical significance in evaluating the data from the research. Before establishing a level of statistical significance, consideration should be given to the two types of statistical error possible; that is, Type I and Type II. A Type I error results when the null-hypothesis/es is/are rejected when it is actually true. A Type II error results when the null-hypothesis/es is/are accepted when it is actually false.[17] The current research was done to test the effect visual perceptual experiences, chronological age level and Piaget's stages of intellectual development have upon visual perceptual learning. In each case the learner was expected to exhibit greater

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[16]Campbell and Stanley, Experimental and Quasi-Experimental Designs in Research, p. 23.

[17]Livingston Schneider, "Relationships Between Concrete and Formal Instructional Procedures and Content-Achievement, Intellectual Development and Learner IQ." Doctoral dissertation, University of Oklahoma, 1977, p. 18.

> score gains from exposure to the visual perceptual experiences than from non-exposure to the visual perceptual experiences at three chronological age levels and Piaget's stage of intellectual development and the null-hypothesis/es should be rejected.

A Type I error means that no significant differences existed, from exposure to the visual perceptual experiences than to non-exposure to the visual perceptual experiences at three chronological age levels and Piaget's stage of intellectual development. Committing Type I error would imply that subjects exposed to the visual perceptual experiences at three chronological age levels and Piaget's stage of intellectual development are able to make significantly greater score gains than those subjects not exposed to the visual perceptual experiences at three chronological age levels and Piaget's stage of intellectual development when this actually is not the case. In terms of educational implementation, committing Type I error would indicate that a change in educational methodology from exposure to the visual perceptual experiences to non-exposure to the visual perceptual experiences should be made. As in reality no significant difference exists between exposure and non-exposure to the visual perceptual experiences, such a change would not effect the quality of education the subjects receive, the only detrimental effect would be financial expenditure necessary to initiate the change in instruction.

A Type II error means that significant differences existed from exposure to the visual perceptual experiences than to non-exposure to the visual perceptual experiences at three chronological age levels and Piaget's stage of intellectual development, yet it was concluded that there is not a significant difference. Committing this type error would be detrimental because it would imply that subjects exposed to the visual perceptual experiences at three age levels and Piaget's stage of intellectual development are able to exhibit score gains. In terms of educational implementation, committing Type II error would indicate that since no significant differences existed between exposure and non-exposure to the visual perceptual experiences, no change need be implemented when in reality a significant difference does exist. The loss to the quality of education is that the less effective visual perceptual experiences would be continued at the expense of the student. Clearly, Type II error was the more serious in this research.

Due to the serious nature of committing Type II error, a reasonably high level of significance should be employed in evaluating the statistical differences between and among tested variables of those subjects exposed to visual perceptual experiences and those subjects not exposed to visual perceptual experiences.[18]

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[18]Ibid., p. 19.

General Recommendations

(1) Since professional opinions continue to differ and research findings appeared to be contradictory relative to visual perceptual experiences and visual perceptual learning, this seemed to demand efficacy studies utilizing respectable research designs.

(2) Theoretical assumptions must at least be qualified and clinical pedagogical practices, based upon assumptions, need to be re-evaluated.

(3) Educators need to annul their relationship with isolated visual perceptual methods and return visual perception to the laboratory of the psycho-physicist, where visual perception can continue to serve as a source of stimulating theory and research.

(4) Educators can continue to employ tradition, educational and learning procedures that are producing positive results and move in the direction of more contemporary strategies as suggested by Renner and Elkind, in the area of science; and Taba and Spodek, in the area of social sciences. Such strategies will assist the child in developing his cognitive powers, which will, in turn, facilitate learning.

(5) Those responsible for the pre-service and in-service education of school personnel, should exert conscious effort in the area of teaching strategies which stimulate the development of cognitive structures.

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APPENDIX A

PIAGET'S STAGES OF INTELLECTUAL DEVELOPMENT

The First Level

> The first stage of intellectual development in Piaget's model begins at birth and continues until the child is approximately two-and-one-half years old; he has called this period the sensory-motor phase. During this phase the child learns that objects are permanent, that just because an object disappears from sight does not mean that it no longer exists. During the sensory-motor period language begins to develop....Basically, however, the child learns to attach sounds to the objects, symbols, and experiences he has had. But this inventing of appropriate sounds for something depends, as does later learning, on the child's having an experience with that something. It is during the sensory-motor period that the first signs begin to emerge that intellect is developed and does not just occur. Now, certainly, the way a sensory-motor child goes about learning is quite different from the way it occurs in an adult, but throughout all the stages of Piaget's model, the fact becomes obvious that later learning cannot occur "unless early learning has been accomplished."[1]

Preceding a description of the second stage of intellectual development in Piaget's model, Renner stressed the need for thoroughly understanding two factors: "the age at which each stage is entered and the passage from stage to stage within the model."[2]

> There is only one stage in Piaget's model whose starting point can be precisely stated--the sensory-motor stage. Piaget has repeatedly pointed out the

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[1] John W. Renner, et al. Research, Teaching, and Learning with the Piaget Model (Norman, Oklahoma: University of Oklahoma Press, 1976), p. 18.

[2] Ibid., p. 21.

inexactness of the various ages at which certain types of intelligence begin to emerge. He has described this inexactness in this way: "To divide developmental continuity into stages recognizable by some set of external criteria is not the most profitable of occupations." A two-and-one-half-year-old child will begin to enter the pre-operational stage, and his exodus from that kind of thinking begins around seven years of age.

In other words, exact, precise ages at which a learner will progress from stage to stage in the model cannot be stated....the child himself determines his progress through the stages. Piaget has described the relationship of the stages within his model and age: "...although the order of succession is constant, the chronological ages of these stages vary a great deal."

...the misconception that a child moves completely from one stage to another can easily be developed. The evidence available suggests that a learner can easily be in the sensory-motor phase on some traits and pre-operational on others. Rather than thinking about a child's moving from one stage to another, consider that he moves into a particular stage on certain traits. As his development progresses, he moves deeper and deeper into a particular stage on some traits. In other words, there is not a chronological line, and as he passes it he has moved from one stage to another, much as he is permitted to vote when he reaches voting age."[3]

The Second Level

"A two-and-one-half-year-old child will begin to enter the pre-operational stage, and his exodus from that kind of thinking begins around seven years of age."[4] Renner reported that for the purposes of using content and instructional methodology, there are five basic characteristics (traits) of the pre-operational child that warrant examination. "Those are (1) egocentrism, (2) irreversibility,

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[3]Ibid., p. 22.

[4]John W. Renner, Don G. Stafford, and William B. Ragan, Teaching Science in the Elementary School (New York: Harper & Row, 1973), p. 70.

(3) centering, (4) stages of transformation, and (5) transductive reasoning."[5] Renner[6] further described these basic characteristics (traits).

> Egocentrism in the young child is one of his most prominent pre-operational traits; the child sees the world from only one point of view--his own. The world as far as he is concerned revolves around him, and he is unaware that he is a prisoner of a single frame of reference for viewing the world. In other words, the child cannot see another's point of view or take that point of view and coordinate it with his own and those of others. He has his own opinion, which his perception has given him, and he feels no responsibility to justify his reasoning nor look for contradictions in it. A pre-operational learner has developed a certain language pattern with which he communicates, and he does not have the ability to adapt his language to the needs of his listeners. Considering his single frame of reference for viewing the world, the language patterns of a pre-operational learner are entirely predictable. The learner in this stage of development loses his perception-bound view of the world and his environment by interacting with it, and that kind of experience must always be provided. He cannot gain any understanding of anything by being told about it or given its abstractions; he thinks only about what he perceives from his observations and interaction with his surroundings. The eogcentric trait of a child continues throughout the pre-operational stage, which ends between six-and-one-half and seven-and-one-half years of age.[7]

The second trait of the preoperational child that has importance from the curriculum-methodology frame of reference is that of irreversibility."[8]

> For a human organism to begin to do intellectual operations, he must be able to reverse his thinking....Reversibility means that a thought is capable of being returned to its starting point. For example: 8 + 6 =

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[5]Renner, et al, Piaget Model, p. 24.

[6]Renner, et al, Teaching Science, p. 70.

[7]Renner, et al, Piaget Model, p. 24.

[8]Ibid., p. 26.

14. and 14 - 6 = 8. The thought started with 8 and returned to 8. Pre-operational children cannot reverse their thinking.[9]

Another trait in the pre-operational model is centering. Renner described this trait as a focus of attention upon one aspect of an object, event, or situation. "The extreme preception-boundness of a pre-operational child is well illustrated by the trait known as states of transformations." Renner[10] described this state with the use of Figure 1 and its accompanying explanation.

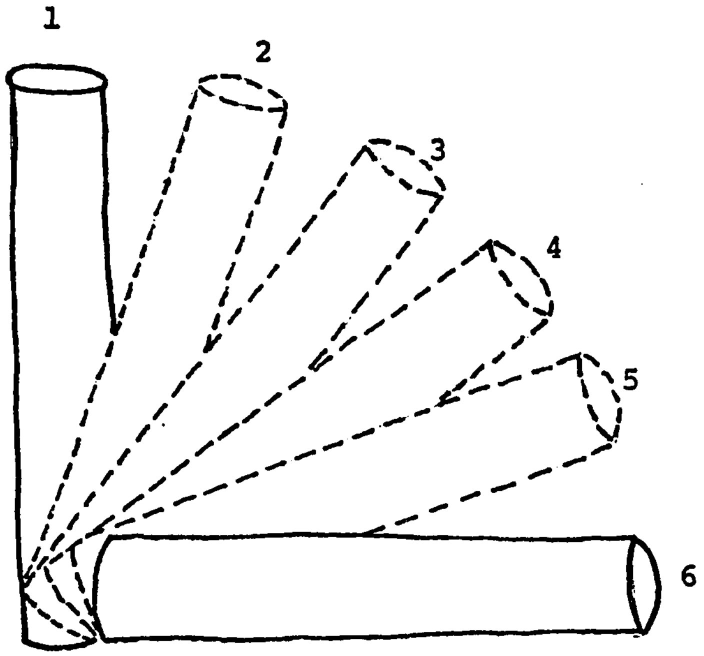

Figure 1.--Transformation.

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[9]Ibid., p. 27.

[10]Ibid., p. 28.

> The figure represents a wooden rod that is standing vertically (position 1) and is then released (positions 2-5). The rod eventually comes to rest as position 6. The rod is in a state of rest when it is held in position 1 and is again in a state of rest in position 6. If a series of pictures were taken of the falling object, it would be seen to pass through many other states, as represented by positions 2-5. In other words, the series of states in the event results in a transformation from the stick standing erect to its horizontal position.[11]

The fifth trait of the pre-operational child is transductive thought. According to Renner, Piaget has called the particular-to-particular reasoning, transduction. Other forms of reasoning are from general to particular (deduction) or particular to general (induction). This kind of reasoning, transduction, begins to appear in the child with the beginning of language and lasts until about four years of age.[12]

The Third Level

Renner further stated that the gross way to think about a concrete operational child is that he is what a pre-operational thinker is not; that is, he can decenter, equilibrate, do mental reversals, begin to reason inductively and deductively and not transductively, see the relationship between states in a transformation, and his egocentric structures begin to thaw out--he can begin to see objects as other people do. "He conserves."[13]

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[11]Ibid., p. 29.

[12]Ibid., p. 31.

[13]Renner, et al, *Teaching Science,* p. 91.

The Fourth Level

Somewhere around eleven years of age, according to Piaget, there begins to emerge from concrete-operational thought minds that can be described as "concerned with reality, but reality is only a subset within a much larger set of possibilities." A person with such thought processes Piaget has called formal operational and has described as "an individual who thinks beyond the present and forms theories about everything, delighting especially in consideration of that which is not." The formal-operational thinker no longer is restricted to thinking only about concrete objects, events, and/or situations. He can now stretch his thinking far beyond reality and into the possible.

Formal-operational thinkers have the ability to take imaginative "trips", but the bases for their trips are firmly rooted in the reality of information they receive from the world around them. Phillips explains the formal operational thinker as being "capable of departures from reality," but adds that "those departures are lawful." A pre-operational thinker cannot think about what it is he thinks. A concrete operational thinker can think about his thinking, as long as objects are present for him to manipulate; and a formal-operational thinker can think about the consequences and/or implications of his thinking. He can think in the abstract and does not need objects to manipulate; he can take data and treat the pattern those data have as only one possible arrangement they might form. As was said earlier, reality is only one possibility as far as the formal, abstract thinker is concerned. The possible is as real to him as the here and now. Another way that may be useful in helping you think about the formal level is to remember that the pre-operational thinker cannot do mental operations while the concrete thinker can perform mental operations with the information he has received from concrete objects. The formal-operational thinker not only performs mental operations with reality but also can perform operations used in mental experimentation.

Formal thinking has two constructs that are useful in its identification. The first of these constructs results from the understanding that a formal thinker has of the importance in his experimentation of keeping all factors constant except one--the one being varied. He has, therefore, a frame of reference, which says that, all other things being equal, such and such a variable has (or does not have) an effect on the outcome of the experiment. The ability of a child to handle the "all-other-things-being-equal" construct can lead you to suspect that you are working with a formal-operational learner. The second construct that is useful in identifying formal thinking and those who use it is that of the proposition. In fact, formal-operational thinking is often called propositional logic. Propositional thinking can be most easily thought of as being of this form: "If (such and such is true), then it follows that (such and such is true), therefore, this (action) is dictated (or suggested)." The "if, then, therefore," construct demands that the person using it depart from reality and push himself into the formation of hypotheses. Such is the ability and prerogative of the formal-operational thinker.[14]

[14]Renner, et al., Piaget Model, p. 66.

APPENDIX B

DEMOGRAPHICS OF TOTAL NUMBER K-4 ELEMENTARY SCHOOLS

OKLAHOMA CITY PUBLIC SCHOOL SYSTEM

Name of School	Percentage Poverty	Total Enrollment
Adams	40.29	541
Arcadia	27.38	63
Arthur	22.43	406
Bodine	17.50	655
Britton	19.46	317
Buchanan	19.39	331
Burbank	10.33	291
Columbus	53.85	331
Coolidge	28.27	513
Davis	48.16	203
Edgemere	48.44	406
Eugene Fields	44.77	381
Fillmore	15.30	446
Gatewood	37.85	231
Harrison	26.14	251
Hawthorne	40.39	288
Hayes	12.05	460
Heronville	40.36	331
Hillcrest	17.10	567
Horace Mann	14.15	278
Johnson	18.37	231
Kaiser	25.01	272
Lafayette	21.58	193
Lee	43.46	292
Linwood	27.91	216
Madison	18.76	276
Mark Twain	64.28	226
Mayfair	21.56	186
Monroe	19.66	149
Nichols Hills	9.33	219
Oakridge	10.19	204
Parmelee	18.81	522
Pierce	35.07	193
Prairie Queen	14.24	503
Putnam Heights	33.94	209
Quail Creek	11.82	336
Rancho	15.31	232
Ridgeview	10.73	484

Name of School	Percentage Poverty	Total Enrollment
Riverside	59.87	122
Rockwood	40.52	387
Ross	32.05	133
Sequoyah	20.06	345
Shidler	65.26	305
Shields Heights	35.54	340
*Southern Hills	15.42	314
Spencer	24.82	348
Stand Watie	42.85	232
Stonegate	7.18	495
Star	29.92	192
Sunset	17.10	191
Telstar	23.87	558
Van Buren	12.14	252
West Nichols Hills	14.07	144
Western Village	10.77	472
Westwood	51.45	309
Willard	72.45	182
Willow Brook	29.20	706
Wilson	49.23	212

District level of poverty using AFDC, U.S. Census, and Free Lunch Program determined statistically a percentage yield of 23.91.

*Totals	Southern Hills	314
	Kindergarten	52
	First Grade	61
	Second Grade	75
	Third Grade	64
	Fourth Grade	62
	Boys	189
	Girls	125
	Black	68
	Other	246

APPENDIX C

LETTER OF PERMISSION

January 20, 1977

Dear Parent,

Children from our school, ages 6, 7, and 8 are being considered as participants in an experimental study to be conducted by a doctoral student at Oklahoma University.

This student is a former curriculum consultant and classroom teacher in the Oklahoma City Public School System, who is now on leave of absence for study.

Your child can benefit from such an experience. The activities within this study will focus on improving perceptual skills which will effect your child's reading abilities in a positive manner.

Two tests will be administered. They are: The Six Piagetian Conservation Tasks and the Marianne Frostig Developmental Test of Visual Perception, Test II, Figure-Ground. The testing will be done in the afternoon here at our school.

If it is permissable that your child participate in this study, please sign below and return to school tomorrow.

Sincerely,

Plex Henry, Principal
Southern Hills School

____
Signature of Parent

____
Child's Name and Age

APPENDIX D

EXERCISES WITH THREE-DIMENSIONAL OBJECTS

Discriminating Objects in a Room: Ask the children to point out various categories of objects, such as round things, red things, wooden things, and so on, in a room or play yard. Then require that they pick out specific objects, such as a particular book, picture, or toy. As the exercise continues, the objects chosen should be less and less conspicuous.

Finding Objects That Are Different: Ask the children to find a square button in a box of round ones, a large block among smaller blocks, a green marble among blue ones, a piece of rough paper among smooth pieces, and so on.

Sorting: Have objects of two or more types together, and require the children to sort them. Provide cubes and spheres, for instance; then provide cubes, spheres, and three- and four-sided pyramids; then all parallelepipeds. Objects can be sorted according to size, color, and texture, as well as shape. The more variables in the group of objects to be sorted, the more difficult the exercise.

Sorting is perhaps the most useful exercise of all. It helps children to concentrate upon particular stimuli and to shift attention when the principle of sorting is changed. And because sorting involves the correct identification of such qualities as size, form, and color, it helps improve constancy, as well as figure-ground perception.

Shifting Attention: Ask the children to pick out particular objects you name from boxes containing many different objects. At first the objects in the boxes should differ greatly from each other, but later the differences should be minimal. When the differences are minimal, ask the children, for instance, to pick out successively from a box of toy houses those with gabled roofs, those with flat roofs, those with three windows, those with green doors, and other variations.[1]

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[1]Marianne Frostig and David Horne, The Frostig Program for the Development of Visual Perception, Teachers' Guide (Chicago: Follett Educational Corporation, 1964), pp. 29-34.

APPENDIX E

INSTRUCTIONS FOR WORK SHEETS--FIGURE-GROUND PERCEPTION

Exercises 1-15:	Intersection Lines
16-20:	Intersecting Figures
21-31:	Hidden Figures
32-44:	Overlapping Figures
45-57:	Figure Completion
58-59:	Figure Assembly
60-64:	Similarities and Differences of Details
65-69:	Reversal of Figure-Ground

Directions for exercises in the above skills areas are similar. Following is an example of such directions.

Figure-Ground Perception

Exercises 1-15: Intersecting Lines

Exercise 1: "Here is a picture of two roads that cross each other. Do you see the car at the top of one road? (Indicate.) Put your finger on it. Good. That car is going to drive down the road to the other car. (Indicate.) Can you follow the road with your finger? (Demonstrate.) Now take a red crayon and draw along the road from the top car to the bottom car. Try to do it without taking your crayon off the page. Keep it right on the line. Now put your finger on the boy at the top of the other road. He wants to play with the boy at the bottom of the road. Can you show with your finger how he runs down the road to get to the boy at the bottom? Fine. Now take a green crayon and draw along the road from the boy at the top to the boy at the bottom. Try to do it without taking your crayon off the page. Keep your crayon right on the line.[1]

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[1]Frostig, Visual Perception, pp. 113-131.

APPENDIX F

SAMPLE LESSON PLAN

Visual Perceptual Experiences

Part I. Exercises with Three-Dimensional Objects

General Objects:

To concentrate upon relevant stimuli and ignore irrelevant stimuli;

To shift attention appropriately;

To scan adequately;

To exhibit more organized behavior.

Specific Objectives:

To sort buttons according to size, color, and texture.

Preparation:

On each child's desk was placed a bag of assorted buttons which varied in size, shape, color, and texture, and the Figure-Ground Paper and Pencil Exercises for the day (turned face down to avoid distraction from the first exercise).

Activity and Evaluation:

The children are asked to empty all buttons out of the plastic bag and spread out all buttons on the exercise sheet in order that each button might be seen. Pupils are asked to find:

1. The largest white buttons; place these on the desk; return these buttons to the other buttons only after the researcher has seen them.

2. The smallest orange buttons; place these on the desk; return these buttons to the other buttons only after the researcher has seen them.

3. All metal buttons; place these on the desk; return these buttons to the other buttons

only after the researcher has seen them.

4. All buttons having any two colors on one button; place these on the desk; return these buttons to the other buttons only after the researcher has seen them.

Follow-Up:

Figure-Ground Paper and Pencil Exercises.

Part II. Figure-Ground Paper and Pencil Exercises.

Exercises 60-64: Similarities and Differences of Details

Exercise 60: "Look very carefully at the top row of figures. Do you see the line of girls holding jump ropes? One of the pictures is a little bit different from the others. Can you find it and put a mark on it with your crayon? Why is it different? Now look at the next row of girls. One of those is different from the others, too. Can you find it and put a mark on it? In what way is it different?"

Give similar instructions for the next two rows. One of the cats has three pairs of stripes instead of two, and one of the peanuts is single instead of double.

Exercise 61: "Here are a lot of lollipops with different patterns on them. Can you find the one that has the same pattern as the one in the box and put a red mark on it? Good. Look at the lollipops again. Can you find two others that are exactly alike? Mark them with your blue crayon."

Exercise 62: "In the box is a picture of a lady's head. There are pictures of more shapes on the rest of the page. Two of them are exactly like the lady's head in the box. Can you find them and mark them with a crayon?"

Exercise 63: "At the top of the page are six circles, each with a pattern inside. One of the patterns is different from the others. Can you mark the one that is different? Now look at the brooms below the lines. Can you mark the one that is different there, too? In what way it is different?"

Exercise 64: "Here is a picture of cows in a field. All of the cows except two have different patterns on them. Two of the cows look exactly alike. Can you find the two cows that look exactly the same and put a mark on each of them?"[1]

[1]Frostig, Visual Perception, pp. 113-131.

APPENDIX G

TIME SCHEDULE

I. Random Selection of Subjects

A. All 90 pupils--30 six-year-olds; 30 seven-year-olds; 30 eight-year-olds.

B. Forty-five in each group--15 six-year-olds; 15 seven-year-olds; 15 eight-year-olds.

Experimental Groups--45 total.
Control Group--45 total.

II. Gather Statistics on the Above Sampling and Population

(Obtain demographics from research department).

III. Pretesting

A. Frostig Test, Figure-Ground Section (Group) =

6-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

7-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

8-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

Total 180 minutes = 3 hours

B. Piagetian Tasks (Six) (All 90)

Individual--10 minutes per pupil x 90 pupils = 900 minutes

Total 900 minutes = 15 hours

IV. Treatment

One month in duration; two 30-minute sessions each week for four weeks

Total 240 minutes = 4 hours

Figure-ground paper and pencil experiences (Three-dimensional exercises)

23 Group I--30 minutes twice a week for four weeks = 240 minutes

25 Group II-- 30 minutes twice a week for four weeks = 240 minutes

Total 45 in two groups at 240 minutes each = 8 hours total

V. Immediate Posttesting

Frostig, Figure-Ground Test =

6-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

7-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

8-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

Total 180 minutes = 3 hours

Piagetian Tasks

Individual--10 minutes per pupil x 90 pupils = 900 minutes

Total 900 minutes = 15 hours

VI. Delayed Posttesting (One month following end of treatment, IV)

Frostig, Figure-Ground Test =

6-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

7-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

8-year-olds--15 per group x 2 groups x 30 minutes each = 60 minutes

Total 180 minutes = 3 hours

Piagetian Tasks

Individual--10 minutes per pupil x 90 pupils = 900 minutes

Total 900 minutes = 15 hours

Total Time = 66 hours

APPENDIX H

TABLE 5

PRETEST, POSTTEST, DELAYED POSTTEST VARIABLES FOR CHRONOLOGICAL AGE LEVELS EIGHT, SEVEN, AND SIX

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	20	9- 0- 3	10
21	107	1	1	1	1	1	1	20	9- 0-21	10
13	106	1	1	1	1	1	1	18	8-11- 6	8
20	106	1	1	1	0	1	1	18	8-11- 3	8
30	106	1	1	1	1	0	1	15	8-10-21	7
27	106	1	1	1	1	1	1	20	8-11-10	10
25	106	1	1	1	1	0	1	13	8-11-10	6
2	105	1	1	1	0	0	1	18	8-10-16	9
9	105	1	1	1	0	0	1	18	8-10- 6	9
26	104	1	1	1	1	0	1	14	8- 8-25	7
10	104	1	1	1	0	1	1	17	8- 8-23	8
4	103	1	1	0	1	0	1	16	8- 8- 6	7
12	103	1	1	1	0	0	1	20	8- 7-25	10
18	103	1	1	1	1	0	1	20	8- 8- 8	10
5	102	1	1	1	1	1	1	20	8- 6-27	10
6	101	1	1	1	1	0	1	15	8- 5-24	8
11	100	1	1	1	1	1	1	20	8- 4-13	10
14	100	1	1	1	1	0	1	15	8- 5-10	8
29	100	1	1	1	1	0	1	17	8- 4-23	9
7	99	1	1	1	1	1	1	19	8- 4-21	10
31	99	1	1	1	1	1	1	16	8- 4-19	8
15	98	1	1	1	0	0	1	20	8- 3-14	10
32	98	1	1	1	1	0	1	18	8- 3-15	9
16	97	1	1	1	1	1	1	18	8- 2-15	9
19	97	1	1	1	1	1	1	16	8- 2-16	8
28	97	1	1	1	0	0	1	20	8- 1-24	10
22	97	1	1	1	1	0	1	19	8- 2- 0	10
23	97	0	1	0	0	0	0	20	8- 2-19	10
24	97	1	1	1	1	1	1	19	8- 2-17	10
17	96	1	0	1	0	0	1	13	8- 1- 6	7

1 means conserved and 0 did not conserve.

TABLE 6

POSTTEST VARIABLES FOR ALL EIGHT-YEAR-OLDS (107-96 MOS.)

		Conservation of:							Figure-Ground Scores:	
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	17	9- 2-16	7
21	107	1	1	1	1	1	1	19	9- 2-28	10
13	106	1	1	1	1	1	1	18	9- 1-13	8
20	106	1	1	1	1	0	1	19	9- 1-10	10
30	106	1	1	1	1	1	1	19	9- 1- 4	10
27	106	1	1	1	1	1	1	18	9- 1-23	8
25	106	1	1	1	1	1	1	17	9- 1-25	7
2	105	1	1	1	0	0	1	17	9- 0-29	8
9	105	1	1	1	1	0	1	17	9- 0-13	8
26	104	1	1	1	1	1	1	18	8-11- 8	8
10	104	1	1	1	1	1	1	15	8-11- 0	8
4	103	1	1	1	0	0	1	18	8-10-13	8
12	103	1	1	1	1	0	1	19	8-10- 2	10
18	103	1	1	1	1	0	1	17	8-10-21	7
5	102	1	1	1	1	1	1	19	8- 9-10	10
6	101	1	1	1	1	0	1	17	8- 8- 7	7
11	100	1	1	1	1	1	1	19	8- 6-26	10
14	100	1	1	1	1	0	1	20	8- 7-23	9
29	100	1	1	1	1	0	1	17	8- 7- 6	8
7	99	1	1	1	1	1	1	19	8- 6-28	10
31	99	1	1	1	1	1	1	19	8- 6-29	10
15	98	1	0	0	0	0	0	20	8- 5-10	10
32	98	1	1	1	1	0	1	20	8- 5-28	10
16	97	1	1	1	1	1	1	19	8- 4-22	10
19	97	1	1	1	1	1	1	19	8- 4-23	10
28	97	1	1	1	0	0	1	19	8- 4- 7	10
22	97	1	1	1	1	1	1	20	8- 4- 7	10
23	97	0	1	0	0	0	0	19	8- 4- 2	10
24	97	1	1	1	1	1	1	20	8- 4-24	10
17	96	1	0	1	1	0	1	13	8- 3-13	5

TABLE 7

DELAYED POSTTEST VARIABLES FOR ALL EIGHT-YEAR-OLDS (107-96 MOS.)

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	19	9- 3- 0	10
21	107	1	1	1	1	1	1	20	9- 2-12	10
13	106	1	1	1	1	1	1	19	9- 1-27	10
20	106	1	1	1	1	0	1	19	9- 1-24	10
30	106	1	1	1	1	1	1	18	9- 1-18	8
27	106	1	1	1	1	1	1	18	9- 2- 7	8
25	106	1	1	1	1	0	1	16	9- 2- 7	7
2	105	1	1	1	1	0	1	19	9- 1-13	10
9	105	1	1	1	1	0	1	17	9- 0-27	8
26	104	1	1	1	1	1	1	19	8-11-22	10
10	104	1	1	1	1	1	0	19	8-11-14	10
4	103	1	1	1	0	0	1	18	8-10-27	9
12	103	1	1	1	1	0	1	18	8-10-16	9
18	103	1	1	1	1	1	1	19	8-11- 5	10
5	102	1	1	1	1	1	1	18	8- 9-24	8
6	101	1	1	1	1	0	1	19	8- 9-21	10
11	100	1	1	1	1	1	1	19	8- 7-10	10
14	100	1	1	1	1	0	1	20	8- 8- 7	10
29	100	1	1	1	1	0	0	15	8- 7-20	7
7	99	1	1	1	1	1	1	19	8- 7-12	10
31	99	1	1	1	1	1	1	19	8- 7-10	10
15	98	1	0	0	0	0	0	18	8- 6- 5	8
32	98	1	1	1	0	0	1	19	8- 6- 4	10
16	97	1	1	1	1	1	1	19	8- 5- 6	10
19	97	1	1	1	1	1	1	18	8- 5- 7	8
28	97	1	1	1	1	0	1	18	8- 4-21	8
22	97	1	1	1	1	1	1	18	8- 4-21	8
23	97	0	0	0	1	0	0	20	8- 4-16	10
24	97	1	1	1	1	1	1	17	8- 5- 8	8
17	96	1	1	1	0	0	1	19	8- 3-27	10

TABLE 8

PRETEST VARIABLES FOR ALL SEVEN-YEAR-OLDS (95-84 MOS.)

Sample Number	Age-Months	Conservation of: Number	Liquid Amount	Solid Amount	Area	Length	Weight	Figure-Ground Scores: Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	0	0	0	0	19	7-11-26	11
27	93	1	1	1	0	0	1	19	7-10-15	11
32	93	1	1	1	1	1	1	15	7-10-20	7
2	92	1	0	0	1	0	1	10	7- 8-21	6
3	92	1	1	1	1	0	1	18	7- 9- 7	9
12	92	1	0	1	1	0	1	19	7- 8-22	11
24	92	1	1	1	1	1	1	18	7- 9-10	9
29	92	1	1	1	1	1	1	19	7- 9- 5	11
5	91	1	0	0	0	0	0	16	7- 8- 4	8
13	90	1	1	1	1	0	1	18	7- 7- 2	9
11	89	1	1	1	1	1	1	19	7- 6-13	11
30	89	1	0	1	0	1	1	20	7- 5-24	11
28	89	1	1	1	1	0	1	20	7- 6- 9	11
31	88	1	1	1	1	0	1	18	7- 4-23	10
33	88	1	1	1	1	1	1	15	7- 5- 8	8
9	87	1	1	1	0	0	1	13	7- 3-22	8
17	86	0	0	0	0	0	0	17	7- 3-19	9
19	86	1	1	1	1	0	1	16	7- 3-23	8
21	86	1	0	1	1	0	1	19	7- 4- 2	11
1	85	1	0	1	0	0	1	18	7- 2-14	10
16	85	1	1	1	1	0	1	18	7- 2-29	10
20	85	1	1	1	0	0	1	17	7- 2-20	9
23	85	1	1	1	1	0	1	12	7- 3- 0	7
14	84	1	0	0	0	0	0	19	7- 1-12	12
15	84	1	1	1	1	0	1	8	7- 1-20	6
18	84	1	1	1	0	0	1	19	7- 1-12	12
22	84	1	1	1	0	1	1	19	7- 2- 5	12
34	84	0	0	0	0	0	0	10	7- 1- 7	7
35	84	1	1	1	0	1	0	20	7- 1-20	12
36	84	1	0	0	0	1	0	10	7- 1-26	7

TABLE 9

POSTTEST VARIABLES FOR ALL SEVEN-YEAR-OLDS (95-84 MOS.)

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	0	0	0	0	19	8- 2- 6	10
27	93	0	1	1	1	1	1	18	8- 0-25	9
32	93	1	1	1	1	0	1	19	8- 1- 0	10
2	92	1	1	1	1	1	1	14	7-11- 1	7
3	92	1	0	0	0	0	0	18	7-11-17	9
12	92	1	1	1	1	0	1	10	7-11- 2	6
24	92	1	1	1	1	1	1	18	7-11-20	9
29	92	1	1	1	1	1	1	18	7-11-15	9
5	91	0	0	0	0	0	0	16	7-10-14	8
13	90	1	1	0	0	0	1	19	7- 9-12	11
11	89	1	1	1	1	1	1	16	7- 8-23	8
30	89	1	0	0	1	1	1	19	7- 8- 4	11
28	89	1	1	1	1	1	1	19	7- 8-19	11
31	88	Moved	-	-	-	-	-	--	-------	--
33	88	1	1	1	1	1	1	18	7- 7- 2	9
9	87	1	1	1	0	0	1	13	7- 6- 2	7
17	86	1	1	0	0	0	0	17	7- 5-13	9
19	86	1	1	1	0	0	1	16	7- 5-17	8
21	86	1	1	1	1	0	1	17	7- 5-26	9
1	85	1	1	0	0	0	0	17	7- 4- 5	9
16	85	1	1	0	1	0	1	18	7- 4-23	10
20	85	1	1	1	1	0	1	20	7- 4-18	11
23	85	1	1	0	1	0	0	11	7- 4-24	7
14	84	1	0	0	0	0	0	18	7- 3-16	10
15	84	1	1	1	1	0	1	18	7- 3-14	10
18	84	1	1	1	0	0	1	18	7- 3- 6	10
22	84	1	1	1	1	1	1	18	7- 4-19	10
34	84	1	0	0	0	0	0	17	7- 3- 1	9
35	84	1	1	1	1	0	1	19	7- 3-14	11
36	84	1	1	1	0	0	1	17	7- 3-20	9

TABLE 10

DELAYED POSTTEST VARIABLES FOR ALL SEVEN-YEAR-OLDS (95-84 MOS.)

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	1	0	0	1	18	8- 2-25	9
27	93	0	0	1	1	0	0	20	8- 1-14	10
32	93	1	1	1	1	1	1	20	8- 1-19	10
2	92	1	1	1	1	1	1	18	7-11-20	11
3	92	1	0	0	0	0	0	18	8- 0- 6	9
12	92	1	1	1	0	1	1	18	7-11-21	11
24	92	1	1	1	1	1	1	19	8- 0- 9	10
29	92	1	1	1	1	1	1	20	8- 0- 4	10
5	91	0	0	0	0	0	0	19	7-11- 4	11
13	90	1	1	1	0	0	0	20	7-10- 1	11
11	89	1	1	1	1	1	1	18	7- 9-12	9
30	89	1	1	1	1	1	1	19	7- 8-24	11
28	89	1	1	0	0	0	0	19	7- 9- 8	11
31	88	Moved	-	-	-	-	-	--	-------	--
33	88	1	1	1	1	1	1	15	7- 7-21	9
9	87	1	1	1	1	0	1	11	7- 6-21	7
17	86	1	1	0	0	0	1	18	7- 6- 2	9
19	86	1	0	0	0	0	1	19	7- 6- 6	11
21	86	1	1	1	1	1	1	18	7- 6-15	9
1	85	1	1	1	0	1	1	19	7- 4-24	11
16	85	1	1	1	1	0	1	19	7- 5-12	11
20	85	1	1	1	1	0	1	20	7- 5- 7	11
23	85	0	0	0	1	0	0	9	7- 5-13	7
14	84	1	0	0	1	0	0	20	7- 4- 5	11
15	84	1	1	0	1	0	0	19	7- 4- 3	11
18	84	1	1	1	0	0	1	18	7- 3-25	10
22	84	1	1	1	1	1	1	19	7- 5-18	11
34	84	1	0	0	0	0	0	18	7- 3-20	10
35	84	1	1	1	0	1	1	20	7- 4- 3	11
36	84	1	1	1	1	0	1	18	7- 4- 9	10

TABLE 11

PRETEST VARIABLES FOR ALL SIX-YEAR-OLDS (83-72 MOS.)

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	1	1	0	0	1	20	7- 0- 4	12
2	83	0	0	0	0	0	0	6	7- 0-14	6
18	83	1	0	1	1	0	1	14	7- 0- 5	8
1	83	1	1	1	0	0	1	20	7- 0-18	12
7	83	0	0	0	0	0	0	11	7- 0- 0	7
20	82	1	1	1	1	0	1	15	6-11- 0	9
14	82	1	0	0	0	0	1	12	6-11-28	8
24	82	1	1	1	1	0	1	14	6-11-17	8
8	82	1	1	1	0	0	1	13	6-11-16	8
11	81	0	0	0	0	0	0	13	6-10-28	8
17	81	0	0	0	0	0	0	17	6-10-22	10
19	81	1	0	0	1	0	1	18	6-10-21	10
12	81	1	0	0	0	0	0	14	6-10- 7	8
13	81	1	1	1	1	0	1	16	6-10- 2	9
5	81	1	0	0	0	0	0	12	6-10-24	8
6	81	1	0	1	0	0	0	14	6-10-18	8
4	79	1	1	1	0	0	1	18	6- 8- 2	11
22	79	1	0	0	0	0	0	17	6- 8- 1	10
16	79	1	0	1	1	1	1	18	6- 9- 0	10
3	77	0	0	0	0	0	0	13	6- 6-15	8
21	77	0	0	0	0	0	0	20	6- 6-20	13
10	77	1	1	1	1	0	1	12	6- 6-19	8
23	75	1	0	0	0	0	1	18	6- 4-20	11
28	74	k	0	1	0	0	1	16	6- 3- 9	10
15	74	1	1	1	1	0	1	15	6- 3-25	9
25	73	0	0	1	0	0	1	8	6- 2-23	8
27	73	0	0	1	1	0	1	16	6- 2- 5	10
29	73	1	1	1	1	0	1	14	6- 2- 5	9
26	72	0	0	0	0	0	0	17	6- 1-20	11
30	72	1	1	1	0	0	1	16	6- 1- 6	10

TABLE 12

POSTTEST VARIABLES FOR ALL SIX-YEAR-OLDS (83-72 MOS.)

Sample Number	Age-Months	Conservation of: Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Figure-Ground Scores: Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	0	0	0	0	0	16	7- 1- 8	9
2	83	0	0	0	0	0	0	7	7- 2-18	6
18	83	1	1	1	0	0	1	17	7- 2- 7	9
1	83	1	1	1	1	0	1	20	7- 2-20	12
7	83	0	0	0	0	0	0	15	7- 2-19	8
20	82	1	1	1	1	0	1	16	7- 1- 4	9
14	82	1	1	1	1	0	1	14	7- 1- 2	8
24	82	1	1	1	1	0	1	17	7- 1-11	9
8	82	1	1	1	0	0	1	18	7- 1-18	10
11	81	0	1	0	0	0	0	11	7- 0- 2	7
17	81	0	0	0	0	0	0	18	7- 0-24	10
19	81	1	1	1	1	0	1	17	7- 0-23	9
12	81	1	1	1	0	0	1	16	7- 0-20	9
13	81	1	0	0	0	0	1	15	7- 0- 4	8
5	81	0	0	0	0	0	0	9	7- 0-26	7
6	81	1	1	1	1	0	1	16	7- 0-20	9
11	79	1	1	1	1	0	1	18	6-10- 6	10
22	79	1	0	0	0	0	0	12	6-10- 5	8
16	79	1	1	1	1	1	1	16	6-11- 2	9
3	77	0	0	0	0	0	0	12	6- 8-19	8
21	77	0	0	0	0	0	0	16	6- 8-22	9
10	77	1	1	1	1	0	0	16	6- 8-21	9
23	75	1	1	1	0	0	0	17	6- 6-22	10
28	74	1	1	1	0	0	1	17	6- 5-11	10
15	74	1	1	1	1	0	1	11	6- 5-20	8
25	73	0	0	0	1	0	0	12	6- 4-20	8
27	73	1	0	0	1	0	0	15	6- 4- 9	9
29	73	1	0	0	0	0	0	15	6- 4- 9	9
26	72	0	0	0	0	0	0	16	6- 3-22	10
30	72	Dropped	-	-	-	-	-	--	-------	--

TABLE 13

DELAYED POSTTEST VARIABLES FOR ALL SIX-YEAR-OLDS (83-72 MOS.)

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	1	0	0	0	0	17	7- 2-29	9
2	83	0	0	0	0	0	0	9	7- 3- 9	7
18	83	1	1	1	0	0	1	17	7- 2-28	9
1	83	1	1	1	0	0	1	20	7- 3-11	11
7	83	0	0	0	0	0	0	13	7- 3-10	8
20	82	1	1	1	1	0	1	17	7- 1-25	9
14	82	1	1	1	1	1	1	17	7- 1-23	9
24	82	1	1	1	1	0	1	16	7- 2- 2	9
8	82	1	1	1	1	0	1	15	7- 2- 9	8
11	81	0	0	0	0	0	0	18	7- 0-23	10
17	81	0	0	0	0	0	0	17	7- 1-15	9
19	81	1	1	1	1	0	1	16	7- 1-14	9
12	81	1	1	1	0	0	1	17	7- 1-11	9
13	81	1	0	0	1	0	1	16	7- 0-25	9
5	81	0	0	0	0	0	0	13	7- 1-17	8
6	81	1	1	1	0	0	0	15	7- 1-11	10
4	79	1	1	1	0	0	1	14	6-10-27	8
22	79	1	0	0	0	0	0	12	6-10-26	8
16	79	1	1	1	1	1	1	18	6-11-23	10
3	77	0	0	0	0	0	0	16	6- 9-10	9
21	77	1	0	0	0	0	1	15	6- 9-13	9
10	77	1	0	0	1	0	0	10	6- 9-12	7
23	75	1	1	1	0	0	0	19	6- 7-13	8
28	74	1	1	1	0	0	1	16	6- 6- 2	9
15	74	1	1	1	0	0	1	18	6- 7-18	11
25	73	1	0	0	1	0	0	10	6- 5-18	8
27	73	0	0	0	1	1	1	15	6- 5- 0	9
29	73	0	0	0	0	0	1	12	6- 5- 0	8
26	72	0	0	0	0	0	0	16	6- 4-13	10
30	72	Dropped	-	-	-	-	-	--	-------	--

APPENDIX I

TABLE 14

PRETEST, POSTTEST, DELAYED POSTTEST VARIABLES FOR CHRONOLOGICAL AGE LEVELS EIGHT, SEVEN, AND SIX-- EXPERIMENTAL AND CONTROL GROUPS

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	105	1	1	1	0	0	1	18	8-10- 6	8
12	103	1	1	1	0	0	1	20	8- 7-25	10
18	103	1	1	1	1	0	1	20	8- 8- 8	10
5	102	1	1	1	1	1	1	20	8- 6-27	10
6	101	1	1	1	1	0	1	15	8- 5-24	7
11	100	1	1	1	1	1	1	20	8- 4-13	10
14	100	1	1	1	1	0	1	15	8- 5-10	7
29	100	1	1	1	1	0	1	17	8- 5-23	8
31	99	1	1	1	1	1	1	16	8- 4-19	7
15	98	1	1	1	0	0	1	20	8- 3-14	10
32	98	1	1	1	1	0	1	18	8- 3-15	9
19	97	1	1	1	1	1	1	16	8- 2-16	7
22	97	1	1	1	1	0	1	19	8- 2- 0	10
24	97	1	1	1	1	1	1	19	8- 2-17	10
17	96	1	0	1	0	0	1	13	8- 1- 6	7

TABLE 15

PRETEST VARIABLES FOR SEVEN-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	0	0	0	0	19	7-11-26	11
27	93	1	0	1	0	0	1	19	7-10-15	11
2	92	1	0	0	1	0	1	10	7- 8-21	6
24	92	1	1	1	1	1	1	18	7- 9-10	9
29	92	1	1	1	1	1	1	19	7- 9- 5	11
11	89	1	1	1	1	1	1	19	7- 6-13	11
30	89	1	0	1	0	1	1	20	7- 5-24	11
28	89	1	1	1	1	0	1	20	7- 6- 9	11
31	88	1	1	1	1	0	1	18	7- 4-23	10
33	88	1	1	1	1	1	1	15	7- 5- 8	8
21	86	1	0	1	1	0	1	19	8- 4- 2	11
1	85	1	0	1	0	0	1	18	7- 2-14	10
16	85	1	1	1	1	0	1	18	7- 2-29	10
20	85	1	1	1	0	0	1	17	7- 2-20	9
35	84	1	1	1	0	1	0	20	7- 1-20	12

TABLE 16

PRETEST VARIABLES FOR SIX-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	1	1	0	0	1	20	7- 0- 4	12
1	83	1	1	1	0	0	1	20	7- 0-18	12
20	82	1	1	1	1	0	1	15	6-11- 0	9
14	82	1	0	0	0	0	1	12	6-11-28	8
11	81	0	0	0	0	0	0	13	6-10-28	8
6	81	1	0	1	0	0	0	14	6-10-18	8
22	79	1	0	0	0	0	0	17	6- 8- 1	10
3	77	0	0	0	0	0	0	13	6- 6-15	8
21	77	0	0	0	0	0	0	20	6- 6-20	13
10	77	1	1	1	1	0	1	12	6- 6-19	8
28	74	1	0	1	0	0	1	16	6- 3- 9	10
15	74	1	1	1	1	0	1	15	6- 3-25	9
25	73	0	0	1	0	0	1	8	6- 2-23	8
26	72	0	0	0	0	0	0	17	6- 1-20	11
30	72	1	1	1	0	0	1	16	6- 1- 6	10

TABLE 17

POSTTEST VARIABLES FOR EIGHT-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	105	1	1	1	1	0	1	17	9- 0-13	7
12	103	1	1	1	1	0	1	19	8-10- 2	10
18	103	1	1	1	1	0	1	17	8-10-21	7
5	102	1	1	1	1	1	1	19	8- 9-10	10
6	101	1	1	1	1	0	1	17	8- 8- 7	7
11	100	1	1	1	1	1	1	19	8- 6-26	10
14	100	1	1	1	1	0	1	20	8- 7-23	10
29	100	1	1	1	1	0	1	17	8- 7- 6	8
31	99	1	1	1	1	1	1	19	8- 6-29	10
15	98	1	0	0	0	0	0	20	8- 5-10	10
32	98	1	1	1	1	0	1	20	8- 5-28	10
19	97	1	1	1	1	1	1	19	8- 4-23	10
22	97	1	1	1	1	1	1	20	8- 4- 7	10
24	97	1	1	1	1	1	1	20	8- 4-24	10
17	96	1	0	1	1	0	1	13	8- 3-12	6

TABLE 18

POSTTEST VARIABLES FOR SEVEN-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	0	0	0	0	19	8- 2- 6	10
27	93	0	1	1	1	1	1	18	8- 0-25	9
2	92	1	1	1	1	1	1	14	7-11- 1	7
24	92	1	1	1	1	1	1	18	7-11-20	9
29	92	1	1	1	1	1	1	18	7-11-15	9
11	89	1	1	1	1	1	1	16	7- 8-23	8
30	89	1	0	0	1	1	1	19	7- 8- 4	11
28	89	1	1	1	1	1	1	19	7- 8-19	11
31	88	Moved	-	-	-	-	-	--	-------	--
33	88	1	1	1	1	1	1	18	7- 7- 2	9
21	86	1	1	1	1	0	1	17	7- 5-26	9
1	85	1	1	0	0	0	0	17	7- 4- 5	9
16	85	1	1	0	1	0	1	18	7- 4-23	10
20	85	1	1	1	1	0	1	20	7- 4-18	11
35	84	1	1	1	1	0	1	19	7- 3-14	11

TABLE 19

POSTTEST VARIABLES FOR SIX-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	0	0	0	0	0	16	7- 1- 8	9
1	83	1	1	1	1	0	1	20	7- 2-20	12
20	82	1	1	1	1	0	1	16	7- 1- 4	9
14	82	1	1	1	1	0	1	14	7- 1- 2	8
11	81	0	1	0	0	0	0	11	7- 0- 2	7
6	81	1	1	1	1	0	1	16	7- 0-20	9
22	79	1	0	0	0	0	0	12	6-10- 5	8
3	77	0	0	0	0	0	0	12	6- 8-19	8
21	77	0	0	0	0	0	0	16	6- 8-22	9
10	77	1	1	1	1	0	0	16	6- 8-21	9
28	74	1	1	1	0	0	1	17	6- 5-11	10
15	74	1	1	1	1	0	1	11	6- 5-20	8
25	73	0	0	0	1	0	0	12	6- 4-20	8
26	72	0	0	0	0	0	0	16	6- 3-22	10
30	72	Dropped	-	-	-	-	-	--	-------	--

TABLE 20

DELAYED POSTTEST VARIABLES FOR EIGHT-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	105	1	1	1	1	0	1	17	9- 0-27	7
12	103	1	1	1	1	0	1	18	8-10-16	8
18	103	1	1	1	1	1	1	19	8-11- 5	10
5	102	1	1	1	1	1	1	18	8- 9-24	8
6	101	1	1	1	1	0	1	19	8- 9-21	10
11	100	1	1	1	1	1	1	19	8- 7-10	10
14	100	1	1	1	1	0	1	20	8- 8- 7	10
29	100	1	1	1	1	0	0	15	8- 7-20	7
31	99	1	1	1	1	1	1	19	8- 7-10	10
15	98	1	0	0	0	0	0	18	8- 6- 5	8
32	98	1	1	1	0	0	1	19	8- 6- 4	10
19	97	1	1	1	1	1	1	18	8- 5- 7	8
22	97	1	1	1	1	1	1	18	8- 4-21	8
24	97	1	1	1	1	1	1	17	8- 5- 8	8
17	96	1	1	1	0	0	1	19	8- 3-27	10

TABLE 21

DELAYED POSTTEST VARIABLES FOR SEVEN-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
25	95	1	0	1	0	0	1	18	8- 2-25	9
27	93	0	0	1	1	0	0	20	8- 1-14	10
2	92	1	1	1	1	1	1	18	7-11-20	11
24	92	1	1	1	1	1	1	19	8- 0- 9	10
29	92	1	1	1	1	1	1	20	8- 0- 4	10
11	89	1	1	1	1	1	1	18	7- 9-12	9
30	89	1	1	1	1	1	1	19	7- 8-24	11
28	89	1	1	0	0	0	0	19	7- 9- 8	11
31	88	Moved	-	-	-	-	-	--	-------	--
33	88	1	1	1	1	1	1	15	7- 7-21	9
21	86	1	1	1	1	1	1	18	7- 6-15	9
1	85	1	1	1	0	1	1	19	7- 4-24	11
16	85	1	1	1	1	0	1	19	7- 5-12	11
20	85	1	1	1	1	0	1	20	7- 5- 7	11
35	84	1	1	1	0	1	1	20	7- 4- 3	11

TABLE 22

DELAYED POSTTEST VARIABLES FOR SIX-YEAR-OLD EXPERIMENTAL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
9	83	1	1	0	0	0	0	17	7- 2-29	9
1	83	1	1	1	0	0	1	20	7- 3-11	11
20	82	1	1	1	1	0	1	17	7- 1-25	9
14	82	1	1	1	1	1	1	17	7- 1-23	9
11	81	0	0	0	0	0	0	18	7- 0-23	10
6	81	1	1	1	0	0	0	15	7- 1-11	10
22	79	1	0	0	0	0	0	12	6-10-26	8
3	77	0	0	0	0	0	0	16	6- 9-10	9
21	77	1	0	0	0	0	1	15	6- 9-13	9
10	77	1	0	0	1	0	0	10	6- 9-12	7
28	74	1	1	1	0	0	1	16	6- 6- 2	9
15	74	1	1	1	0	0	1	18	6- 7-18	11
25	73	1	0	0	1	0	0	10	6- 5-18	8
26	72	0	0	0	0	0	0	16	6- 4-13	10
30	72	Dropped	-	-	-	-	-	--	-------	--

TABLE 23

PRETEST VARIABLES FOR EIGHT-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	20	9- 0- 3	10
21	107	1	1	1	1	1	1	20	9- 0-21	10
13	106	1	1	1	1	1	1	18	8-11- 6	8
20	106	1	1	1	0	1	1	18	8-11- 3	8
30	106	1	1	1	1	0	1	15	8-10-21	7
27	106	1	1	1	1	1	1	20	8-11-10	10
25	106	1	1	1	1	0	1	13	8-11-10	6
2	105	1	1	1	0	0	1	18	8-10-16	8
26	104	1	1	1	1	1	1	14	8- 8-25	8
10	104	1	1	1	0	1	1	17	8- 8-23	9
4	103	1	1	0	1	0	1	16	8- 8- 6	7
7	99	1	1	1	1	1	1	19	8- 4-21	10
16	97	1	1	1	1	1	1	18	8- 2- 15	9
28	97	1	1	1	0	0	1	20	8- 1-24	10
23	97	0	1	0	0	0	0	20	8- 2-19	10

TABLE 24

PRETEST VARIABLES FOR SEVEN-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
32	93	1	1	1	1	1	1	15	7-10-20	7
3	92	1	1	1	1	0	1	18	7- 9- 7	9
12	92	1	0	1	1	0	1	19	7- 8-22	11
5	91	1	0	0	0	0	0	16	7- 8- 4	8
13	90	1	1	1	1	0	1	18	7- 7- 2	9
9	87	1	1	1	0	0	1	13	7- 3-22	8
17	86	0	0	0	0	0	0	17	7- 3-19	9
19	86	1	1	1	1	0	1	16	7- 3-23	8
23	85	1	1	1	1	0	1	12	7- 3- 0	7
14	84	1	0	0	0	0	0	19	7- 1-12	12
15	84	1	1	1	1	0	1	8	7- 1-20	6
18	84	1	1	1	0	0	1	19	7- 1-12	12
22	84	1	1	1	0	1	1	19	7- 2- 5	12
34	84	0	0	0	0	0	0	10	7- 1- 7	7
36	84	1	0	0	0	1	0	10	7- 1-26	7

TABLE 25

PRETEST VARIABLES FOR SIX-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores: (PA/CA x 10)
2	83	0	0	0	0	0	0	6	7- 0-14	6
18	83	1	0	1	1	0	1	14	7- 0- 5	8
7	83	0	0	0	0	0	0	11	7- 0- 0	7
24	82	1	1	1	1	0	1	14	6-11-17	8
8	82	1	1	1	0	0	1	13	6-11-16	8
17	81	0	0	0	0	0	0	17	6-10-22	10
19	81	1	0	0	1	0	1	18	6-10-21	10
12	81	1	0	0	0	0	0	14	6-10- 7	8
13	81	1	1	1	1	0	1	16	6-10- 2	9
5	81	1	0	0	0	0	0	12	6-10-24	8
4	79	1	1	1	0	0	1	18	6- 8- 2	11
16	79	1	0	1	1	1	1	18	6- 9- 0	10
23	75	1	0	0	0	0	1	18	6- 4-20	11
27	73	0	0	1	1	0	1	16	6- 2- 5	10
29	73	1	1	1	1	0	1	14	6- 2- 5	9

TABLE 26

POSTTEST VARIABLES FOR EIGHT-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	17	9- 2-16	7
21	107	1	1	1	1	1	1	19	9- 2-28	10
13	106	1	1	1	1	1	1	18	9- 1-13	8
20	106	1	1	1	1	0	1	19	9- 1-10	10
30	106	1	1	1	1	1	1	19	9- 1- 4	10
27	106	1	1	1	1	1	1	18	9- 1-23	8
25	106	1	1	1	1	1	1	17	9- 1-25	7
2	105	1	1	1	0	0	1	17	9- 0-29	7
26	104	1	1	1	1	1	1	18	8-11- 8	8
10	104	1	1	1	1	1	1	15	8-11- 0	6
4	103	1	1	1	0	0	1	18	8-10-13	8
7	99	1	1	1	1	1	1	19	8- 6-28	10
16	97	1	1	1	1	1	1	19	8- 4-22	10
28	97	1	1	1	0	0	1	19	8- 4- 7	10
23	97	0	1	0	0	0	0	19	8- 4- 2	10

TABLE 27

POSTTEST VARIABLES FOR SEVEN-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
32	93	1	1	1	1	0	1	19	8- 1- 0	10
3	92	1	0	0	0	0	0	18	7-11-17	9
12	92	1	1	1	1	0	1	10	7-11-12	6
5	91	0	0	0	0	0	0	16	7-10-14	8
13	90	1	1	0	0	0	1	19	7- 9-12	11
9	87	1	1	1	0	0	1	13	7- 6- 2	7
17	86	1	1	0	0	0	0	17	7- 5-13	9
19	86	1	1	1	0	0	1	16	7- 5-17	8
23	85	1	1	0	1	0	0	11	7- 4-24	7
14	84	1	0	0	0	0	0	18	7- 3-16	10
15	84	1	1	1	1	0	1	18	7- 3-14	10
18	84	1	1	1	0	0	1	18	7- 3- 6	10
22	84	1	1	1	1	1	1	18	7- 4-19	10
34	84	1	0	0	0	0	0	17	7- 3- 1	9
36	84	1	1	1	0	0	1	17	7- 3-20	9

TABLE 28

POSTTEST VARIABLES FOR SIX-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
2	83	0	0	0	0	0	0	7	7- 2-18	6
18	83	1	1	1	0	0	1	17	7- 2- 7	9
7	83	0	0	0	0	0	0	15	7- 2-19	8
24	82	1	1	1	1	0	1	17	7- 1-11	9
8	82	1	1	1	0	0	1	18	7- 1-11	10
17	81	0	0	0	0	0	0	18	7- 0-24	10
19	81	1	1	1	1	0	1	17	7- 0-23	9
12	81	1	1	1	0	0	1	16	7- 0-20	9
13	81	1	0	0	0	0	1	15	7- 0- 4	8
5	81	0	0	0	0	0	0	9	7- 0-26	7
4	79	1	1	1	1	0	1	18	6-10- 6	10
16	79	1	1	1	1	1	1	16	6-11- 2	9
23	75	1	1	1	0	0	0	17	6- 6-22	10
27	73	1	0	0	1	0	0	15	6- 4- 9	9
29	73	1	0	0	0	0	0	15	6- 4- 9	9

TABLE 29

DELAYED POSTTEST VARIABLES FOR EIGHT-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
1	107	1	1	1	1	0	1	19	9- 3- 0	10
21	107	1	1	1	1	1	1	20	9- 3-12	10
13	106	1	1	1	1	1	1	19	9- 1-27	10
20	106	1	1	1	1	0	1	19	9- 1-24	10
30	106	1	1	1	1	1	1	18	9- 1-18	8
27	106	1	1	1	1	1	1	18	9- 2- 7	8
25	106	1	1	1	1	0	1	16	9- 2- 7	7
2	105	1	1	1	1	0	1	19	9- 1-13	10
26	104	1	1	1	1	1	1	19	8-11-22	10
10	104	1	1	1	1	1	0	19	8-11-14	10
4	103	1	1	1	0	0	1	18	8-10-27	8
7	99	1	1	1	1	1	1	19	8- 7-12	10
16	97	1	1	1	1	1	1	19	8- 5- 6	10
28	97	1	1	1	1	0	1	18	8- 4-21	8
23	97	0	0	0	1	0	0	20	8- 4-16	10

TABLE 30

DELAYED POSTTEST VARIABLES FOR SEVEN-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
32	93	1	1	1	1	1	1	20	8- 1-19	10
3	92	1	0	0	0	0	0	18	8- 0- 6	9
12	92	1	1	1	0	1	1	18	7-11-21	11
5	91	0	0	0	0	0	0	19	7-110 4	11
13	90	1	1	1	0	0	0	20	7-10- 1	11
9	87	1	1	1	1	0	1	11	7- 6-21	7
17	86	1	1	0	0	0	1	18	7- 6- 2	9
19	86	1	0	0	0	0	1	19	7- 6- 6	11
23	85	0	0	0	1	0	0	9	7- 5-13	7
14	84	1	0	0	1	0	0	20	7- 4- 5	11
15	84	1	1	0	1	0	0	19	7- 4- 3	11
18	84	1	1	1	0	0	1	18	7- 3-25	10
22	84	1	1	1	1	1	1	19	7- 5-18	11
34	84	1	0	0	0	0	0	18	7- 3-20	10
36	84	1	1	1	1	0	1	18	7- 4- 9	10

TABLE 31

DELAYED POSTTEST VARIABLES FOR SIX-YEAR-OLD CONTROL GROUP

		Conservation of:						Figure-Ground Scores:		
Sample Number	Age-Months	Number	Liquid Amount	Solid Amount	Area	Length	Weight	Raw Score	Age Equivalents	Scaled Scores (PA/CA x 10)
2	83	0	0	0	0	0	0	9	7- 3- 9	7
18	83	1	1	1	0	0	1	17	7- 2-28	9
7	83	0	0	0	0	0	0	13	7- 3-10	8
24	82	1	1	1	1	0	1	16	7- 2- 2	9
8	82	1	1	1	1	0	1	15	7- 2- 9	8
17	81	0	0	0	0	0	0	17	7- 1-15	9
19	81	1	1	1	1	0	1	16	7- 1-14	9
12	81	1	1	1	0	0	1	17	7- 1-11	9
13	81	1	0	0	1	0	1	16	7- 0-25	9
5	81	0	0	0	0	0	0	13	7- 1-17	8
4	79	1	1	1	0	0	1	14	6-10-27	8
16	79	1	1	1	1	1	1	18	6-11-23	10
23	75	1	1	1	0	0	0	19	6- 7-13	8
27	73	0	0	0	1	1	1	15	6- 5- 0	9
29	73	0	0	0	0	0	1	12	6- 5- 0	8

APPENDIX J

TABLE 32

MEANS AND STANDARD DEVIATIONS OF FIGURE-GROUND SCALE SCORES FOR EXPERIMENTAL AND CONTROL GROUP EIGHT-YEAR-OLDS

Pretest		Posttest		Delayed Posttest	
Experimental	Control	Experimental	Control	Experimental	Control
8	10	7	7	7	10
10	10	10	10	10	10
10	9	7	8	10	10
10	8	10	10	8	10
7	7	7	10	10	8
10	10	10	8	10	8
7	6	10	8	10	7
8	8	8	7	7	10
7	7	10	6	8	10
10	8	10	8	8	10
9	7	10	7	10	8
7	10	10	10	8	10
10	9	10	10	8	10
10	10	10	10	8	8
6	10	6	10	10	10
$\overline{X}$ = 8.60	$\overline{X}$ = 8.60	$\overline{X}$ = 9.00	$\overline{X}$ = 8.60	$\overline{X}$ = 8.80	$\overline{X}$ = 9.26
S.D. = 1.50	S.D. = 1.40	S.D. = 1.50	S.D. = 1.45	S.D. = 1.20	S.D. = 1.06

TABLE 33

MEANS AND STANDARD DEVIATIONS OF FIGURE-GROUND SCALE SCORES FOR EXPERIMENTAL AND CONTROL GROUP SEVEN-YEAR-OLDS

Pretest		Posttest		Delayed Posttest	
Experimental	Control	Experimental	Control	Experimental	Control
11	7	10	10	9	10
11	9	9	9	10	9
6	11	7	6	11	11
9	8	9	8	10	11
11	9	9	11	10	11
11	8	8	7	9	7
11	9	11	9	11	9
11	8	11	8	11	11
10	7	Moved	7	Moved	7
8	12	9	10	9	11
11	6	9	10	9	11
10	12	9	10	11	10
10	12	10	10	11	11
9	7	11	9	11	10
12	7	11	9	11	10
$\overline{X}$ = 10.06	$\overline{X}$ = 8.80	$\overline{X}$ = 9.50	$\overline{X}$ = 8.86	$\overline{X}$ = 10.21	$\overline{X}$ = 9.93
S.D. = 1.48	S.D. = 2.04	S.D. = 1.18	S.D. = 1.35	S.D. = .85	S.D. = 1.34

TABLE 34

MEANS AND STANDARD DEVIATIONS OF FIGURE-GROUND SCALE SCORES FOR EXPERIMENTAL AND CONTROL GROUP SIX-YEAR-OLDS

Pretest		Posttest		Delayed Posttest	
Experimental	Control	Experimental	Control	Experimental	Control
12	6	9	6	9	7
12	8	12	9	11	9
9	7	9	8	9	8
8	8	8	9	9	9
8	8	7	10	10	8
8	10	9	10	10	9
10	10	8	9	8	9
8	8	8	9	9	9
13	9	9	8	9	9
8	8	9	7	7	8
10	11	10	10	9	8
9	10	8	9	11	10
8	11	8	10	8	8
11	10	10	9	10	9
10	9	Dropped	9	Dropped	8
$\bar{X}$ = 9.60	$\bar{X}$ = 8.86	$\bar{X}$ = 8.85	$\bar{X}$ = 8.80	$\bar{X}$ = 9.21	$\bar{X}$ = 8.53
S.D. = 1.67	S.D. = 1.41	S.D. = 1.50	S.D. = 1.14	S.D. = 1.08	S.D. = .71

TABLE 35

MEANS AND STANDARD DEVIATIONS OF FIGURE-GROUND SCALE SCORES FOR SIX, SEVEN, AND EIGHT-YEAR-OLD EXPERIMENTAL AND CONTROL GROUPS ON PRE, POST, AND DELAYED POSTTESTS

	Pretest		Posttest		Delayed Posttest	
Age	Experimental	Control	Experimental	Control	Experimental	Control
Eight	$\bar{X}$ = 8.60 S.D. = 1.50	$\bar{X}$ = 8.60 S.D. = 1.40	$\bar{X}$ = 9.00 S.D. = 1.50	$\bar{X}$ = 8.60 S.D. = 1.45	$\bar{X}$ = 8.80 S.D. = 1.20	$\bar{X}$ = 9.26 S.D. = 1.06
Seven	$\bar{X}$ =10.06 S.D. = 1.48	$\bar{X}$ = 8.80 S.D. = 2.04	$\bar{X}$ = 9.50 S.D. = 1.18	$\bar{X}$ = 8.86 S.D. = 1.35	$\bar{X}$ =10.21 S.D. = .85	$\bar{X}$ = 9.93 S.D. = 1.34
Six	$\bar{X}$ = 9.60 S.D. = 1.67	$\bar{X}$ = 8.86 S.D. = 1.41	$\bar{X}$ = 8.85 S.D. = 1.50	$\bar{X}$ = 8.80 S.D. = 1.14	$\bar{X}$ = 9.21 S.D. = 1.08	$\bar{X}$ = 8.53 S.D. = .71