AN INVESTIGATION OF THE NATURE OF CONCEPT FORMATION IN CEREBRAL PALSIED SCHOOL CHILDREN

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John E. Jordan

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This is to certify that the

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Major professor

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AN INVESTIGATION OF THE NATURE OF CONCEPT FORMATION IN CEREBRAL PALSIED SCHOOL CHILDREN

By

John E. Jordan

AN ABSTRACT

Submitted to the School for Advanced Graduate Studies
of Michigan State University of Agriculture and
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of the requirements for
the degree of

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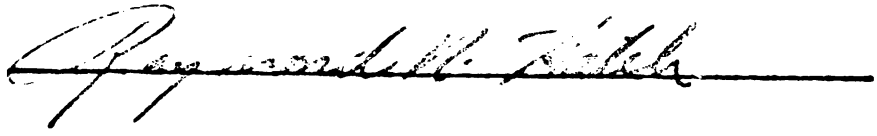
Approved 

JOHN E. JORDAN ABSTRACT

The Problem

This study was concerned with ascertaining some of the characteristics of concept formation in cerebral palsied school children. Its major objective was to determine the relationship of mental age to certain aspects of conceptualization. Specifically the study attempted to test two hypotheses:

1. There is a positive relationship between mental age and the various aspects of conceptual functioning in cerebral palsied children.
2. Concept formation ability is more highly related to mental age than to kind of cerebral palsy or degree of disability.

The Sample

The sample consisted of thirty cerebral palsied school children from the Lansing, Michigan Public Schools. They ranged in age from 4.6 to 20.1 with a mean age of 10.3 and a standard deviation of 3.10. The mental ages ranged from 2.8 to 17.1 with a mean of 8.44 and a standard deviation of 3.92.

Procedure and Methodology

Scores were obtained for all the subjects on the following variables:

1. Mental Age. The Stanford-Binet Intelligence Scale was used to obtain the mental age of the subjects. The Columbia Mental Maturity Scale was also used as a check on the Binet scores.
2. Concept Formation. A concept formation test of the sorting type was used which permitted a maximum of six logical concepts to be attained.
3. Physical Disability. The subjects were ranked for degree of physical disability by two physical therapists and an occupational therapist who knew the subjects well. The rankings were based on the medical records and the muscle tests given by the therapists.
4. Speech and Language Disability. Fifteen of the subjects were receiving speech therapy. They were ranked as to degree of speech and language disability: both remedial and developmental-wise; attempting to rule out the psychological factors.
5. Kind of Cerebral Palsy. This was determined from the medical records and the professional opinion of the therapists.

JOHN E. JORDAN ABSTRACT

Statistical analysis of the relationship of mental age to these variables was investigated by means of correlations or correlation-like statistics and tests for the significance of the differences. The statistics accounted for the small sample and the rank order of some of the data.

Results

1. Mental age was a significantly better predictor of concept formation ability, than was degree of physical disability or kind of cerebral palsy as represented by spasticity versus non-spasticity.
2. Illogical conceptual responses were more characteristic of the spastic versus the non-spastic than were repetitive responses.
3. Normal children were significantly superior to cerebral palsied children in all aspects of concept formation ability.
4. The cerebral palsied group were significantly more variable than the normal on the number of logical and bi-dimensional concepts achieved, and less variable on mean time per concept and on the number of non-functional concepts produced.

AN INVESTIGATION OF THE NATURE OF CONCEPT FORMATION IN CEREBRAL PALSIED SCHOOL CHILDREN

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A DISSERTATION

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Dedicated to

My Wife

Artie

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CHAPTER I

THE NATURE OF THE PROBLEM

Cerebral palsy is one of the many physical disabilities that American education is attempting to cope with today. Because of its many neuromuscular involvements, it presents a more complicated problem than do most other groups of physically disabled children.

No other single group of children need a greater variety of professional help in habilitation and rehabilitation. Therapists, educators, psychologists, dentists, medical specialists, social workers, nurses, and all who work with the cerebral palsied child must be sympathetic to the total needs of the child and must adopt the philosophy of the team approach in their efforts. No other group of disabled children presents to the school a situation where a "meeting of minds" is more mandatory than does cerebral palsy.

The most commonly accepted problem of cerebral palsied children is that of ambulation. However, the nature of the disability incurs many associated impairments in vision, audition, intelligence, seizures, perception, sensory discrimination, or almost any other type of impairment.

The treatment of cerebral palsied children has followed the medical pattern of most other physical disabilities. Most of the medical effort has been expended in devising

methods of physical therapy, new techniques in corrective surgery, occupational therapy, and other reconstructive aspects of medicine.

Only recently, as the neurological implications of cerebral palsy have been made apparent, has the total area of intellectual functioning become a major problem. Even with this new awareness, most of the past investigations have been concerned with the intellectual aspects of learning the activities of daily living; which are a real problem to the cerebral palsied child.

Relatively little investigation has been conducted with cerebral palsied school children on the nature of the higher mental processes, such as conceptualization, memory or reasoning. However, therapists are aware that progress in physical therapy depends to a large extent on the mental ability of the child to profit from the teaching aspects of physical therapy; i.e. to teach a child a three-point crutch gait is a learning process. Teachers have been baffled by the inability of cerebral palsied children to make satisfactory progress in school.

Conceptualization is the intellectual process by which the environment is reduced to law and order by the mind of the child. Events are ordered and classified so that each "new" experience does not occur as a new one, but in relationship to past happenings.

In other words the child forms "classes of experiences" or concepts and by their use is able to predict and control

events in his environment. In the words of Strauss and Kephart:

> Not only is the concept based upon elements which are present in the immediate situations, but it also includes those which have occurred in past situations. The concept involves elaborating this present organization by the addition, also in an organized manner, of elements which we retain from experience of similar types in the past . . . . . .
> . . . . . .
> Basic to the formation of concepts is generalization . . . . . .
> It is obvious that the formation of concepts involves an intricate organization of relations. ... Since the concept is the most complicated of the processes of organization which a child is required to make, it follows that the brain-injured child would have particular difficulty in making these groupings. We have seen that, in most cases, the grouping or organization process is the one which gives him the most trouble. It is therefore to be expected that here, where organization is at a premium, is where his difficulty would be most obvious (35:115, 124, 125).

Thus, it becomes apparent that knowledge of the conceptual processes of the cerebral palsied child would be of value in working with all areas of his disability.

To date, very little research has been conducted on the higher mental processes, such as conceptualization, since cerebral palsy has been regarded more as an orthopedic than as a neurological problem.

STATEMENT OF THE PROBLEM

The purpose of the present study is to investigate the nature of concept formation in cerebral palsied children by analyzing how they perform on a grouping or organizational task, which as indicated above is their major area of difficulty. After a review of literature pertinent to concept

formation in cerebral palsy and the intellectual testing of the cerebral palsied, a complete procedure and methodology will be presented in Chapter III, whereby it is proposed to analyze the nature of conceptualization in cerebral palsied school children.

The following hypotheses are offered in order to test some of the implications arising out of the previous discussion:

Hypothesis I: There is a positive relationship between mental age and the various aspects of conceptual functioning in cerebral palsied children.

Hypothesis II: Concept formation ability is more highly related to mental age than to kind of cerebral palsy or degree of disability.

DEFINITIONS

Cerebral palsy can be defined from many viewpoints: as an orthopedic condition, an educational problem, a neurological defect, as an intellectual deficit or in terms of its social and economic implications. It is one of the most complicated afflictions of the physically disabled. Denhoff has stated: "There is still little correlation between causes, the physiology and pathology of cerebral palsy" (7:1).

Cerebral Palsy. Due to the many ramifications and involvements of the condition, it appears that any "total definition" of cerebral palsy must encompass all the possibilities previously implied. The technical nature of much of the medi-

cal information that follows is best expressed by direct quotations from the specialists in the field rather than by attempting to paraphrase it.

Cruickshank and Raus have summarized as follows the rather definitive attempts of Denhoff to present an exhaustive definition of cerebral palsy:

> As a standard definition he (Denhoff) refers to Perlstein who says that cerebral palsy is generally defined as a 'condition, characterized by paralysis, weaknesses, incoordination, or any other aberration of motor function due to pathology of the motor control centers of the brain.' Herein cerebral palsy is defined solely in terms of its physical components. A still more limited definition of cerebral palsy is one wherein it is conceived as 'a condition in which interferences with the control of the motor system arises as a result of lesions occurring from birth trauma.' This definition may be criticized from two points of view: namely, (a) cerebral palsy is more than merely a "motor" problem, and (b) cerebral palsy, etiologically speaking, is not limited to birth trauma alone. Thus the practical definition ... of Denhoff's ... warrants serious consideration. From such a point of view cerebral palsy is seen as one component of a broader brain damage syndrome comprised of neuromotor dysfunction, psychological dysfunction, convulsions, and behavior disorders of organic origin. In some cerebral palsied individuals only a single factor may appear; other individuals may be characterized by any combination of the factors mentioned. Closely related to the above definition is that of Swartz and his associates who believe that cerebral palsy should be defined as an aggregate of handicaps; i.e., emotional, neuromuscular, special sensory and peripheral sensory, caused by damaged or absent brain structures. These latter definitions appear to be more nearly in harmony with the reality of the situation in terms of the findings which recent studies have reported (6:1, 2).

Thus, the condition of cerebral palsy is seen as an entity involving neural, muscular, sensory, social and psychological components and implications. Denhoff's practical definition is especially desirable in a school situation where the cerebral palsied child must be viewed as more

than an impaired physical organism, but rather as a person attempting to constructively develop his maximum potential.

Concept Formation. As with Coleman, (3) for the purpose of this study, "concept formation" is defined as a process in which an individual, confronted with the task of classifying a group of objects, proceeds to discriminate the essential common properties of the various objects and to group them accordingly. This requires use of the processes of organization and generalization.

Intelligence. Wechsler's definition of intelligence as "the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (46:3) is also acceptable for the purposes of this study.

HISTORY OF CEREBRAL PALSY

The condition of cerebral palsy was first described by William John Little (25) in a lecture before the Obstetrical Society of London on October 2, 1861. The condition has been called Little's disease, spastic diplegia, cerebellar ataxia, hemiplegia, cerebrospastics, et cetera. The term cerebral palsy was chosen and popularized by Phelps (11:180) because of its all-inclusive possibilities. It describes all types of paralysis, incoordination, psychological dysfunction, sensory and crippling effects that arise from aberrations in brain structure. It does not include spinal palsies, such as

poliomyelitis or severing of the spinal cord, peripheral nerve palsies or muscle palsies.

Incidence. Although cerebral palsy is established as a "non-fatal and non progressive" type of disease, its national importance is indicated by Phelps (29) who stated that seven new cases are added each year for each 100,000 population. The statistics indicated that one of these seven will die at birth so this would indicate a community incidence of eight-four for each 10,000 at age twenty-one. Linck (24) estimated in 1947 there were 350,000 children and young adults in America afflicted by cerebral palsy.

While the New York study (21) on the incidence of cerebral palsy raised some questions as to the validity of the above estimates (their estimate being about two in 100,000), a later report said that a "very large percentage of the cerebral palsied patients are in need of service at the present time (1953)."

Etiology. Fay lists the recognized causes of cerebral palsy as:

> (1) birth trauma; (2) effects of the RH factor; (3) anoxia due to increased intracranial pressure, asphyxia, edema, or hydrocephalus; (4) encephalitis, prenatal virus infections; (5) meningitis; (6) tumors, cysts, hydromas, clots and abscesses; (7) congenital anomalies, angiomas, aneurysms; (8) defects in blood circulatory or spinal fluid mechanisms, Pacchionian filters; and subarachnoid pathways; (9) systemic or miscellaneous factors that secondarily effect the normal functions of an originally normal brain organ (nephritis, drugs, toxins, etc.) (11:180).

Classification. Such a complex etiology enables cerebral palsy to be classified many ways. Perlstein classifies cerebral palsy according to:

> (1) the anatomic site of the brain lesion; (2) the qualitative nature of the clinical symptom present, whether spasticity, athetosis, rigidity, etc.; (3) the topographical involvement of the extremities; and (4) etiology (27:55).

Tables IX and X classify the subjects of this study according to sex, clinical and topographical diagnoses. For the purposes of this study, it is not necessary to classify the subjects according to the anatomic site of the brain lesion or by etiology. Further, such information is often indefinite for a particular subject and difficult to ascertain in a definitive manner.

One of the most common systems of classifying cerebral palsy is that of Phelps which is given in Table I as adapted by Fay (11:182).

NEED FOR THE STUDY

The history of cerebral palsy, with its complex etiological and classification systems and the preceding discussion has pointed up the need for research in the intellectual functioning of the cerebral palsied.

The acceptance of the importance of the neurological aspects of the brain damage in cerebral palsy has accentuated this need.

Sarason included cerebral palsy in his rather comprehensive treatment of the psychological problems of mental de-

TABLE I

CEREBRAL PALSY CLASSIFICATION (PHELPS-FAY)
(ADAPTED FROM FAY) (11:182)

Diagnoses	Part of Brain Affected
Spastic Paralysis	Cerebral
1. Non-spastic Paralysis	
2. Atonic Type	
Athetosis	Mid-brain
1. Deaf	
2. Tension	
3. Non-tension	
4. Hemiplegia	
5. Tremor	
6. Cerebellar Release	
7. Emotional Release	
8. Head, Neck, Arm	
9. Shudder Type	
10. Rotary Type	
11. Dystonic Type	
12. Flail Type	
Tremors and Rigidities	Basal Ganglia
1. Parkinsonian Types	
2. Decerebrate Types	
Ataxia	Cerebellum *
1. Cerebellar	
2. Kinesthetic	
High Spinal Spastic	Medulla
Mixed	Diffuse

* According to Pohl (30)

ficiency. After a lengthy review of cerebral palsy, he concluded that:

> From the time of Little's original work in 1863 until the third decade of the present century, research in cerebral palsy was largely the domain of the medical specialist. Problems of etiology and pathology received the greatest attention. Although the relation between brain damage and intellectual functioning had always been of major interest to many medical workers, the mental functioning of the cerebral palsied received scant attention (33:169).

Thus, the need for the study becomes apparent. There has been little basic research on the intellectual functioning of cerebral palsied school children and even a smaller amount in the higher mental functions such as concept formation. The recent studies (18) indicating lower estimates of intellectual ability in the cerebral palsied also points to the need for research in conceptualization.

LIMITATIONS OF THE STUDY

The limitations of the study consist primarily in:

1. The small number of subjects. However, large numbers of such subjects are not available in any one school. A sample of thirty is large enough to warrant the use of the statistical tools employed in this study.
2. The limited statistical inferences that can be derived from such a sample. As samples become larger and representative, they more nearly represent the parent population. However, the sample is hypothesized to be fairly representative of cerebral pal-

sied school children, which is actually the parent population in this study.

3. The necessity of obtaining ranking measures of some of the variables due to the lack of any scaled measuring device. Ranking measures are not discrete and continuous data. They indicate direction better than degree.
4. The fact that the I.Q. distribution in the sample does not parallel that of the total cerebral palsied population. While this limits inferences to the total cerebral palsied population, it does not necessarily limit inferences to the cerebral palsied school population as implied in number three above.

ORGANIZATION OF THE THESIS

This thesis is organized according to the following plan:

Chapter I serves as an introduction to the nature of the problem involved in this study.

Chapter II is a summarization of the most significant research related to this study. The research has been divided into four major divisions: (1) concept formation in general, (2) concept formation and brain damage, (3) concept formation and cerebral palsy, and (4) intellectual measurement in cerebral palsy.

Chapter III is concerned with the procedure and methodology of this study. It describes the sample, the experi-

mental tasks and the intelligence test. In addition, it describes the ratings of physical and language disability. The chapter concludes with an explanation of the statistical procedures used in the analysis of the data obtained in the study.

Chapter IV presents the results of the study in tabular and explanatory forms.

Chapter V presents a summary of the results with conclusions and recommendations.

CHAPTER II

REVIEW OF RELATED RESEARCH

CONCEPT FORMATION

The total field of concept formation has always been of considerable interest to psychologists and others interested in the so-called higher mental processes.

Coleman's (3) study contained an excellent review of the general literature on concept formation. His review was concerned with the types of concept formation which have been investigated with reference to intelligence. He found eight types: namely, (1) concepts of time, (2) concepts of space, (3) concepts of number, (4) studies involving form discrimination and form analysis, including the use of sorting tests, (5) concepts of causal relationships, (6) social concepts, (7) studies involving the use of abstract reasoning, including learning, and (8) studies involving specific intelligence tests and items customarily used in such tests.

Coleman's hypothesis was that concept formation ability was more highly related to mental age than to chronological age. Using fifty children each at ages seven, nine and eleven, the Wechsler Intelligence Scale for children and a concept formation test of the "sorting type," he obtained significant differences on three variables: the number of

logical concepts achieved, the mean time necessary to produce a concept, and the number of non-functional concepts achieved.

These variables were all significantly related to mental age and more highly related to mental age than to chronological age.

CONCEPT FORMATION AND BRAIN DAMAGE

The purpose of this review is to ascertain the nature of research that has been conducted on concept formation in cerebral palsied school children. Cerebral palsy is subsumed under the broader classification of brain damage. This review will not attempt to synthesize all the literature dealing with brain damage and concept formation, but only that which is necessary to gain a historical perspective on conceptualization in cerebral palsied brain-damaged school children.

Psychological research on brain-damaged individuals was in its infancy in the early part of the twentieth century. The work of Goldstein (14) gave added impetus to the area following World War I. His work also furnished a beginning theoretical basis for mental functioning with postulated cerebral correlates.

One of the early studies dealing with concept formation in brain-damaged adults was that of Halstead (15). Since it has set the direction of experimental thought in investigating concept formation in cerebral palsied children, it will

be reviewed in some detail.

The study was concerned with attempting to determine how alterations with the cerebrum affected the "higher" mental functions. Halstead's study was conducted on twenty-six "carefully selected neurosurgical patients" at the University of Chicago Clinics in the late 1930's. Of these cases, eleven had a considerable lesion in one frontal lobe; one had an undetermined amount of cortial atrophy residual to removal of a small meningioma from the right frontal lobe; fourteen had lesions in the brain posterior to the frontal lobes, including one instance of cerebellar lesion. These patients ranged in age from fifteen to sixty-three. Eleven normal subjects were used as controls; ages twelve to fifty-six.

The area and extent of the damage was ascertained by the following methods: (1) lateral X-ray plate in which silver clips outline the lesions, (2) operative notes by the surgeon, (3) sketch of the operative field made by the surgeon at the time of the operation, and (4) diagram of the operative field made by Halstead at the time of the operation.

Halstead's (15:1274) test objects, listed in Table II, consisted of sixty-two objects which differed in size, shape, color, brightness, weight, material, hardness and position. The objects were presented to the subject in a predetermined arrangement on the surface of a table (2' by 3' at a height of 30"). Good rapport was established before testing began.

TABLE II

OBJECTS USED IN HALSTEAD'S STUDY
(ADAPTED FROM HALSTEAD)
(15:1274)

Objects	
Glass Bottle Labeled "Camphor"	Pink Candle Holder for Cakes
Glass Stopper	Bakelite Bracelet
House Key	Rubber Grommet
Wooden Pulley	Red Paper Stock
Colored Picture of a Rooster	Small Padlock
Glass Bottle and Stopper Labeled "Bergamot"	Red Poker Chip
Pink Yarn	Card Labeled "Hairpin"
Yellow Yarn	Metal Thimble
Multicolored Cube	Piece of Thick Roundish Stick
Metal Whistle	Red Poker Chip
Colored Picture of a Bell	Colored Picture of a Rabbit
Cancelled Foreign Postage Stamp	Black Wooden Cube
Toy Metal Spoon	Small Glass Jar
Bone Chess Pawn	Toy Metal Fork
Miniature Electric Light Socket	Small Metal Key
Blue Yarn	Metal Pulley
Coarse Sandpaper	Blue Bakelite Earring
Smoked Glass Lens	Canvas Doll Slipper
Pipe Stem	Toy Metal Knife
Playing Card	Small Metal Key
Metal Jar Lid	Miniature Electric Light Bulb
Small Cork	Metal Puzzle
Pipe Bowl	Round Wooden Box Lid
Picture of a House Key	Round Wooden Box
Small Wax Candle	Fine Sandpaper
Rubber-Covered Wire	Card Labeled "Pipe"
Lipstick	Blue Poker Chip
Wax Crayon	Flashlight Bulb
Metal Hairpin	Colored Picture of a Doll
Red Wool Cloth	
Piece of Thin Roundish Stick	
Abstract Design	
Ping-Pong Ball	

Speed or rate of performance was not mentioned or suggested as a factor. The testing time with the normal subjects varied between one and one-half and two hours, whereas the testing time for the cerebral injury patients averaged about thirty minutes; necessitating as many as seven testing sessions to obtain the necessary information.

The testing situation was divided into five parts (15:1274-1276):

> Part I was concerned with establishing the range of interest and familiarity of the subjects with the test-objects. The subject was asked: "Have any of these things ever been of interest to you -- if so, pick them up one at a time." The examiner also ascertained if the subject knew the names of the objects not chosen; looking for evidence for anomia at all times.
>
> Part II was concerned with having the subject make a "spontaneous" grouping of some of the test-objects. The subject was told: "Place those things together which seem to you to belong together." After five groups were achieved, the subject was allowed to rest for five minutes at the first pause or slowing in rate of progress.
>
> Part III was concerned with testing for recall of the test-objects by the method of imminent recall, i.e. at the end of the five minute rest period the articles were covered up and the subject was asked to name the things he saw on the table.
>
> Part IV was concerned with testing for nominal equivalence. The cover was removed from the objects and the subject asked why he had put the objects together in groups. The test objects were then randomly mixed, and the subject asked to group them another way. This was continued until no further ways of grouping could be ascertained by the subject.
>
> Part V was concerned with determining in a preliminary way the basis of equivalence of the test-objects in groups. The group of test-objects previously made by the subjects and five groups prepared by the examiner were used. The subject was asked if certain objects could be either removed or added to the group without disturbing its grouping principle.

The results of this experiment established what has since become known as the characteristic modes of response of brain-damaged individuals in conceptual behavior. Halstead's frontal lobe (his analysis is based on them alone) brain-damaged subjects used fewer test-objects in their first spontaneous grouping (Part II). Rorschach examination of these subjects also revealed evidence of constriction.

When tested for recall (Part III) after five minutes, the frontal lobe subjects averaged fewer recalled objects than did the normal subjects. The frontal lobe patients did not remember any more of the grouped than ungrouped test-objects, whereas normal individuals tended to remember better those objects they had grouped. This suggests that frontal lobe lesion can reduce or eliminate the effects of experience; the learning hypothesized to have occurred from the previous grouping.

The frontal lobe cases also produced a smaller number of groups despite the fact they took 30 per cent longer on the test than the other subjects. Further, the frontal lobe cases produced groups calling for a categorical attitude, which caused Halstead (15:1289) to question Goldstein and Weigl who had asserted that subjects with frontal lobe lesions could not adopt such a conceptual attitude.

CONCEPT FORMATION AND CEREBRAL PALSY

One of the first comprehensive studies attempting to deal with conceptual behavior in cerebral palsied children was that of Cottom. She stated that the literature to 1941:

> Concluded that cerebral injury of ten results in a diminution of abstract behavior and a corresponding increase in more concrete responses to problem situations, as well as in a loss in ability to shift, voluntarily, from one aspect or attribute of a problem to another ... She raises the question ... would one find a lack of the development of such abstract behavior in cases of brain injury during infancy or immaturity? (4:27)

Cottom also indicated that research has typed the brain-injured as being characterized by stereotypy and by impairment in the ability to perceive abstract relationships. Cottom used twenty-six "spastic school children" matched in sex, chronological age, and estimated mental age (estimated for cerebral palsied only) with twenty-six physically normal children. She administered a series of thirteen sorting situations; a completion test involving concrete, pictorial and verbal material; a light pattern memory test and a string-pattern test.

The tests were administered as follows: (1) Sorting Test: A group of thirty-two objects, fifty-four leather, glass and cardboard forms, and two lists of words, in different combinations constituted the thirteen sorting test situations. Her results are contained in Table III. (2) Light Pattern Test: This test required the subject to repeat a patterned sequence of colored lights which could be varied and indefinitely increased in complexity. The test began

TABLE III

SUMMARY OF RESULTS IN COTTOM'S SORTING TEST SITUATIONS I-XIII (FROM COTTOM) (4:34)

Type of Response	Spastics	Normals
1. Total Classifications on the Basis of Color	40	19
2. Total Classifications on the Basis of Shape	70	98
3. Total Classifications on the Basis of Size	27	36
4. Total Classifications on the Basis of Material	21	13
5. Total Classifications on the Basis of Familiar Associations	42	43
6. Total Classifications on the Basis of Comprehensive Relationships*	65	99
7. Total Classifications on the Basis of Fantasy and Design	30	1

* These totals include some of the color, shape and material classifications totaled above.

TABLE IV

SUMMARY OF THE RESULTS OF COTTOM'S LIGHT-PATTERN TEST (FROM COTTOM) (4:35)

Type of Response	Spastics	Normals
1. Successfully Completed Five-Light Patterns (Upper Limit)	0	2
2. Successfully Completed Four-Light Patterns	11	10
3. Successfully Completed Three-Light Patterns	8	9
4. Successfully Completed Two-Light Patterns	1	0
5. Exhibited "Stereotyped" Behavior	9	1

with two light patterns and continued until the subject failed five out of eight patterns of a certain complexity. Cottom's results are contained in Table IV. (3) The Completion Test: This test consisted of three groups of objects, three of pictures and four of words, each group having in common the fact that something was lacking to complete it or to make it useful. Cottom's results are contained in Table V. (4) The Patterned String Test: This test consisted of twenty patterns: four each using two, three, four, five and six strings. Kindergarten children only were used for this test. A Life-Saver was attached to one string which the child could pull toward him by finding the correct string and pulling on it. The results are contained in Table VI.

Cottom summarized her results by saying:

> With one or two exceptions the spastic group differed demonstrable from the normal in three general respects: first, a wider range of individual differences in type of response within any one test situation, with bizarre or fantastic responses found only among the spastics; second, a greater tendency toward more concrete types of response, with less ability to shift toward the more abstract forms of behavior; and, third, a greater tendency toward stereotyped responses no matter what the nature of the test situation. Consistency within the battery was the rule in nearly all the cases (4:42).

Several other points of interest are noted in Cottom's analysis of the various tests. The spastics preferred color classifications, where normal subjects preferred shape. For both groups the concepts of color, size, and shape seemed basic, and they fell back upon it when unable to derive other grouping principles.

TABLE V

SUMMARY OF RESULTS IN COTTOM'S "COMPLETION" TEST (FROM COTTOM) (4:36)

	Types of Response	Spastics	Normals
1.	All Concrete Tasks Correct on First or Second Trial	13	15
2.	All Pictorial Tasks Correct on First or Second Trial	14	14
3.	Three to Four Verbal Tasks Correct on First or Second Trial	4	8
4.	One to Two Verbal Tasks Correct on First or Second Trial	11	4
5.	Exhibited Stereotyped Behavior	3	0
6.	Consistently Guessed When in Doubt	4	7
7.	Matched Items Instead of Completing the Series	1	3
8.	"Gave up" When in Doubt	4	5
9.	Consistently Needed Second Trial	3	1

TABLE VI

SUMMARY OF RESULTS IN COTTOM'S STRING-PATTERN TEST (FROM COTTOM) (4:38)

	Types of Response	Spastics	Normals
	A. Number of Patterns Correctly Solved on First Trial		
1.	Nineteen to Twenty	11	11
2.	Fifteen to Seventeen	3	4
3.	Twelve to Fourteen	1	2
4.	Nine to Eleven	1	1
5.	Six to Eight	3	2
6.	Three to Five	1	1
	B. Overt Movement Utilized In Obtaining Solution		
1.	Extensive Head, Trunk and Arm Movements	11	0
2.	Extensive Finger Movements	1	3

The spastic children were markedly more deliberate than the normals. The spastics studied the situations longer before beginning to respond. Halstead (15:1280) also noted the deliberate behavior of frontal lobe injured patients.

Cottom throughout her article has interspersed several statements which bear directly on the hypotheses stated on page four of this study. They are:

> Mental age apparently has some rather definite connection with the ability to reproduce the more complex patterns (4:35).
>
> Are unusual responses of spastics analogous to the type and severity of their disability? (4:38)
>
> Stereotypy (perseveration in present study) apparently has little relationship to the estimated mental ages of our subjects (4:40).
>
> These findings would indicate that a severe speech difficulty was more often connected with stereotyped behavior, with "fantasy" responses, and with difficulty with verbal (abstract) material than such categories as estimated mental age or type and severity of disability in general (4:40).

It is apparent that these statements of Cottom relate to the operational hypotheses stated in Chapter III, which assert that mental age is related more to difficulty in various areas of conceptualization than is degree of physical disability or kind of cerebral palsy. A weakness in Cottom's study is the grouping together of spastics and athetoids, whereas Holden's (19) study indicated they should be treated separately.

There has been considerable speculation (36:64) as to the difference in concept formation between the brain-injured

mentally defective and the "garden-variety" mentally defective. Strauss and Werner (38) conducted a study on this problem. Two groups of twenty children each were used. The first group was mentally retarded of the familial, hereditary or endogenous type. The second group showed evidence of brain damage: the so-called exogenous, brain damaged mentally defective. A further control experiment utilizing ten normal children was conducted. Strauss and Werner used an adaptation of Halstead's (15) test in their study and found several characteristics differentiating the brain-injured mentally defective from the non-brain-injured mentally defective. They are:

(1) The brain-injured children selected more objects than the children in the two control groups.

(2) There was a significantly higher percentage of uncommon responses in the brain-injured group than in the control groups.

(3) A principle of selection of objects made by brain-injured children seemed to be based particularly upon usual or accidental or apparently insignificant details.

(4) The brain-injured children were markedly attracted by properties of objects apt to elicit motor response (38:168)

The brain-injured were further characterized by:

(1) Arrangement of objects in circumscribed unity.

(2) Formalistic behavior (vis, meticulosity, organic pedantry, arbitrary patterning, etc.)

(3) Dynamic-concrete grasp of relationship. (e.g., dramatization, animation of the situation). (38:168)

One of the most recent studies dealing specifically with concept formation in cerebral palsied children is that

of Dolphin and Cruickshank (9). Because of the similarity of cerebral palsied children to exogenous mentally retarded children studied by Strauss and Werner (38), Dolphin and Cruickshank were interested in testing for similarities in concept formation between the two groups. They devised their study as follows: two groups of thirty children each were selected; one cerebral palsied, the other physically normal. There were sixteen boys and fourteen girls in each group. The mean chronological age of the cerebral palsied was 10.026 and the normal children 10.173. The range of intelligence quotients was from 78 to 129 inclusive with sixteen children in each group having I.Q. scores above ninety.

The Picture Object Test was given to these sixty children individually. The test (9:387) involves determining relationships between life situations as represented in pictures and in a collection of small objects. Two enlarged pictures were pasted on white cardboard and mounted on wooden blocks. They were presented upright on the table before the child. Picture I showed individuals running away from a large wave which was breaking over a boardwalk. Picture II showed a large building which was on fire during the night. One hundred two small objects were arranged in random order to the left on the top of the table. The pictures were facing the child at the rear of the table. The objects used for the study (9:387-388) are contained in Table VII.

Dolphin and Cruickshank's instructions to the child were as follows:

TABLE VII

OBJECTS USED IN DOLPHIN AND CRUICKSHANK'S TEST
(ADAPTED FROM DOLPHIN AND CRUICKSHANK)
(9:387, 388)

Objects		
Glass Bottle	Fire Engine	Colored Picture of a Rooster
Colored Cube	Wire	Rubber Covered Wire
Sunglasses	Rubber Hose	Colored Picture of a Ball
Wax Crayon	Swab	Small Round Red Button
Glass Stopper	Nails	Piece of Red Wool Cloth
Paint Brush	Screws	Card Labeled "Ball"
Cork	Yellow Yarn	Card Labeled "Pipe"
Hairpin	Earring	Cancelled Foreign Postage Stamp
Metal Jar Lid	Pipe Bowl	
Metal Whistle	Chair	Card Labeled "Hairpin"
Metal Pulley	Table	Colored Picture of a Doll
House Key	Clock	Colored Picture of a Rabbit
Padlock	Stove	Round Paper Box Lid
Playing Card	Wash Stand	
Father Doll	Bathtub	
Mother Doll	Metal Puzzle	
Brother Doll	Burned Matches	
Sister Doll	Rubber Grommet	
Baby Doll	Coarse Sandpaper	
Lipstick	Piece of Cord	
Metal Fork	Thick Round Stick	
Metal Spoon	Picture of a Key	
Pipe Bowl	Small Wax Candle	
Paper Clip	Toy Metal Knife	
Pink Yarn	Electric Socket	
Metal Thimble	Ping-Pong Ball	
Rubber Band	Red Paper Stock	
Scissors	Thin Round Stick	
Bracelet	Small Metal Key	
Black Cube	Red Poker Chip	
Doll's Shoe	Blue Poker Chip	
Doll Dishes	Box of Matches	
Toy Hammer	Electric Light Bulb	
Toy Saw	Toy Screwdriver	
Toy Augur	Round Paper Box	
Toy Wrench	Fire Chief Car	
Bed	Brown Glass Bottle	
Cotton	Medium Size Stick	
Chess Pawn	Chest of Drawers	
Soap	Typewriter Eraser	
Bus	Flashlight Bulb	
Police Car	Small Metal Spring	
Oil Truck	Plastic Bottle Top	
Red Coupe	Pink Candleholder for Cakes	
Red Sedan	Cylindrical Wooden Piece	

> Do you see this picture? It is a picture of those children who are running from this wave which might drown them. Now this picture shows a building on fire. Do you see the smoke and the flames coming from the house? There you see a number of objects. Put before the picture of the children running from the water those things which go with that picture. Those things which go before the building on fire put over here, and those things which you are sure do not belong to either picture put over here. (9:388)

When the child had finished putting all the objects in one of the piles, he was asked his reason for placement and verbatim responses were recorded. Table VIII is adapted from Dolphin and Cruickshank (9:391), and compares the number of objects chosen by cerebral palsied and other children.

TABLE VIII

COMPARISON OF NUMBER OF OBJECTS USED BY THE CEREBRAL PALSIED AND NORMAL GROUPS WITH THE RESULTING "t" SCORES FOR THE PICTURE OBJECT TEST (ADAPTED FROM DOLPHIN AND CRUICKSHANK) (9:391)

	Cerebral Palsy Group			Normal Group		
	Picture I (2)	Picture II (3)	Total (4)	Picture I (6)	Picture II (7)	Total (8)
Mean No. of Objects Used	8.26	27.633	35.9	4.03	13.33	17.36
Standard Deviation	6.771	20.260	26.260	2.851	11.50	14.12
t Scores Between						
Columns 2 and 6				2.2741		
Columns 3 and 7				3.3255		
Columns 4 and 8				3.5381		
Per cent of Significance of t						
Columns 2 and 6				2		
Columns 3 and 7				1		
Columns 4 and 8				1		

Table VIII shows a high degree of significant difference between the number of objects chosen by cerebral palsied and normal children. This agrees with the findings of Halstead (15), Cottom (4), and Strauss and Werner (38). There were other differences in Dolphin and Cruickshank's study besides the number of objects used such as:

> The cerebral palsy group (1) made more selections of objects based on secondary qualities of the objects, (2) chose a larger number of uncommon objects, (3) dramatized the picture in their selection of objects, (4) extended the pictures into space and time, (5) frequently rejected an object after having initially selected it, and (6) in some cases were unable to organize the pictures into a meaningful whole (9:392).

INTELLECTUAL MEASUREMENT OF THE CEREBRAL PALSIED

Holden (19) reviewed the psychological studies on cerebral palsy between 1947 to 1952. His review was based on articles reported in the Psychological Abstracts. The review reported only seventeen articles for the fifteen year period between 1931 and 1946, but a total of ninety-one articles for the five year period between 1947 and 1952. Holden grouped the nature of the studies between 1947 and 1952 under four groups: namely, (1) new techniques in testing, (2) mental evaluation, (3) personality evaluation, and (4) basic psychological research in cerebral palsy. In his summary Holden stated that "most" of the articles were devoted to the problem of intellectual evaluation.

Writers in the late 1940's and early 1950's were saying with Denhoff that:

> The basic need in the psychological evaluation of the child with cerebral palsy is the development of simple measures than can indicate educability and prognosticate the ultimate level of intellectual attainment (7:9).

The criticisms against the standard intelligence tests as a measure for the cerebral palsied have been aptly summarized by Hill as follows:

1. It is impossible to assess the intellectual capacity of the cerebral palsied. Therefore, the I.Q. has no meaning -- at least a different meaning -- when used to describe the intellectual status of children with cerebral palsy.

2. Present instruments are inadequate for use with the cerebral palsied.

3. Cerebral palsied children should be measured by tests standardized on the cerebral palsied population rather than the general population.

4. In many instances diagnoses are given by those who have little or no training in understanding the problems of brain-injured children (17:591).

While recognizing the partial validity of all of these claims, the concensus of the literature recognizes the desirability of using the standard measures of intelligence with adaptations and supplementary tests as necessary. (1; 23; 41; 19; 22; 23)

The psychologists who worked with Hohman (18:283) used the Stanford-Binet Intelligence Scale, The Vineland Social Maturity Scale, The Merrill Palmer and the Cornell Cox as their intellectual criterion. They considered that 56 per cent of their 477 subjects responded satisfactorily to the tests, 34 per cent responded well enough to define a general range of intelligence and only 9 per cent were so disabled as to obviate the use of standard tests in intellectual test-

ing. Hohman's (18) article, which summarized the important studies in intelligence levels in cerebral palsied individuals, indicated that between 50 to 70 per cent are mentally retarded and that at least 50 per cent are seriously retarded and mentally defective. Only 3 per cent score an I.Q. of 110 or above, whereas 23 per cent of the normal child population will be above 110.

The Columbia Test of Mental Maturity (2) is one of the most recent attempts to devise a special test standardized on a cerebral palsied population. It requires no verbal responses and a minimum of motor responses. In its standardization, correlations of .66 to .88 were obtained between various age levels of this test and the Stanford-Binet.

Enough research has not yet accumulated to indicate the practical value of this test; but it appears to have much to offer because of its great adaptability to the handicapped child such as, its lack of verbal responses and its minimum requirement of motor responses.

SUMMARY

This review of research reveals some rather definite trends. The studies to date on concept formation in cerebral palsied children have been based on Halstead's (15) study which was conducted on adult operative patients.

The concept formation tests have utilized numerous objects with stimulus values that have been at odds with the rather well established factors in brain damage: (a) forced

responsiveness to stimuli, (b) perseveration, (c) dissociation, (d) disinhibition, (e) and disturbances of the figure-background relationship (17:591).

Studies with the cerebral palsied have used biased samples with respect to intelligence. Sixteen or 53 per cent of Dolphin's and Cruickshank's (9:387) thirty subjects had I.Q. scores above ninety; whereas Hohman's (18:287) study indicated that only 16 per cent of cerebral palsied children score at or above ninety.

The literature also indicated (17:52) that, in most instances, it is possible to secure a valid test of intelligence on the cerebral palsied with the standard tests of intelligence. The reliability and validity of such testing depends on the ability of the examiner to make such modifications as are necessary without doing violence to the test standardization, at the same time using special tests or procedures when the specific disability of the cerebral palsied child necessitates such.

CHAPTER III

PROCEDURE AND METHODOLOGY OF THE STUDY

It is evident from a review of the literature that concept formation has not been adequately investigated in cerebral palsied school children. The studies that have attempted to deal with the subject have used methods which penalize the cerebral palsied child because of his specific learning difficulties, his mental ability and his restricted experience. A decade ago workers in the field of cerebral palsy were assuming there was no intimate connection between the disability and proficiency in concept formation. It was assumed that with increasing chronological age and experience, the child would grow out of his deficit in concept formation ability. Recent studies such as Hohman's (18), which have investigated the intellectual ability of cerebral palsied children, have caused a downward revision in the estimate of their intellectual potential.

Coleman's (3) study showed a positive relationship between mental age and conceptualization rather than between chronological age and conceptualization.

To a large degree this study is patterned after that of Coleman's. The identical experimental tasks are used for the following reasons: their accessibility to statistical treatment, their relative freeness from cultured and experiential

factors, their wide range of difficulty and their adaptability to testing some hypotheses in cerebral palsied brain-damaged children. The identical experimental tasks were further used in order to facilitate making comparisons between "normal" and cerebral palsied children. Coleman's study, on normal children, was conducted in the same geographical area within a year previous to this study.

SUBJECTS

The subjects were thirty cerebral palsied children enrolled in the orthopedic units of Walnut Street Elementary School, Pattengill Junior High and Eastern High Schools in Lansing, Michigan during the school year of 1955-1956. Scores on the concept formation task, the Stanford-Binet Intelligence Scale and the Physical and language disability rank were obtained for each subject with the results indicated in Table XI.

The obtained I.Q. scores ranged from extremely mentally defective through average, bright average and superior levels: ranging from 27 to 138. The high degree of overlap of mental ages from grade-to-grade should be noted. The ages of the subjects ranged from 4.6 to 20.1 with a mean of 10.3 and a standard deviation of 3.10, while the mental ages of the subjects ranged from 2.8 to 17.1 with a mean of 8.44 and a standard deviation of 3.92. Finally, the sample was composed of sixteen boys and fourteen girls. Tables IX and X contain the clinical and topographical diagnoses of the subjects.

TABLE IX

CLINICAL DIAGNOSES AND SEX OF SUBJECTS

Diagnoses	Boys	Girls	Totals
Spastic	12	11	23
Athetoid	1	3	4
Ataxia	1		1
Tremor-Ataxia	1		1
Spastic-Athetoid (Mixed)	1		1
Totals	16	14	30

TABLE X

TOPOGRAPHICAL DIAGNOSES AND SEX OF SUBJECTS

Diagnoses	Boys	Girls	Totals
Hemiplegia - Right	4	4	8
- Left	4	1	5
Paraplegia	1	4	5
Quadriplegia	7	5	12
Totals	16	14	30

THE EXPERIMENTAL TASKS

The Conceptual Task. This task is identical to that of Coleman's (3). It consists of a series of plastic pieces (one-eighth inch thick) of three different forms (circle, equilateral triangle, and square), three different colors (red, yellow, and green), and three different sizes (1 1/8, 1 9/16 and 1 7/8 inch circles; 1, 1 3/8 and 1 11/16 inch squares; 1 1/2, 2 3/16 and 2 9/16 inch equilateral triangles), for a total of twenty-seven pieces. According to Coleman, the different forms of the same size were made equal in size by equating surface areas. It was determined that if the sides of the figures were equated, the resulting perceptual differences between the sides were so great as to virtually force a classification according to this dimension. By equating areas rather than sides, the size difference is still well above the threshold, but requires the perception of relationship rather than absolute size.

A standard set of directions for administration was devised by Coleman. (See Appendix)

After it is certain that the child knows the names of the colors involved, he is asked to place all of the pieces into different groups so that a common principle governs his placement of the pieces. In other words, the subject is told to place all of the pieces into piles so that all of the pieces in each pile belong together in some way. Essentially the same directions are repeated with systematic hints until

the subject can no longer classify the pieces in any way.

The concept formation test was constructed and used for the following reasons:

1. It provides a range of difficulty from simple to complex.
2. It has more than one solution in a problem which is potentially solvable by individuals with a wide range of ability.
3. It makes possible illogical or inappropriate solutions.
4. It is relatively free from the effects of past experience.
5. The results are easily quantifiable in various dimensions.
6. It lends itself to an operational definition of concept formation.

The concept formation test is scored on six different variables:

1. Score for time. The mean time necessary to achieve a concept is obtained by dividing the total time by the number of logical concepts achieved.
2. Number of logical concepts. With the twenty-seven pieces of the concept formation task, six logical concepts are possible: classifications based on color, shape, and size, each yielding three groupings, and combinations of these such as, color-shape, color-size, shape-size, each making nine groupings.

The first three concepts are referred to as unidimensional since they require a single common principle, and the second three are referred to as bidimensional since they require a double principle in their solution.

3. Number of unidimensional concepts. The concepts of color, shape and size requiring a single grouping principle.
4. Number of bidimensional concepts. The concepts of color-shape, shape-size and color-size require a double grouping principle.
5. Number of illogical or alogical concepts. These are defined as those concepts which do not conform to the instructions, in that pieces are misplaced, or there are other than three or nine groupings.
6. Number of repetitive concepts. During the course of the administration any concept which is repeated is called a repetitive concept.

Numbers 2, 3, and 4 are called functional concepts, while numbers 5 and 6, for this purpose, are termed non-functional concepts. The results of the concept formation test are summarized in Table XI.

The Intelligence Test. The Stanford-Binet Intelligence Scale: Form L (43) was used as the intellectual criterion for the following reasons:

1. The test is now in wide clinical use with cerebral palsied children and much work has been done on its

applicability to these children (18; 22; 23).

2. The test has a low basal mental age (two years) which is necessary for the children of this study.
3. The test has high motivational qualities at the lower ages which is especially necessary for brain-damaged cerebral palsied children.
4. The mental age scores are readily used in statistical analysis.

The Stanford-Binet Intelligence Scale: Form L has been standardized on children from age two through the Superior Adult III level or from the mental age of two years through twenty-two years and ten months. A review of the literature shows that with slight adaptations, which in no way invalidates the test, the Binet test can be used with most cerebral palsied children. This proved to be true in our sample. Table XI contains the data from the Binet intelligence test.

As a corollary measure the Columbia Mental Maturity Scale (2) was also given to twenty-four subjects who had also been given the Stanford-Binet. This is a relatively new test and one which has been standardized on cerebral palsied subjects in New York. This test was given as a further check on the Stanford-Binet scores and also to further research on the test. It is new yet indicates promise in the field of cerebral palsy.

Since the main hypotheses of this study are to test the relationship of mental age to certain other variables, mental age scores are used rather than I.Q. scores. Further, our

population has a relatively wide age range and age is a factor in the I.Q. equation.

Diagnoses and Physical Disability Ranking. Table XI gives the medical diagnoses and rank of disability of each subject. The diagnoses were obtained from the medical records of the children whenever possible, and supplemented by the professional opinion of two physical therapists and an occupational therapist. These therapists had worked with the children intensively and were intimately acquainted with them.

The subjects were ranked from one to thirty as to degree of total physical disability. The subject receiving a rank of "one" is most disabled. Each subject had been given muscle tests as used in physical and occupational therapy. This test grades the use of the muscle in six categories: normal, good, fair, poor, trace, zero.

The "physical disability rating" attempted to consider the total individual: both upper and lower extremities, ambulation with and/or without support, and general physical incapacity. The ranking attempted to disregard the "functional disability" of the subject, as this is influenced heavily by intelligence and learning. The results of the muscle test and medical reports indicated some subjects should be able to walk unaided, but were unable to do so. This would be regarded, in our present state of knowledge of cerebral palsy, as a functional disability and this subject would rank as less physically disabled than another who might be

walking with some degree of proficiency.

Speech and Language Ranking. The speech therapist ranked the subjects who receive speech training from one to fifteen according to degree of severity. The subject receiving a rank of "one" is most severely affected. Only fifteen of the thirty subjects were receiving speech therapy. The rankings are presented in Table XI. This rating included total language disability, both remedial and developmental. Cerebral palsied children often have remedial speech needs, such as faulty articulation and sound substitutions, as well as a lack of speech development due to many physiological and psychological factors. The speech therapist attempted to rule out the intellectual factors, as far as possible, in ranking the children in order of speech handicap. This was done in order that the language handicap could be correlated with the intellectual as well as physical impairment. This necessitated that the intellectual component be ruled out of the speech and language rating. Table XII shows the correlations between speech and language, physical disability, kind of cerebral palsy, mental age and concept formation ability.

OPERATIONAL HYPOTHESES

With reference to the procedure and general hypotheses stated on page four, the hypotheses may now be stated in operational terms.

1. The number of logical concepts produced is more

highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy.

2. The degree of speech and language disability is more highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy.
3. The mean time necessary to produce a concept is more highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy. This is an inverse relationship.
4. The degree of dimensionality of the concept produced is more highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy. Dimensionality is defined as a measure of the number of factors in a concept, such as color or color-shape.
5. The formation of illogical concepts is more highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy. This is an inverse relationship.
6. The formation of repetitive or perseverative concepts is more highly related to mental age than it is to: (a) degree of physical disability, (b) kind of cerebral palsy. This is an inverse relationship.

PROCEDURES FOR ANALYSIS OF THE DATA

Since the operational hypotheses on pages 40-41 express a stronger relationship between conceptual ability and mental age than between conceptual ability and disabilities due to cerebral palsy, it is necessary to secure measures to show the relationships of all these variables.

The factors of mental age, physical disability rank, spasticity vs non-spasticity and affected topographical area (these latter two being "kinds" of cerebral palsy) must be related to measures of concept formation (number of logical concepts, mean time per concept, degree of dimensionality of concept, number of illogical concepts and repetitive concepts) and to degree of speech and language disability.

The analysis of the data must also test the hypothesis that the correlation with mental age is higher than with measures of cerebral palsy difficulty. The data are of several kinds:

1. Enumeration data - mental age, number of logical concepts, mean time, i.e., any counted or scaled data.
2. Ranked data - physical disability rating, and speech and language disability rating.
3. Dichotomous data - spastic vs non-spastic.
4. Trichotomous data - hemiplegia, paraplegia, quadriplegia.

These differing kinds of data make it impossible to use the same measure of relationship for all comparisons. A so-

lution to this difficulty can be resolved, when correlating, as follows:

1. Enumeration vs enumeration data use product moment correlation.
2. Enumeration vs ranked data use rank order correlation. (convert enumeration data to ranked)
3. Enumeration vs dichotomous data use point-biserial correlation.
4. Enumeration vs trichotomous data use contingency coefficient.
5. Ranked vs ranked data use rank order correlation.
6. Ranked vs dichotomous data use White's T test.
7. Ranked vs trichotomous data use the Kruskal - Wallis H Test.

The rank order correlation coefficients were corrected for bias by applying formula 11.45 from Walker and Lev (45:282).

No correction for bias is available for the contingency coefficient. It is not a very satisfactory estimate of the correlation coefficient, but was used because it was the only available measure.

The next step in the analysis of the data is to test the significance of the difference between the measures of relationship with the Binet vs conceptual ability and the measures of degree and kind of cerebral palsy vs conceptual ability.

Since the usual Z transformation technique assumes independent random samples, another test was used. Walker and Lev's formula 10.60 (45:257) requires the three correlations and the number of cases in the sample. Although the test is designed for use only with product moment correlations and the data included rank-order, point-biserial and contingency coefficients, no other test known approached usefulness in this situation. These latter correlations all approximate the product moment correlation and the assumption is made that the formula is useful in this instance also.

CHAPTER IV

ANALYSIS OF THE DATA

The basic data of the results of this study are contained in Table XI. It lists, for every subject, the chronological age, sex, grade, Binet mental age, I.Q., physical disability rank (P.D.R.), speech and language disability rank (S.L.D.R.), mean time per concept in seconds, number of illogical concepts, number of repetitive concepts, and the individual concepts achieved. Tables XII-XX are based on the data from Table XI. All of the data are based on a sample of thirty, except in those places in the tables where a lesser "N" is indicated. Only fifteen subjects were receiving speech therapy and three subjects had no repetitive concepts; reducing those respective samples to fifteen and twenty-seven.

From Table XI and also Table IX it will be noted that the sample was composed of twenty-five spastics, four athetoids, one ataxia, one tremor-ataxia, and one mixed spastic-athetoid. Analysis revealed that the sample was composed of 76 per cent spastics which agrees highly with Hohman's (18:288) estimate that spastics account for 75 per cent of all cerebral palsied cases. The sample showed no numerical sex difference, being composed of sixteen boys and fourteen girls. The grade placement of the subjects showed five sub-

TABLE XI

MEDICAL DIAGNOSES, AGE, SEX, GRADE, BINET MENTAL AGE, I.Q., PHYSICAL DISABILITY RANK, SPEECH AND LANGUAGE DISABILITY RANK, MEAN TIME PER CONCEPT IN SECONDS, NUMBER OF ILLOGICAL CONCEPTS, NUMBER OF REPETITIVE CONCEPTS, AND THE CONCEPTS ACHIEVED FOR INDIVIDUAL SUBJECTS

Subj. No.	Diagnoses	Age at Binet Test	Sex	Grade	Binet Men. Age	I.Q.	P.D.R. *	S.L.D.R. **	Mean Time Sec.	Ill. Concepts	Rep. Concepts	Concepts Achieved (v) C 1	Sh 2	S 3	C-Sh 4	Sh-S 5	C-S 6	No. of Concepts
1	Left Spastic Hemiplegia	11-2	M	3	6-10	61	15	—	118	5	—	v	—	—	—	—	—	1
2	Right Spastic Hemiplegia	5-6	F	K	3-9	68	16	3	77	6	—	—	—	—	—	—	—	0
3	Right Spastic Hemiplegia	13-10	F	Sp. ***	3-9	27	3	1	189	5	—	v	—	—	—	—	—	1
4	Right Spastic Hemiplegia	7-10	F	1	6-10	87	30	6	339	3	1	v	—	—	—	v	—	2
5	Spastic Paraplegia	9-7	F	3	8-2	85	19	13	165	4	1	v	—	—	v	—	—	2
6	Left Spastic Hemiplegia	11-1	M	5	13-1	118	22	—	212	1	4	v	v	—	v	v	—	4
7	Left Spastic Hemiplegia	6-5	F	5	6-3	97	17	15	172	4	1	—	—	—	v	—	—	1
8	Spastic Quadriplegia	15-4	M	6	12-2	83	6	—	132	0	4	v	v	v	—	—	v	4
9	Spastic Paraplegia	9-8	F	4	10-6	109	20	—	164	0	5	—	v	—	—	v	—	2
10	Spastic Quadriplegia	10-10	M	2	6-7	61	24	—	177	0	5	v	—	—	—	—	—	1
11	Spastic Quadriplegia	6-3	F	K	4-11	71	10	—	195	5	0	—	—	—	—	—	—	0
12	Left Spastic Hemiplegia	9-1	M	2	6-4	70	21	14	103	4	1	v	—	—	—	—	—	1
13	Spastic Paraplegia	8-8	F	2	6-2	71	8	9	105	2	3	v	—	—	—	—	—	1
14	Spastic Paraplegia	4-6	M	K	2-8	59	14	—	61	5	0	—	—	—	—	—	—	0

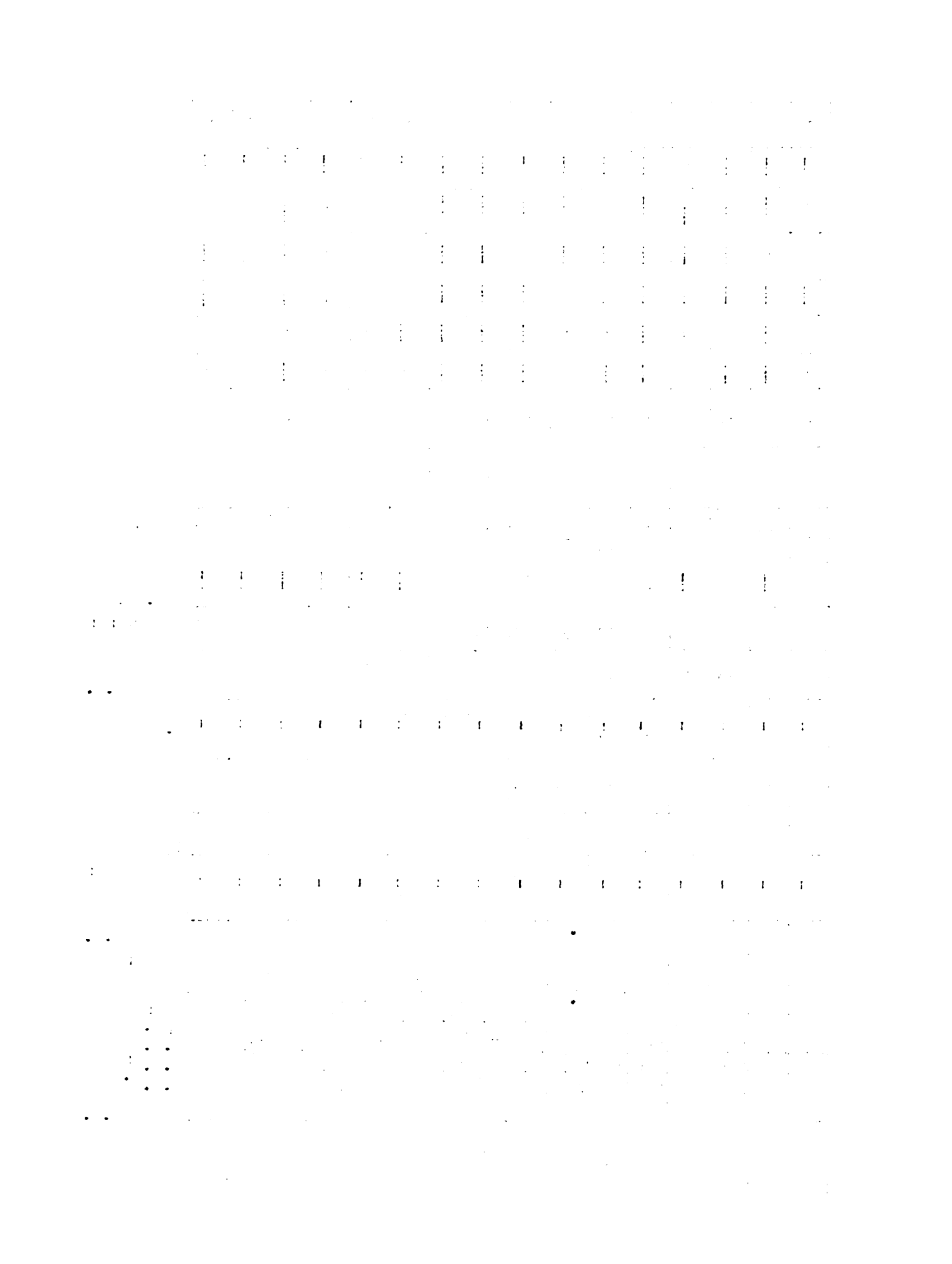
15	Spastic Quadriplegia	8-1	M	2	8-8	107	5	10	246	2	3	v	v	—	v	v	—	4
16	Spastic Quadriplegia	12-2	F	4	10-8	88	2	—	183	0	5	—	—	—	v	—	—	1
17	Athetoid Quadriplegia	9-9	F	2	5-8	58	1	7	321	1	4	—	v	—	—	—	—	1
18	Left Spastic Hemiplegia	11-8	M	6	10-2	87	28	—	115	1	3	v	—	—	—	—	v	2
19	Athetoid Quadriplegia	8-3	F	1	4-10	59	4	12	174	2	4	—	—	—	—	—	—	0
20	Tremor Ataxia Quadriplegia	8-7	M	4	11-10	138	13	11	317	1	4	—	v	—	—	v	—	2
21	Mixed Spas.-Athet. Hemiplegia	7-0	M	1	6-8	95	26	5	174	6	0	v	v	—	—	—	—	2
22	Spastic Hemiplegia	9-3	F	3	10-2	110	25	4	153	1	4	—	—	—	v	—	—	1
23	Spastic Paraplegia	6-1	F	K	4-2	68	23	2	43	5	0	—	—	—	—	—	—	0
24	Right Spastic Hemiplegia	5-11	M	K	3-3	55	18	8	109	5	0	—	—	—	—	—	—	0
25	Right Spastic Hemiplegia	6-8	M	1	7-4	110	27	—	218	3	2	v	—	—	v	v	—	3
26	Athetoid Quadriplegia	19-3	F	9	14-2	94	12	—	99	2	1	v	v	v	v	v	v	6
27	Right Spastic Hemiplegia	15-3	M	9	17-3	119	29	—	87	3	0	v	v	v	v	v	—	5
28	Spastic Quadriplegia	15-8	M	8	17-10	121	9	—	166	3	2	—	v	—	—	—	—	1
29	Athetoid Quadriplegia	20-1	M	11	13-4	89	7	—	197	0	5	v	v	v	—	v	—	4
30	Ataxia Quadriplegia	15-8	M	5	8-4	56	11	—	219	1	4	v	v	—	—	v	—	3

* P.D.R. - Physical Disability Rank (No. 1 being severest)

** S.L.D.R. - Speech and Language Disability Rank (No. 1 being severest)

*** Sp. - Special - Unable to perform at any academic grade level

1. Color
2. Shape
3. Size
4. Color-Shape
5. Shape-Size
6. Color-Size



jects in kindergarten, four in grade one, five in grade two, three in grade three, three in grade four, three in grade five, two in grade six, one in grade eight, two in grade nine, one in grade eleven, and one being designated as special. It will also be noted that I.Q. scores are given in Table XI although the hypotheses of the study deal with mental age. The I.Q. scores are given to furnish an index of intellectual ability as they take into account the age of the subject, whereas a mental age score alone does not indicate such.

TABLE XII

RELATIONSHIP BETWEEN ASPECTS OF CEREBRAL PALSY, MENTAL AGE AND SELECTED CONCEPTUAL VARIABLES

Variables	Mental Age	P.D.R. (8)	Spastic vs Non-Spastic	Affected Area (H. P.Q.) (7)
No. of logical concepts	.709 (1)	.176 (2)	-.455 (3)	.476 (5)
Speech and language disability (N=15)	-.356 (2)	-.197 (2)	N.S. (4)	.272 (6)
Mean time (Seconds)	.090 (1)	.233 (2)	-.347 (3)	.457 (5)
Degree of dimensionality	.222 (1)	-.095 (2)	.194 (3)	.161 (5)
No. of illogical concepts	-.544 (1)	-.177 (2)	.340 (3)	.453 (5)
No. of repetitive concepts (N=27)	.293 (1)	.382 (2)	-.545 (3)	.415 (5)

(1) Product-moment correlation
(2) Rank-order correlation (uncorrected for bias in rho)
(3) Point-biserial correlation
(4) White's T test
(5) Contingency coefficient
(6) Kruskal-Wallis H Test
(7) Hemiplegia, paraplegia, quadriplegia
(8) Physical disability rating

Table XII gives the statistical relationship between the measures of concept formation and speech and language disability when contrasted against mental age, degree of physical disability and kind of cerebral palsy. It will be noted that the kind of statistic applied for each of the relationships is indicated.

TABLE XIII

SIGNIFICANCE OF LEVEL OF RELATIONSHIP BETWEEN ASPECTS OF CEREBRAL PALSY, MENTAL AGE AND SELECTED CONCEPTUAL VARIABLES

Variables	Mental Age	P.D.R. (1)	Spastic vs Non-Spastic	Affected Area (H.P. Q.) (2)
No. of logical concepts	.01	N.S.	.05	.02 (3)
Speech and Language disability (N=15)	N.S.	N.S.	N.S.	N.S.
Mean Time (Seconds)	N.S.	N.S.	.05	.02 (4)
Degree of Dimensionality	N.S.	N.S.	N.S.	N.S.
No. of illogical concepts	.01	N.S.	N.S.	.02 (5)
No. of repetitive concepts (N=27)	N.S.	N.S.	.01	N.S.

(1) Physical disability rating
(2) Hemiplegia, Paraplegia, Quadriplegia
(3) P more than H more than Q
(4) Q more than H more than P
(5) H more than P more than Q

Table XIII gives the results of the null hypotheses test which assumes that the correlation will be zero. The corre-

lations between number of logical concepts and mental age as well as the number of illogical concepts and mental age is significant at the 1 per cent level. Kind of cerebral palsy, as expressed by spasticity vs non-spasticity was related to the number of logical concepts produced at the 5 per cent level and to the number of repetitive concepts produced at the 1 per cent level. Affected topographical area (hemiplegia, paraplegia, quadriplegia) was related to the number of logical concepts at the 2 per cent level, to mean time per concept at the 2 per cent level and to the number of illogical concepts at the 2 per cent level.

The degree of physical disability was not statistically related to any of the aspects of concept formation as was stated in hypothesis one in chapter three.

TABLE XIV

RELATIONSHIP BETWEEN MENTAL AGE, PHYSICAL DISABILITY RATING AND SELECTED CONCEPTUAL VARIABLES WITH RESULTING "t" SCORES AND LEVELS OF SIGNIFICANCE OF DIFFERENCE

Variables	Mental Age	P.D.R. (2)	t Score	Significance Level
No. of logical concepts	.709	.18 (1)	2.82	.01
Speech and language disability (N=15)	-.37 (1)	-.20 (1)	.445	N.S.
Mean Time (Seconds)	.090	.24 (1)	-.551	N.S.
Degree of Dimensionality	.222	.10 (1)	1.18	N.S.
No. of illogical concepts	-.544	-.18 (1)	-1.59	N.S.
No. of repetitive concepts (N=27)	.293	-.40 (1)	-.399	N.S.

(1) Corrected for bias in rho (2) Physical disability rating

Table XIV employs the "t" test for the significance of a difference between mental age and physical disability rating when compared against aspects of concept formation and speech and language disability. The table reveals that the number of logical concepts produced was related more to mental age than it was to physical disability at the 1 per cent level. None of the other aspects of concept formation were related significantly more to mental age than to physical disability.

TABLE XV

RELATIONSHIP BETWEEN MENTAL AGE, KIND OF CEREBRAL PALSY AND SELECTED CONCEPTUAL VARIABLES WITH RESULTING "t" SCORES AND LEVELS OF SIGNIFICANCE OF DIFFERENCE

Variables	Mental Age	Spastic vs N-Spas. (5)	t Score	Significance Level
No. of logical concepts	.709	-.455	6.67 (1)	.01
Speech and Language Disability (N=15)	.37	N.S. (4)	--	--
Mean Time (Seconds)	.090	-.347	-.907	N.S.
Degree of Dimensionality	.222	.194	.096	N.S.
No. of Illogical Concepts	-.544	.340	-4.94 (2)	.01
No. of Repetitive Concepts (N=27)	.293	-.545	4.34 (3)	.01

(1) If signs were disregarded t would be 1.45 (N.S.).
(2) If signs were disregarded t would be 1.13 (N.S.).
(3) If signs were disregarded t would be -1.31 (N.S.).
(4) Used White's T test. Cannot make a "t" test on unlike statistics.
(5) Kind of cerebral palsy.

Table XV indicates the statistical relationship between mental age and kind of cerebral palsy (spastic vs non-spastic) when contrasted against aspects of concept formation and speech and language disability. The "t" test was used to test the significance of the differences. The table shows three significant differences. The number of logical, illogical and repetitive concepts produced was related more to mental age than to spasticity vs non-spasticity at the 1 per cent level.

However, if signs are disregarded they are not significantly different. The relationship between mental age and number of illogical concepts was numerically higher than between spastic vs non-spastic and number of illogical concepts. The relationship between mental age and number of repetitive concepts was numerically lower than that between spastic vs non-spastic and number of repetitive concepts.

Correlations were also obtained between mental age and the following variables:

1. Degree of physical disability (-.072).
2. Spasticity vs non-spasticity (-.303).
3. Affected topographical area (.106).

In other words, as mental age increased physical disability and spasticity decreased.

Table XVI employs the "t" test for the significance of a difference between mental age, kind of cerebral palsy (topographical area) as contrasted against aspects of concept formation and speech and language disability. The table reveals that neither mental age nor kind of cerebral palsy, as indi-

cated by affected topographical area of the body, was significantly related more than the other to concept formation.

TABLE XVI

RELATIONSHIP BETWEEN MENTAL AGE, KIND OF CEREBRAL PALSY AND SELECTED CONCEPTUAL VARIABLES WITH RESULTING "t" SCORES AND LEVELS OF SIGNIFICANCE OF DIFFERENCE

Variables	Mental Age	Topographical Area (1)	t Score	Significance Level
No. of logical Concepts	.709	.476	1.57	N.S.
Speech and Language Disability (N=15)	-.37	.272	.200	N.S.
Mean Time (Seconds)	.090	.457	-1.61	N.S.
Degree of Dimensionality	.222	.161	.249	N.S.
No. of Illogical Concepts	-.544	.453	.533	N.S.
No. of Repetitive Concepts (N=27)	.293	.415	-.511	N.S.

(1) Kind of cerebral palsy

The analysis of Tables XVII and XVIII demands some explanation as to how the information was obtained since the data reported by Coleman (3) are not directly comparable to that of the present study. Since the present study desires to make comparisons to his study, an effort was made to compare both the means and the variances of the two studies.

The mean scores were compared by the "t" test. Since the "t" test assumes that the variances of the two groups are the same, an F test was applied to these two measures.

TABLE XVII

LEVEL OF SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF THE NORMAL AND CEREBRAL PALSIED GROUPS ON SELECTED VARIABLES

Variables	Means		t Score	Significance Level
	Normal	Palsied		
Mental Age (Months)	125.15	101.33	2.68	.05
No. of Logical Concepts	3.05	1.83	3.96	.01
Mean Time (Seconds)	377.91	167.67	8.78	.01
No. of Non-functional Concepts	4.31	4.81	-3.31	.01
No. of uni-dimensional Concepts	1.61	1.10	2.91	.01
No. of bi-dimensional Concepts	1.42	.73	4.37	.01

TABLE XVIII

LEVEL OF SIGNIFICANCE OF DIFFERENCE BETWEEN THE VARIANCE OF THE NORMAL AND CEREBRAL PALSIED GROUPS ON SELECTED VARIABLES

Variables	Standard Deviations		F Score	Significance Level
	Normal	Palsied		
Mental Age (Months)	--	47.93	--	--
No. of Logical Concepts	1.18	1.60	1.885	.01
Mean Time (Seconds)	244.00	72.02	11.238	.01
No. of Non-functional Concepts	1.61	.41	15.104	.01
No. of Uni-dimensional Concepts	.88	1.02	1.378	N.S.
No. of Bi-dimensional Concepts	.65	.81	1.592	.05

In the one case where the null hypothesis, as to the equality of the standard deviations of the two groups, was accepted, the usual F test (9:253 - formula 13.9) was applied. In the cases where the preceding null hypothesis was rejected a "t" test, (9:253 - formula 13.7) which does not make the assumption of equal variances, was used. In one case, mental age, no estimate of the variance in the control group (Coleman's) was available. Consequently, a weaker hypothesis was used: that a group with the mean of the normal group could have been drawn from the cerebral palsied population.

The estimates of the means and variances in the normal group were obtained as follows:

Means = (50 times mean of seven year olds plus 50 times mean of nine year olds plus 50 times mean of eleven year olds) divided by 150.

Variances = 50 times S squared for seven year olds plus 50 times S squared for nine year olds plus 50 times S squared for eleven year olds plus the sum of (group mean of seven year olds squared plus group mean of nine year olds squared plus group mean of eleven year olds squared) minus the (total of the three means) squared and divided by the number of groups. (3) All of the foregoing divided by N(150).

For the means, the data were treated as though all seven year olds were at the mean for the seven year olds, all nine year olds at the mean for nine year olds, and the same idea for the eleven year olds. This should yield the same value as if the original data were used.

In obtaining the variance, use was made of the theorem that states: the total sum of squares, equals the within groups sum of squares, plus the among groups sum of squares.

Analysis of Table XVII reveals there is a statistically significant difference between the normal and cerebral palsied group on the means of all the variables: mental age, number of logical concepts produced, mean time per concept, number of non-functional concepts, number of uni-dimensional concepts, and number of bi-dimensional concepts. They were all significantly different at the 1 per cent level except mental age which was significant at the 5 per cent level.

In other words, the cerebral palsied group was of lower mental age, produced fewer logical concepts, took less time per concept (factor of disinhibition and forced responsiveness to stimuli), produced more non-functional concepts, a fewer number of uni-dimensional concepts, and lesser number of bi-dimensional concepts. All of these mean differences were of statistical significance.

Table XVIII contains the F scores and significance levels between the amount of variance in the normal and cerebral palsied group on the variables of number of logical concepts, mean time per concept, number of non-functional concepts, num-

ber of uni-dimensional concepts, and the number of bi-dimensional concepts.

It will be noted that no test could be made on the variance of mental age, as the variance for the normal group could not be ascertained from Coleman's data. The cerebral palsied group was more variable on the number of logical and bi-dimensional concepts achieved and less variable on mean time per concept and on the number of non-functional concepts produced; all these variances being at a statistically significant level.

TABLE XIX

DISTRIBUTION OF I.Q. SCORES IN NORMAL CHILD POPULATION AND IN CEREBRAL PALSIED SAMPLE

I.Q. Classification	Per cent	
	Normal Child Population	Cerebral Palsied Sample
Below 50	--	3
Below 70	3	30
70-89	22	30
90-109	52	16
110-129	22	16
130 up	1	3
Totals	100	98

Table XIX presents I.Q. scores in certain classifications for the normal child population and the cerebral palsied children of this study. Inspection of the table reveals that greater percentages of cerebral palsied children were in the lower I.Q. ranges, especially at the mentally defective level.

TABLE XX

PER CENT OF CERTAIN GROUPS FALLING BELOW AN I.Q. SCORE OF 90

I.Q. Group	Per cent Below 90
Normal Child Population	23
Dolphin and Cruickshank (21)	47
Present Study	63
Cerebral Palsy Estimate (18)	75

Table XX compares the per cent of children falling below an I.Q. score of 90, the accepted lower limit of normal intelligence. It will be noted that, for normal children, only 23 per cent will possess less than normal intelligence, 47 per cent of Dolphin and Cruickshank's (9) cerebral palsied children were below average intelligence, and 63 per cent of the children in the present study were below average intelligence. It is estimated (18) that 75 per cent of children in the total cerebral palsied population will be below average.

This comparison indicates that the present cerebral palsied sample more nearly represents the cerebral palsied population than did Dolphin and Cruickshank's study. The difference between the percentages in the present study and Hohman's estimate for the cerebral palsied population was largely in the two tails of the I.Q. distribution. Hohman indicated only 3 per cent above an I.Q. of 110, the present study had 19 per cent above this level. Hohman further indicated 75 per cent below average intelligence and the present study had 63 per

cent below average. This was accounted for by the nature of the sample. All the children in the present study were public school children. The cerebral palsied children of extremely low intelligence were not in public schools; being either at home or in some type of custodial situation.

The clinical evidence in the field of cerebral palsy also indicates that, as a class, the higher I.Q. levels are also less physically handicapped. Since Hohman's sample was drawn from hospital cases, he obtained less cases from the higher intellectual ranges. Further, since the lower range of intelligence was excluded from the sample of cerebral palsied school children, the percentage value of the cases in the upper ranges assumed higher numerical value.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to investigate the relationship between conceptual ability, mental age, and degree and kind of disability in cerebral palsied school children. The study attempted to test the following hypotheses:

1. There is a positive relationship between mental age and the various aspects of conceptual functioning in cerebral palsied children.
2. Concept formation ability is more highly related to mental age than to kind of cerebral palsy or degree of disability.

The sample for the study was composed of thirty cerebral palsied school children from the orthopedic classes of Lansing, Michigan. The ages of the subjects ranged from 4.6 to 20.1 with a mean of 10.3 and a standard deviation of 3.10 while the mental ages of the subjects ranged from 2.8 to 17.1 with a mean of 8.44 and a standard deviation of 3.92. The sample was composed of sixteen boys and fourteen girls. It was also composed of 76 per cent spastics versus 24 per cent non-spastics, 43 per cent hemiplegia, 16 per cent paraplegia, and 40 per cent quadriplegia.

The Stanford-Binet was used as the mental age criterion. It was judged to be a satisfactory measure of mental age in

the cases of this study. The Columbia Mental Maturity Scale was administered to twenty-four of the thirty subjects with a resulting correlation of .886 between the two measures.

The following measures were secured on the subjects:

1. Medical diagnoses
2. Mental age
3. Physical disability ranking
4. Number of logical concepts
5. Mean time per concept
6. Degree of dimensionality
7. Number of illogical concepts
8. Number of repetitive concepts (N=27)
9. Speech and language disability rating (N=15)

The analysis of the results revealed the following relationships to be statistically different from zero:

1. The number of logical concepts produced was positively related to mental age at the 1 per cent level.
2. The number of illogical concepts produced was negatively related to mental age at the 1 per cent level.
3. The number of logical concepts produced was negatively related to spasticity versus non-spasticity at the 5 per cent level.
4. The mean time necessary to produce a concept was negatively related to spasticity versus non-spasticity at the 5 per cent level.
5. The number of repetitive concepts produced was negatively related to spasticity versus non-spasticity at the 1 per cent level.

6. The number of logical concepts produced was positively related to affected topographical area at the 2 per cent level.
7. The mean time necessary to produce a concept was positively related to affected topographical area at the 2 per cent level.
8. The number of illogical concepts produced was positively related to affected topographical area at the 2 per cent level.

The significance of the difference of the previous eight relationships was investigated with the use of the "t" test. The following significant differences were obtained:

1. The number of logical concepts produced was related more to mental age than to physical disability at the 1 per cent level: as mental age increased so did the number of logical concepts, the correlation being .709. As physical disability rank increased (becoming less severe) so did the number of logical concepts.
2. The number of logical concepts produced was related more to mental age than spasticity versus non-spasticity at the 1 per cent level: as mental age increased, the number of logical concepts produced increased but as spasticity versus non-spasticity increased, the number of logical concepts produced decreased.

3. The number of illogical concepts produced was related more to mental age than to spasticity versus non-spasticity: as mental age increased the number of illogical concepts decreased and as spasticity versus non-spasticity increased the number of illogical concepts increased.
4. The number of repetitive concepts was related more to mental age than to spasticity versus non-spasticity at the 1 per cent level: as mental age increased so did the number of repetitive concepts (correlation is low but positive) but as spasticity versus non-spasticity increased the number of repetitive concepts decreased. It will be noted in point number three above that, as spasticity versus non-spasticity increased, the number of illogical concepts increased. Thus, illogical responses were more characteristic of spasticity than were repetitive responses.

The following results were obtained when the means and variances of the thirty cerebral palsied and Coleman's (3) 150 normal subjects were tested for significance of differences by the "t" and F tests.

Means - "t" test:

1. The cerebral palsied had a lower mean mental age. (5 per cent level)
2. The cerebral palsied produced less logical concepts. (1 per cent level)

3. The cerebral palsied took less time per concept. (1 per cent level)
4. The cerebral palsied produced more non-functional concepts. (1 per cent level)
5. The cerebral palsied produced fewer uni-dimensional concepts. (1 per cent level)
6. The cerebral palsied produced fewer bi-dimensional concepts. (1 per cent level)

Variances - F test:

1. The cerebral palsied were more variable in number of logical concepts produced. (1 per cent level)
2. The cerebral palsied were less variable in mean time per concept. (1 per cent level)
3. The cerebral palsied were less variable in number of non-functional concepts produced. (1 per cent level)
4. The cerebral palsied were more variable in number of bi-dimensional concepts produced. (5 per cent level)

Conclusions. The data appear to justify the following conclusions, subject to the limitations of this study:

1. Mental age was a significantly better predictor of concept formation ability than was degree of physical disability, or kind of cerebral palsy as represented by spasticity versus non-spasticity. The affected topographical area of the body was not

significantly related to concept formation ability. The correlation between mental age and number of logical concepts produced was .709 whereas the correlation between mental age and degree of physical disability was -.072. Thus, for practical purposes, the correlation was zero between physical disability and mental age but relatively high between mental age and conceptualization.

2. Illogical conceptual responses were more characteristic of the spastic versus the non-spastic than were repetitive responses. The correlation between illogical concepts produced and spasticity versus non-spasticity was positive while the correlation between repetitive responses and spasticity versus non-spasticity was negative. Thus, as spasticity increased the number of illogical concepts increased, but as spasticity increased the number of repetitive concepts decreased.
3. Normal children were significantly superior to cerebral palsied children in all aspects of concept formation ability. The differences in the ten groups were significantly different on the means and variances of all the conceptual variables. The normal group produced more logical, uni-dimensional, and bi-dimensional concepts, less non-functional concepts, and took less time to work on each concept than did the cerebral palsied group.

4. The cerebral palsied group was significantly more variable than the normal on the number of logical and bi-dimensional concepts achieved and less variable on mean time per concept and on the number of non-functional concepts produced. Thus, the cerebral palsied group was more variable on the "higher" or more abstract aspects of conceptualization; i.e., number of logical and bi-dimensional concepts achieved, and less variable on the "lower" or less abstract aspects of conceptualization; i.e. time per concept and number of non-functional concepts produced.

Thus, hypotheses 1 (a), 1 (b), 5 (b) and 6 (b) in Chapter III were proved. All of the hypotheses were in the direction hypothesized except number three which concerned mean time per concept. The cerebral palsied took less time per concept than did the normal subjects.

RECOMMENDATIONS AND IMPLICATIONS

The results of this research have further confirmed some of the previous findings in conceptualization in the cerebral palsied. It adds to the literature the first investigation, of concept formation ability in cerebral palsied school children, that has utilized a rather direct and culture-free conceptual test.

Recommendations. The following general recommendations are offered for further research:

1. This study should be duplicated on a larger sample as a check on the results and conclusions offered above.
2. Future studies in concept formation in cerebral palsied children should attempt to sample the cerebral palsy population in proportionate percentages of each I.Q. classification as well as the percentages in each medical diagnostic category.
3. In studies of conceptualization, the spastic versus the non-spastic should be treated separately in statistical analysis.

Implications. The results of this study pose several implications concerning conceptualization in cerebral palsied school children.

1. The intellectual testing of the cerebral palsied is of extreme importance in their educational planning. Since the most significant finding of the entire study was the relationship between mental age and the number of logical concepts produced, rather than in relation to degree or kind of cerebral palsy, it is more important in educational planning to know the child's mental ability than it is to know how seriously he is disabled.
2. The conceptual abilities of the spastic cerebral palsied were more impaired than the non-spastic. This finding has many implications for the education of the spastic cerebral palsied. They will

need more specialized teaching methods that will help them develop abilities in generalization and abstraction.

3. The cerebral palsied were more distractable than normal children. They reacted in an impulsive, disinhibited fashion, being unable to exhibit deliberate and controlled ideation which would result in "good" organization of incoming stimuli. This means their learning environment must be relatively free of distracting events and that they should not be expected to respond to several competing stimulus objects at the same time.
4. The study implied that illogical ideational behavior may be more characteristic of cerebral palsied than perseverative behavior. The literature on brain-damaged children in general has emphasized the prevalence of perseverative ideation.

SELECTED BIBLIOGRAPHY

1. Bice, H. W., "Two Steps Toward Improvement of Psychological Services for the Cerebral Palsied," American Journal of Mental Deficiency, 54: 212-217, 1949.

2. Burgemeister, B. B., Blum, L. H., and Large, I., Columbia Mental Maturity Test and Manual, Yonkers on Hudson: World Book Company, 1954.

3. Coleman, L., "An Investigation of the Relationship Between Categorizing Behavior and Intelligence In School Children," Unpublished Doctor's Dissertation, Michigan State College, East Lansing, Michigan, 1955.

4. Cottom, C. A., "A Study of the Reactions of Spastic Children to Certain Test Situations," Journal of Genetic Psychology, 57: 27, cont., 1941.

5. Crowell, D. H., Crowell, Doris C., "Intelligence Test Reliability for Cerebral Palsied Children," Journal of Counseling Psychology, 18: 276, cont., 1954.

6. Cruickshank, W. M., Raus, G. M., Cerebral Palsy, Its Individual and Community Problems, Syracuse University Press, 1955.

7. Denhoff, E., "Needs in the Field of Psychologic Appraisal of Children With Cerebral Palsy," New England Journal of Medicine, 243: 524-527, reprint 1-10, 1950.

8. Doll, E. A., "Mental Evaluation of Children With Cerebral Palsy," Crippled Child, 30: (1), 67, cont., 1952.

9. Dolphin, Jane E., Cruickshank, W. M., "Pathology of Concept Formation in Children With Cerebral Palsy," American Journal of Mental Deficiency, 56: (2), 386-392, 1951.

10. Edwards, A. L., Statistical Methods for the Behavioral Sciences, New York: Rinehart and Co., 1954.

11. Fay, Temple, "Cerebral Palsy, Medical Considerations and Classification," The American Journal of Psychiatry, 107: 180-183, 1950.

12. Fay, Temple, "Desperately Needed Research in Cerebral Palsy," Cerebral Palsy Review, 14: (3-4), 4, 11, 13, 15, 1953.

13. Garrett, J. F., (Ed.), Psychological Aspects of Physical Disability, Washington, D.C., U. S. Government Printing Office, 1952.

14. Goldstein, K., The Organism, New York: American Book Co., 1939.

15. Halstead, W. C., "Preliminary Analysis of Grouping Behavior of Patients With Cerebral Injury by the Method of Equivalent and Non-Equivalent Stimuli," American Journal of Psychiatry, 96: 1263, cont., 1940.

16. Heilman, Ann, "Intelligence in Cerebral Palsy, ... A New Interpretation of Research Studies," Crippled Child, 30: (2) 11-13, 28, 1952.

17. Hill, A. S., "Cerebral Palsy, Mental Deficiency and Terminology," American Journal of Mental Deficiency, 59: 587-594, 1955.

18. Hohman, L. B., "Intelligence Levels in Cerebral Palsied Children," American Journal of Physical Medicine, 32: 282-290, 1953.

19. Holden, R. H., "A Review of Psychological Studies in Cerebral Palsy; 1947 to 1952," American Journal of Mental Deficiency, 57: 92-99, 1952.

20. Holden, R. H., "Improved Methods in Testing Cerebral Palsied Children," American Journal of Mental Deficiency, 56: 349-353, 1951.

21. Joint Committee to Study the Problem of Cerebral Palsy, "Report to the Legislature of the State of New York," Legislative Document No. 55, Albany, New York, 1949.

22. Katz, Elias, "Can The Mental Ability of the Cerebral Palsied be Measured," California Journal of Educational Research, 6: 3-8, 1955.

23. Katz, Elias, "Success on Stanford-Binet Intelligence Scale Test Items of Children With Cerebral Palsy as Compared With Non-Handicapped Children," Cerebral Palsy Review, 16: (1), 18-19, 1955.

24. Linck, L. J., National Society for Crippled Children and Adults, Bulletin, Oct. 30, 1947.

25. Little, W. J., "On the Influence of Abnormal Parturition, Difficult Labors, Premature Birth, and Asphyia Neonatorum, On the Mental and Physical Condition of the Child Especially in Relation to Deformities," Transactions of the Obstetrical Society of London, 13: 1861.

26. McGaughran, L. S., "Predicting Language Behavior From Object Sorting," Journal of Abnormal and Social Psychology, 49: 183-195, 1954.

27. Perlstein, M. A., "Infantile Cerebral Palsy: Classification and Clinical Correlations," Journal of the American Medical Association, 149: 30-34, 1952.

28. Phelps, W. M., "General Management of the Cerebral Palsied Problem," Cerebral Palsy Review, 13: (11), 3-4, 9, 1952.

29. Phelps, W. M., "Recent Trends in Cerebral Palsy," Archives of Physical Therapy, 23: 232, cont., 1942.

30. Pohl, J. F., Cerebral Palsy, Saint Paul: Bruce Publishing Company, 1950.

31. Precker, J. A., "Toward a Theoretical Brain - Model," Journal of Personality, 22: 310-325, 1954.

32. Richardson, Elizabeth J., Kobler, F. J., "Testing the Cerebral Palsy Child," Exceptional Child, 21: 101-109, 1954.

33. Sarason, S. B., Psychological Problems In Mental Deficiency, New York: Harper and Brothers, 1953.

34. Shapiro, M. B., "An Experimental Investigation of the Block Design Rotation Effect: An Analysis of the Psychological Effect of Brain Damage," British Journal of Medical Psychology, 27: 84-88, 1954.

35. Strauss, A. A., Kephardt, N. C., Psychopathology and Education of the Brain-Injured Child, II: New York: Grune and Stratton, 1955.

36. Strauss, A. A., Lehtinen, L. E., Psychopathology and Education of the Brain-Injured Child, New York: Grune and Stratton, 1947.

37. Strauss, A. A., Schuessler, Karl, "Socialization, Logical Reasoning, and Concept Development In the Child," American Sociological Review, 16: 514-523, 1951.

38. Strauss, A. A., Werner, H., "Disorders of Conceptual Thinking in the Brain-Injured Child," Journal of Nervous and Mental Diseases, 96: 153-172, 1942.

39. Strauss, A. A., Werner, H., "Experimental Analysis of the Clinical Syndrom "Perseverations" in Mentally Retarded Children," American Journal of Mental Deficiency, 47: 185, cont., 1942.

40. Strauss, A. A., Werner, H., "The Mental Organization of the Brain-Injured Mentally Defective Child," American Journal of Psychiatry, 97: 1194, cont., 1941.

41. Strother, C. R., "Evaluating Intelligence of Children Handicapped by Cerebral Palsy," Crippled Child, 23: 82-83, 1949.

42. Symposium, Psychological Problems of Cerebral Palsy, National Society for Crippled Children and Adults, 1952.

43. Terman, L. M., Merrill, Maude A., Measuring Intelligence, New York: Houghton Mifflin Co., 1937.

44. Vinacke, W. E., "Concept Formation in Children of School Ages," Education, 74: 527-534, 1954.

45. Walker, Helen M., Lev, J., Statistical Inference, New York: Henry Holt and Co., 1953.

46. Wechsler, D., The Measurement of Adult Intelligence, Baltimore: Williams and Wilkins, 1944.

47. Weider, Arthur, Contributions Toward Medical Psychology: Theory and Psychodiagnostic Methods, New York: Ronald Press, 2 vols., 1953.

48. Yates, A. J., "The Validity of Some Psychological Tests of Brain Damage," Psychological Bulletin, 51: 359-379, 1954.

APPENDIX

APPENDIX

DIRECTIONS FOR ADMINISTRATION OF THE CONCEPT FORMATION TEST

The blocks are scattered randomly in both color and shape before the subject.

> Do you know what color this is? (Show large red triangle.) And what color this is? (Show medium yellow circle.) And this? (Show small green square.)
> I want you to put these pieces into different piles so that all of the pieces in each pile are the same or belong together. You may do this any way that you like, but be sure that all of the pieces in each pile are the same as each other in some way. Use all of the pieces.

These same directions may be repeated if the subject does not understand, or if he fails to respond.

After the first concept is achieved, regardless of kind or quality, say:

> That's very good. Now tell me why you put the pieces into those piles. What about each of the piles is the same? Why are all of the pieces in each pile the same?

This procedure is used after each concept and the response is to be written as verbatim as possible.

After the first concept is achieved, and the reason for such is obtained, the pieces are again scattered randomly.

> That was very good. Now I want you to put the pieces into piles again, but this time make the pieces belong together in a different way; make the pieces in each pile the same but in a different way than you did it before.

These directions are repeated if the subject produces

the second concept, and they are used as long as the subject continues to produce a new concept. As soon as he repeats, cannot respond after a reasonable length of time, or produces an illogical concept, then Hint I is presented. If a concept is forthcoming, then the above directions are repeated until the subject cannot respond, and Hint II is presented. This is continued until either six concepts have been achieved or all the hints have been presented.

If the subject fails to produce a concept with the above directions:

> Last time you put all of the pieces of the same color (or appropriate sort) in one pile, and all of another color (or appropriate sort) in another pile. This time I want you to put the pieces into piles so that the pieces are alike in another way.

Repetition of the directions and hints are presented as described above.

Hint I: Place src,[1] mgs, and lyt in a row in front of the subject. Place pieces six inches apart on this and subsequent hints also.

> Put all of the pieces into piles like this. Remember, all of the pieces in one pile should be the same, but don't make them the same as you did the last times.

Hint II: If the first concept was color, or color and shape, place lgt, mgs, sgc in front of subject.

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[1] The designation "src" means small red circle. The first letter refers to size, the second letter to color, and the last to the shape.

Put them into piles like this. Use all of them.

If the first concept was shape, or shape and size, place lys, mgs, srs in front of subject.

Put them into piles like this. Use all of them.

If the first concept was size, place lrt, lyc, lgs in front of subject.

Put them into piles like this. Use all of them.

Hint III: If the first two concepts were color and shape, or combinations of these, place lgs, mgs, sgs in front of subject.

> Put the pieces into piles like this. Although you can put them into three piles, you can also put them into more than three piles. Use all of them.

If the first two concepts were color and size, or combinations of these, place sgt, sgc, sgs in front of subject and repeat directions.

If the first two concepts were size and shape, or combinations of these, place lgt, lyt, lrt in front of subject and repeat directions.

When all of the directions have been presented and/or the hints have been exhausted, and the maximum number of concepts has not been produced, a final set of general directions is presented:

> Now let's try it once more. Put the pieces into different piles so that all of the pieces in each pile are the same or belong together in some way. Remember, make them belong together in a different way than all the other times you have done it.