

University of Windsor

Scholarship at UWindor

Electronic Theses and Dissertations

Theses, Dissertations, and Major Papers

1976

An investigation of Vygotsky's concept of the zone of proximal development.

Lynn M. Lukow
University of Windsor

Follow this and additional works at: <https://scholar.uwindsor.ca/etd>

Recommended Citation

Lukow, Lynn M., "An investigation of Vygotsky's concept of the zone of proximal development." (1976).
Electronic Theses and Dissertations. 1140.
<https://scholar.uwindsor.ca/etd/1140>

This online database contains the full-text of PhD dissertations and Masters' theses of University of Windsor students from 1954 forward. These documents are made available for personal study and research purposes only, in accordance with the Canadian Copyright Act and the Creative Commons license—CC BY-NC-ND (Attribution, Non-Commercial, No Derivative Works). Under this license, works must always be attributed to the copyright holder (original author), cannot be used for any commercial purposes, and may not be altered. Any other use would require the permission of the copyright holder. Students may inquire about withdrawing their dissertation and/or thesis from this database. For additional inquiries, please contact the repository administrator via email (scholarship@uwindsor.ca) or by telephone at 519-253-3000ext. 3208.

INFORMATION TO USERS

THIS DISSERTATION HAS BEEN
MICROFILMED EXACTLY AS RECEIVED.

This copy was produced from a microfiche copy of the original document. The quality of the copy is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Canadian Theses Division
Cataloguing Branch
National Library of Canada
Ottawa, Canada K1A 0N4

AVIS AUX USAGERS

LA THESE A ETE MICROFILMEE
TELLE QUE NOUS L'AVONS RECUE

Cette copie a été faite à partir d'une microfiche du document original. La qualité de la copie dépend grandement de la qualité de la thèse soumise pour le microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

NOTA BENE: La qualité d'impression de certaines pages peut laisser à désirer. Microfilmée telle que nous l'avons reçue.

Division des thèses canadiennes
Direction du catalogage
Bibliothèque nationale du Canada
Ottawa, Canada K1A 0N4

AN INVESTIGATION OF VYGOTSKY'S CONCEPT OF THE ZONE
OF PROXIMAL DEVELOPMENT

by

Lynn M. Lukow

B.A., University of Windsor, 1974

A Thesis
Submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the
Requirements for the Degree
of Master of Arts at the
University of Windsor

University of Windsor
Windsor, Ontario

1976

© Lynn M. Lukow 1976

ABSTRACT

An attempt to operationalize Vygotsky's (1962) concept of the "zone of proximal development" was undertaken by determining whether children purported to be at the same level of intellectual development vary in the ability to benefit from instruction. Of 76 kindergarten aged children performing at the same level on a pretest of class inclusion problems, those receiving instruction demonstrated significantly greater variance after instruction than those receiving no instruction. Thus the main hypothesis was supported.

Instruction was given for a second set of tasks and the performance of the instruction group was compared over both tasks. Although the test of the relationship yielded non-significant results, the correlation between performance on the two tasks suggests a fairly strong relationship, indicating that the ability to benefit from instruction is reliable over different tasks. The findings are discussed in relation to implications in the areas of ability testing and education.

ACKNOWLEDGEMENTS

The author would like to express her thanks to the following:
to Dr. A. McCabe for her wisdom, devotion, and constant encouragement;
to Dr. A. Kobasigawa and Dr. J. Powell for their helpful criticism;
to Mr. L. Gignac, Mrs. S. Johnson, and the kindergarten children
of St. John the Baptist School for their kindness and cooperation;
and to Mary Anne Martin and William Novosedlik for their technical
assistance.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
LIST OF TABLES	iv
LIST OF FIGURES	v
Chapter	
I INTRODUCTION	1
II METHOD	19
III RESULTS	28
IV DISCUSSION	34
BIBLIOGRAPHY	46
APPENDIX A	50
APPENDIX B	52
VITA AUCTORIS	54

LIST OF TABLES

Table		Page
1	Table of the Class Inclusion Problems Outlined by Hatano and Kuhara (1971)	22
2	Mean Performance and Variance Estimates Computed in June and October and Pooled Estimate of Variance	29
3	Contingency Table for X^2 Performances on the Class Inclusion Posttest and the Stanford Binet Posttest (with instruction)	33

LIST OF FIGURES

Figure		Page
1	Relationship between pretest and post-test results (after training) for a conservation of continuous quantity task.....	5
2	Relationship between pretest and post-test results (after training) for a conservation of non-continuous quantity task	6
3	Relationship between pretest and post-test results (after training) for a conservation of length task.....	8
4	Relationship between pretest and post-test results (after training) for class-inclusion tasks	10
5	Relationship between pretest and post-test results (after training) for class-inclusion and conservation tasks.....	11
6	Relationship between pretest and post-test results for the no instruction group	30
7	Relationship between pretest and post-test results for the instruction group	31

CHAPTER I

INTRODUCTION

Soviet educators have severely criticized intelligence testing as a method of measuring childrens' abilities. They view adult instruction as being a critical feature of education and argue that while standardized tests provide a measure of the child's current knowledge they do not adequately measure the child's ability to profit from such instruction. Intelligence test scores typically mask certain kinds of variation in ability rather than describe individual differences among children. Soviet psychologist L. S. Vygotsky (1962) has demonstrated this variation in ability between two children who are at the same level of mental development according to standardized tests.

"Having found that the mental age of two children was eight [he] gave each of them harder problems than they could manage on their own and provided some slight assistance: the first step in a solution, a leading question or some other form of help. [He] discovered that one child could, in cooperation, solve problems designed for twelve year olds while the other would not go beyond problems intended for nine year olds. Thus, the discrepancy between a child's actual mental age and the level he reaches in solving problems with assistance indicates his "zone of proximal development".¹ (p. 103). Vygotsky suggests that the zone of proximal development provides an index of the child's potential to achieve once he has been given assistance.

¹Thought and Language; L. S. Vygotsky, Massachusetts Institute of Technology Press, Cambridge, Massachusetts, 1962.

Vygotsky's criticism of the use of standardized tests to measure a child's level of intellectual development stems from the fact that the standardized test is, for the most part, a measure of what information the child has already acquired but gives no indication as to what the child can learn. The Wechsler Intelligence Scale for Children (WISC) (1967) is an example of the kind of standardized test at which Vygotsky's criticism is directed. The vocabulary subtest examines the child's knowledge of the meaning of various words. In this test it is rather unlikely that a ghetto child who has not been exposed to fairy tales will be acquainted with the word "fable". The Picture Completion subtest requires that the child provide the missing detail for a number of common items such as "fox" or "fish". Success on these items is quite dependent on prior exposure to specific information. A child who has never seen a fish can hardly be expected to know that it is missing a dorsal fin.

To date, there has been no systematic investigation of the zone of proximal development in the experimental literature. Based on Vygotsky's work it is suggested that there is greater variation in ability among children who are purported to be at the same level of intellectual development than would be indicated by standardized tests.

Training studies conducted by Inhelder, Bovet, and Sinclair (1974) involving the Piagetian tasks of conservation and class inclusion do provide data to support Vygotsky's concept of a "zone of proximal development". The general aim of the Inhelder, et al.

studies was to give a better understanding of the modes of transition between one stage of cognitive development and the next. They proposed that transition could be accelerated through training procedures. The cognitive tasks chosen for study were conservation (the understanding that a given quantity remains the same despite changes in shape or position) and class inclusion (the understanding that a superordinate class B is larger than its subclasses A and A¹). The training procedures concentrated on an interaction between the child and the environment to foster the formation of new structures through the integration and coordination of already existing schemes.

The general conclusion of the Inhelder et al. studies was that cognitive development can be accelerated with adequate training. While these findings support the authors' hypothesis, they also lend support to the emphasis which Soviet educators place on instruction. The findings are also specifically supportive of Vygotsky's concept of the zone of proximal development. In each of their training procedures, children who were initially judged to be at the same level of cognitive development reached different levels of problem solving after the training procedure. Such data clearly demonstrates that children do vary in their ability to profit from instruction.

In the first training study the conservation of continuous quantity was examined. The children were required to predict whether the amount of liquid poured from identical beakers A and A¹ into beakers B and B¹ (different heights and diameters) and finally into beakers C and C¹ (the same size as A and A¹) remained constant. The children were assigned to one of four different levels according to

conservation skill on a pretest and then a training procedure was initiated (see Figure 1). The posttest results indicated that children who were initially at the same level reached different levels of conservation skill after training. Of the fifteen children who were at Level I in the pretest, thirteen made no progress at all, one reached Level II and one reached Level IV. Of the six children who were at Level II in the pretest, one child made no progress at all, two children reached Level III, and three children reached Level IV. Nine children were at Level III in the pretest. Posttest results indicated that these children were distributed across four levels after training. It is evident then, that the progress made by children at the same levels of competence in the conservation of continuous quantity was not equal after instruction. In fact, Inhelder et al. noted that "at the beginning the children were fairly close to one another and in the posttest they were much further apart."² (p. 49).

In a second training study the authors examined the transition from conservation of discontinuous to continuous quantities. An identical pattern is obvious from the posttest results. Children at the same level in the pretest reached different levels of problem solving after training. For example, children at Level III on the pretest ranged from Levels II-V on the posttest (see Figure 2).

²Learning and the Development of Cognition; B. Inhelder, H. Sinclair, and M. Bovet, Harvard University Press, Cambridge, Mass., 1974.

FIG. 1

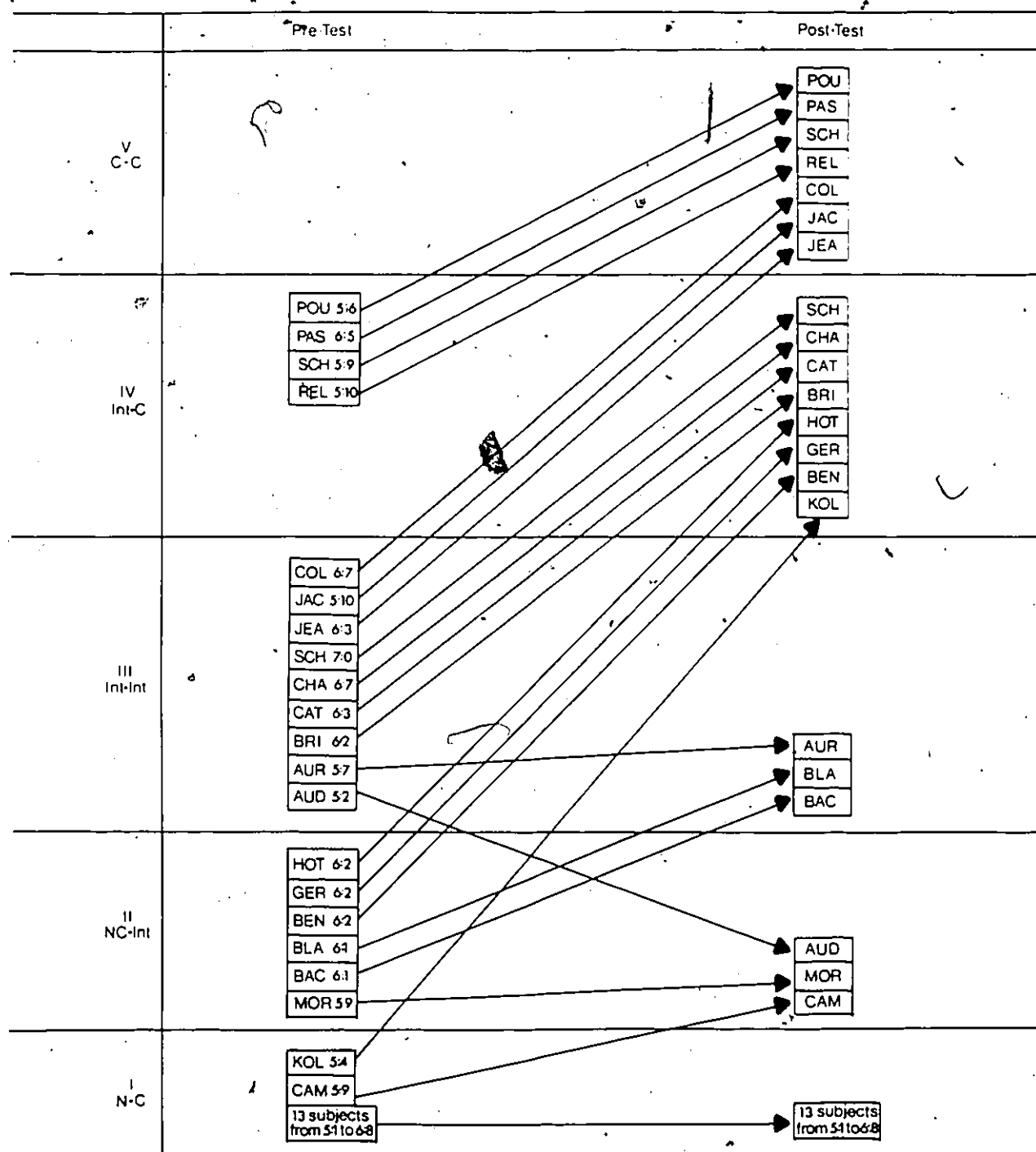


Fig. 1: Relationship between pretest and post-test results (after training) for a conservation of continuous quantity task.

Note: Adapted from "Learning and the Development of Cognition" by B. Inhelder, H. Sinclair and M. Bovet, 1974, p. 50. Copyright 1974 by the President and Fellows of Harvard College.

FIG. 2

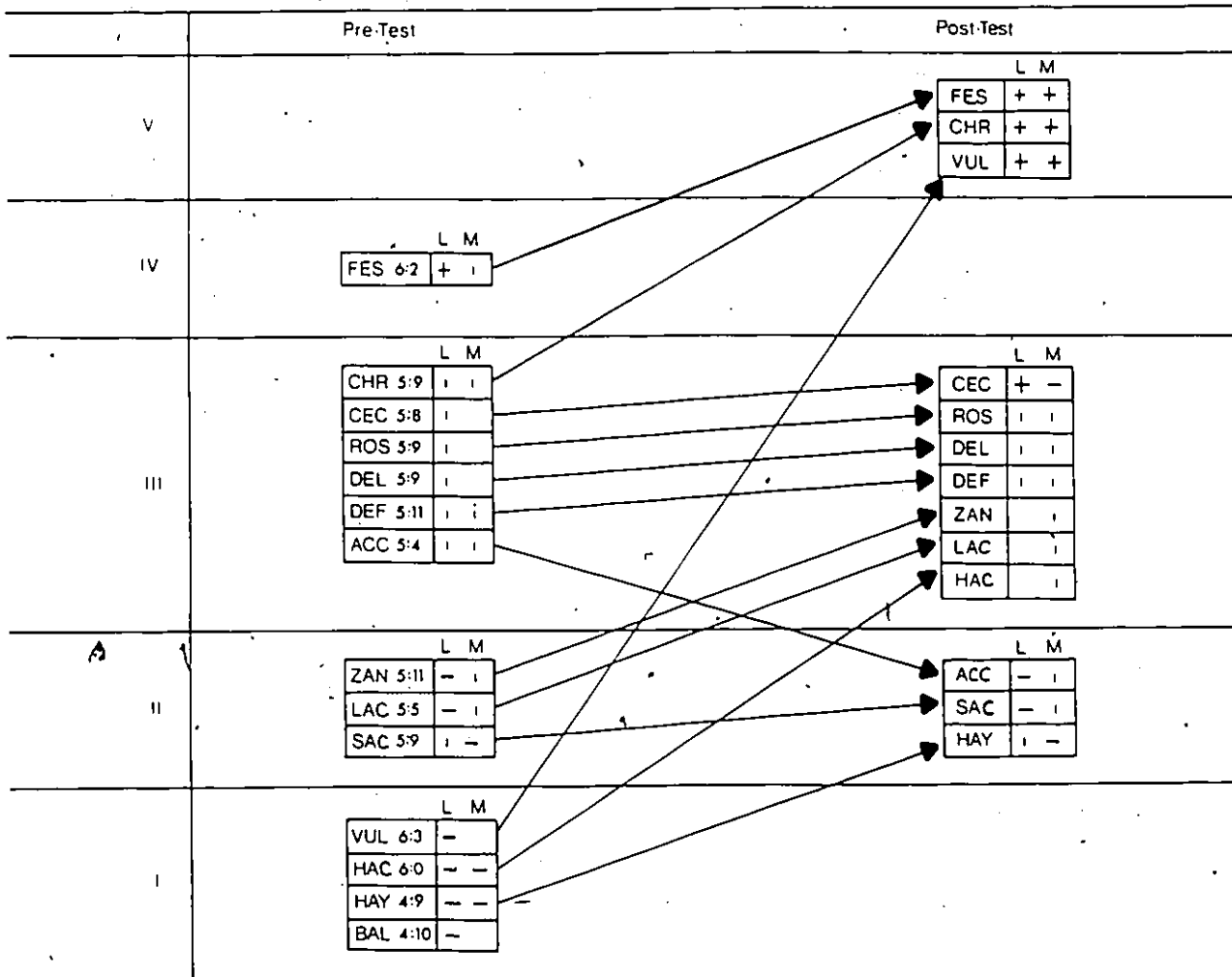


Fig. 2: Relationship between pretest and post-test results (after training) for a conservation of non-continuous quantity task.

Note: Adapted from "Learning and the Development of Cognition" by B. Inhelder, H. Sinclair and M. Bovet, 1974, p. 65. Copyright 1974 by the President and Fellows of Harvard College.

In another training study Inhelder et al. examined the relationship between the acquisition of the conservation of number and the conservation of length. Again children who were at the same level of conservation skill in the pretest were found to be at different levels on a posttest which followed training in conservation of length. In fact, children judged to be at the lowest level on the pretest were distributed over all possible levels of performance on the posttest (see Figure 3).

To summarize, each of the training studies conducted by Inhelder et al. concerning the acquisition of conservation clearly demonstrate the differing abilities of children judged to be at the same level of cognitive development to benefit from instruction. Furthermore, Inhelder et al. reported that in each of the conservation training studies there is no significant progress made by any of the control subjects. Thus, the role of learning due to the effects of time can be ruled out as a causative agent.

Class Inclusion

In order to examine the developmental links between different logical structures, Inhelder et al. decided to compare conservation concepts with the concepts of the logic of classes. However, before an investigation of the effect of training in class-inclusion on the acquisition of conservation (and vice versa) was undertaken, a preliminary experiment involving only class-inclusion was conducted.

FIG. 3

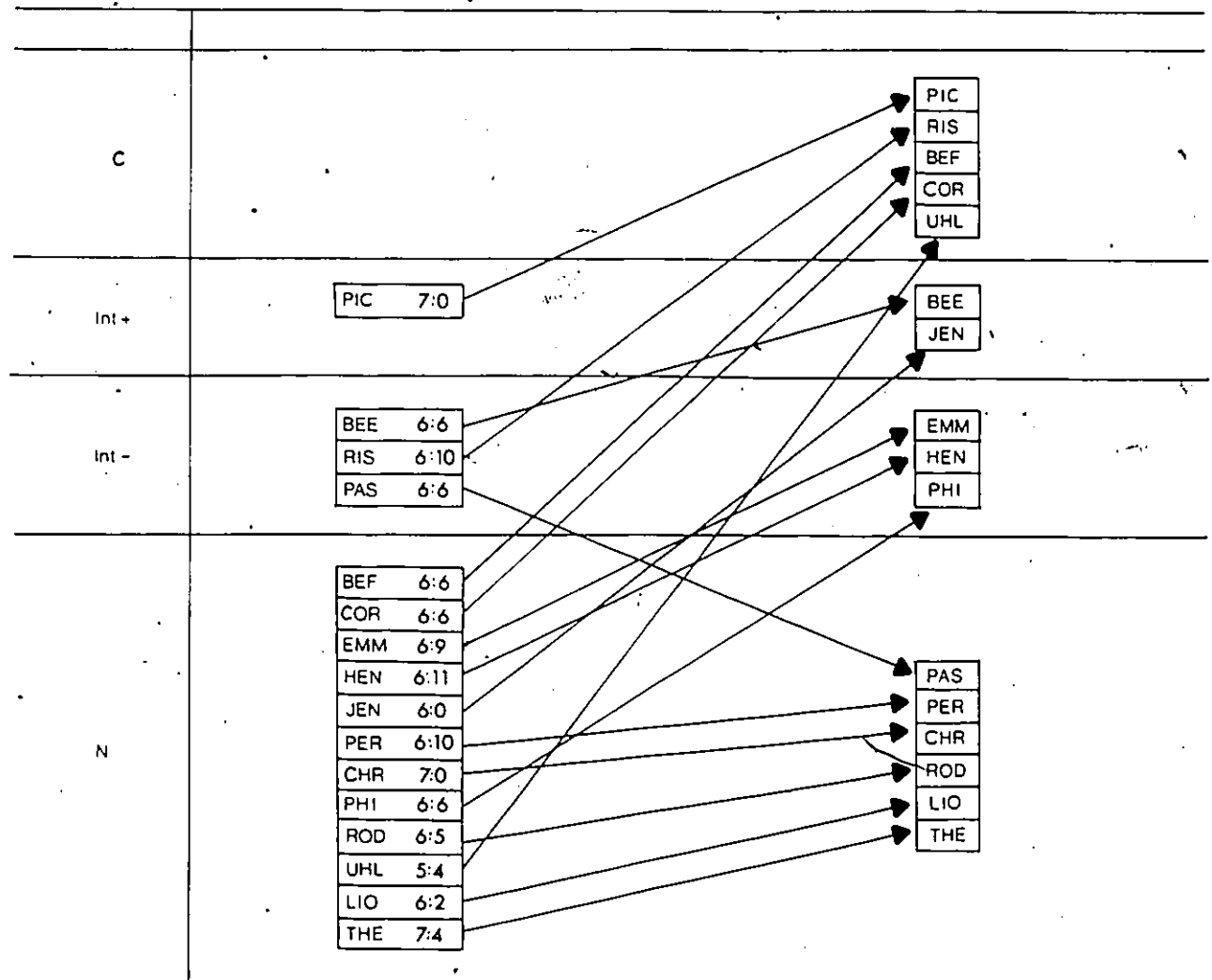


Fig. 3: Relationship between pretest and post-test results (after training) for a conservation of length task.

Note: Adapted from "Learning and the Development of Cognition" by B. Inhelder, H. Sinclair and M. Rovet, 1974, p. 149. Copyright 1974 by the President and Fellows of Harvard College.

The children were assigned to one of two levels according to their ability to answer class inclusion questions on a pretest. (e.g., Are there more flowers or more daisies?). A training procedure was then initiated. Again, the posttest results indicated that children who were at the same level on the pretest reflected different levels of ability in solving the class-inclusion problems after training. Of the eight children who were at Level I on the pretest, four made no progress at all, three progressed to Level II and one progressed to Level IV. The four children who were at Level II on the pretest distributed themselves over two levels of success on the posttest which followed training (see Figure 4).

In a subsequent experiment, the effect of training in class inclusion on the acquisition of both class-inclusion and conservation was examined. The results of the posttest on class inclusion problems revealed a similar pattern. The sixteen children who were at Level I on the pretest were distributed over all possible levels of performance on the posttest (see Figure 5). Again, children who were at the same level of cognitive development in the pretest did not benefit equally from training.

The findings of Inhelder et al. are similar to those of a study conducted by Hatano and Kuhara (1971). The study was designed to facilitate the grasp of class inclusion in a group of children who ranged in age from 5.5 to 6.2 years. Hatano and Kuhara constructed a number of tasks to assess the grasp of class inclusion. Their pre- and posttest tasks included pictorial class inclusion problems, verbal inclusion problems, comprehension of two classes having a

FIG. 4

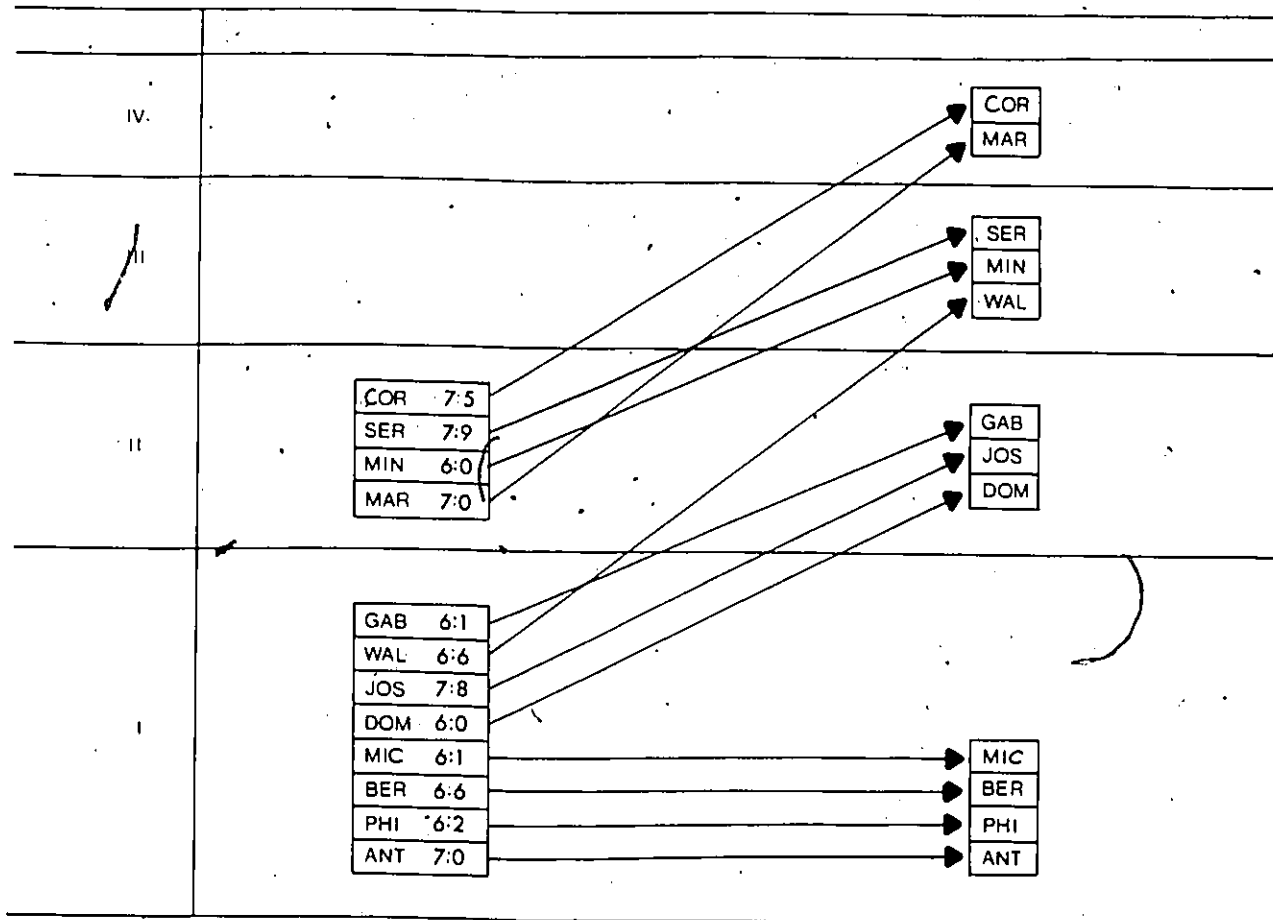


Fig. 4: Relationship between pretest and post-test results (after training) for class-inclusion tasks.

Note: Adapted from "Learning and the Development of Cognition" by B. Inhelder, H. Sinclair and M. Bovet, 1974, p. 183. Copyright 1974 by the President and Fellows of Harvard College.

FIG. 5

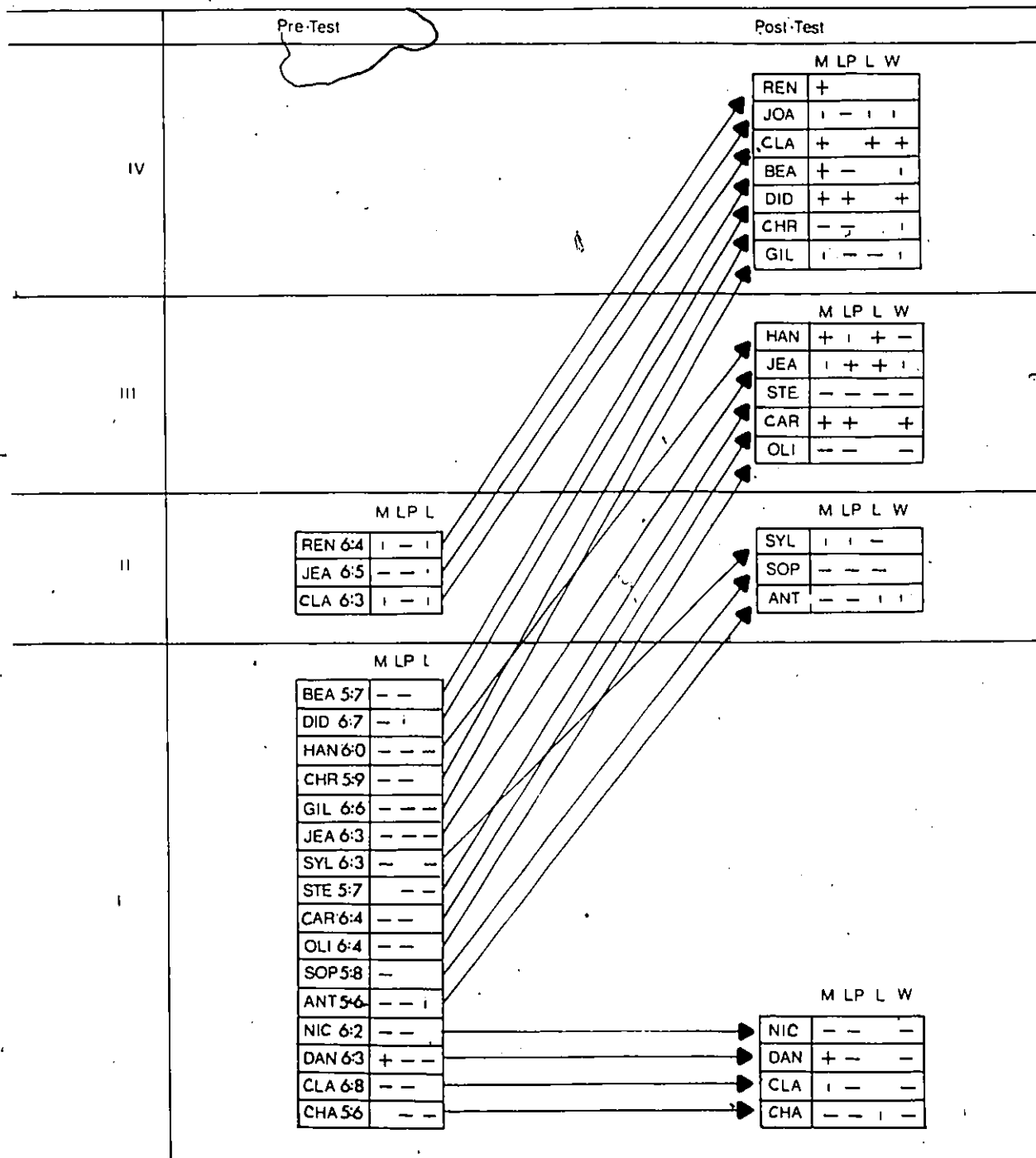


Fig. 5: Relationship between pretest and post-test results (after training) for class-inclusion and conservation tasks.

Note: Adapted from "Learning and the Development of Cognition" by B. Inhelder, H. Sinclair and M. Bovet, 1974, p. 218. Copyright 1974 by the President and Fellows of Harvard College.

Mutually implicational relation, mixed numerical comparisons, and two dimensional identification problems.

Although each test was designed to test the grasp of class-inclusion, the childrens' performance during the pretest indicated that some of the tasks were responded to as being more difficult than others. The order of difficulty according to the percentage of correct responses was: (1) two dimensional identification problems (82.7%); (2) some and all problems (67.3%); (3) mixed numerical comparisons involving mutually exclusive and partly overlapping relations (67.3%); (4) verbal inclusion problems (53.8%); (5) mutual implication (23.1%); (6) mixed numerical comparisons involving inclusion relations (23.1%); and (7) pictorial inclusion relations (13.5%). Thus in the Hatano and Kuhara study certain presentations of the class inclusion problem proved more difficult than others.

The training procedure adopted by Hatano and Kuhara included a standard training procedure and an auxiliary procedure. In the standard training procedure the subjects were taught how to distinguish different types of logical relations of classes as well as to see their relative size. In the auxiliary training procedure, training in double classification and/or visualization of relations between two classes was provided. In both the Inhelder et al. and the Hatano and Kuhara studies the authors sought to produce a grasp of class inclusion in as many trainees as possible, irrespective of the number of training trials. Therefore, it is impossible to assess whether the variance among the subjects' scores increased as a result of training.

However, Hatano and Kuhara designated three groups of subjects by the ease of learning and measured by the number of training trials required. The five "quick learners" made just two errors each in the first trials. The four "average learners" made equal numbers of correct and false judgments in the comparison of two classes related by inclusion. The four "slow learners" made seven or more incorrect responses in the first trials and needed 20 more trials.

The results obtained by Hatano and Kuhara and by Inhelder et al. are consistent with and supportive of Vygotsky's notion of the zone of proximal development since different levels of problem solving were reached by children initially purported to be at the same level of development with the aid of instruction. Unfortunately, these results cannot be used to test the existence of a zone of proximal development because the authors did not hold the number of training trials constant. In addition, the intensive nature of their training procedure may have obscured, to some extent, the variability among subjects. The use of a less intensive procedure for instruction is more consistent with Vygotsky's procedure of providing "slight assistance: the first step in a solution, a leading question, or some other form of help".³ (p. 103).

The present study was an attempt to operationalize Vygotsky's zone of proximal development using performance on class inclusion

³Thought and Language, L. S. Vygotsky, Massachusetts Institute of Technology Press, Cambridge, Massachusetts, 1962.

problems (as representative of the grasp of logical relations) as a vehicle for demonstration. Class inclusion involves the logical comprehension that, when subclasses A and A^1 additively compose or constitute the superordinate class B (e.g., the subclass boys and the subclass girls form the superordinate class children) then $B \supset A$ and $B - A^1 = A$. Class inclusion problems are appropriate to the investigation of the zone of proximal development for several reasons. First, the results of the training studies conducted by Inhelder, et al. provide evidence that children who are initially classified at the same level of competence on a number of class inclusion problems reach different levels of problem solving after they have been exposed to instruction. The results of the class inclusion training study conducted by Hatano and Kuhara also mirror this finding.

Secondly, there is evidence that the time during which the grasp of class inclusion is acquired may be what Montessori (1967) refers to as a "sensitive period". The sensitive period for any area of instruction is a period when its influence is most fruitful because the child is most receptive to it. She found, for instance, that if a child is taught to write early, at the age of four and a half or five, he responds with "explosive writing", an abundant and imaginative use of speech which is never duplicated by children a few years older. This is a striking example of the strong influence that instruction can have when the corresponding functions have not yet fully matured. The successful attempts to train the grasp of class inclusion (one of the concrete operations) in the

pre-operational child (Inhelder, et al., 1974; Hatano and Kuhara, 1971; and Kohnstamm, 1967) provide evidence for this stage as a sensitive period in the grasp of class inclusion.

Finally, class-inclusion problems are additionally appropriate to the investigation of the zone of proximal development since great variability in the age of acquisition of the inclusion relation has been reported in the experimental literature. Such variability suggests that the acquisition of class inclusion reasoning may be sensitive to instruction.

Inhelder and Piaget (1950) carried out an extensive investigation of the inclusion relation and reported that children do not acquire the inclusion response until they reach the age of seven or eight. However, Ahr and Youniss (1970) and other experimentors (Kohnstamm, 1967; Kalil, Lerner and Youssef, 1974) have indicated that the conventional test of class inclusion is quite sensitive to procedural modifications. Modifications which can reduce or raise the age level at which the grasp of class inclusion is demonstrated included presentation of the problem in a verbal format, use of three dimensional, concrete objects, reference manipulation, auditory cue sequence manipulation, and proportion manipulation.

For example, Wohlwill (1968) presented the problem in a typical format of asking questions about pictorial material and in an entirely verbal format with no pictures present. He found that in three of four experiments children between the ages of five and seven years were significantly more successful with verbal items.

The superiority of the verbal condition was attributed to the weakening of a subclass comparison set engendered by the perception of a majority and a minority subclass in the pictorial condition.

Kohnstamm (1967) presented inclusion questions with verbal items, pictorial items, and items involving concrete objects (i.e., Lego building blocks). His results indicated that 30% of the verbal items, 40% of the pictorial items and 90% of the Lego block items were answered correctly. Thus, using concrete materials to assess the grasp of class inclusion results in significant success even at five years of age.

Kalil, Youssef, and Lerner (1974) suggested that Piaget's paradigm for the inclusion response may prove confusing to the child because it is more likely that the children have encountered situations which require subclass comparisons (e.g., Are there more boys than girls?) as opposed to superordinate-subclass comparisons. The development of "learning sets" by which children may misconstrue the class versus the subclass question as a comparison of two subclasses was hypothesized. If the child then uses the name of the total class as a reference to the unmentioned subclass the misreferencing is called "substitution". Kalil, et al. suggested that alterations in the method of class inclusion assessment could weaken these inferred misreferencing "learning sets".

In the Kalil, et al. study, a reference manipulation involved providing concrete physical reference to the subordinate components of the stimulus array. A proportion manipulation involved presenting two subclasses with equal elements and an auditory cue sequence

manipulation involved presenting the superordinate class first. Each of these task manipulations was found to affect performance significantly for kindergarten and first grade subjects (age range: 5.5 to 7.0 years) and the more task variables introduced to weaken the inferred "learning sets", the more success was demonstrated in the class inclusion problems.

However, the results of an experiment conducted by Brainerd and Kaszor (1974) to examine Wohlwill's (1968) verbal facilitation effect and Ahr and Youniss' relative size of subclass effect did not support the argument that class inclusion problems are sensitive to procedural modifications. Even when the items in the subclass were verbally presented and equally distributed, the observed median age for the grasp of class inclusion was nine to ten years.

Thus, there is great variability in the age at which class inclusion appears and such variability is significant because Piaget has used the onset of class inclusion as a general indicator of the presence of concrete operations.

The aim of the present study was to provide standard instructions for the class inclusion problems devised by Hatano and Kuhara (1971) in an attempt to operationalize the zone of proximal development. It was hypothesized that children who were exposed to instruction would demonstrate greater variation in the ability to benefit from instruction than would children to whom instruction was not given. Thus, the independent variable was instruction and the dependent variable was the number of tasks successfully completed.

In order to validate the measure of variation in ability among children who were exposed to instruction on the class inclusion problems, instruction was given for another set of problems. The problems consisted of different subtests of the Stanford Binet Intelligence Test (1960). Performance on these subtests was evaluated on the basis of the number of items successfully completed.

CHAPTER II

METHOD

Subjects: An initial group of 172 kindergarten children from the Essex County Separate School System served as subjects for a screening pretest. The pretest consisted of questions involving the relational concepts "more" and "less", questions involving the child's ability to recognize shape and colour, and class inclusion problems. All children who met the pre-established criterion of success on the two least difficult of the Hatano and Kuhara (1971) class inclusion problems and failure in the more difficult problems were selected for participation. In all, 76 children (39 boys and 37 girls) ranging in age from 4 years, 10 months to 6 years, 3 months were selected. The subjects were randomly assigned to the experimental or control group. The mean age for subjects in each group was 5 years, 7 months. Two children from the experimental group were absent when the Stanford-Binet posttest was administered leaving 36 children in the experimental group.

Materials: The materials consisted of a number of drawings on white cards which measured $12\frac{1}{2} \times 14$ cm. Twelve different cards were used. The composition of the cards was as follows:

Card 1: 1 red hexagon
1 green hexagon
1 red trapezoid
1 green trapezoid

Card 2: 1 red circle
1 red triangle
1 blue square
1 blue triangle
1 white circle

- 1 green square
- 1 green circle
- 1 yellow triangle
- 1 yellow square
- Card 3: 3 white squares
- Card 4: 2 white squares
4 blue squares
- Card 5: 4 blue circles
- Card 6: 2 blue circles
4 blue squares
- Card 7: 3 red airplanes
2 blue airplanes
1 yellow airplane
2 yellow cars
1 blue car
1 red car
- Card 8: 8 red apples
2 yellow bananas
- Card 9: 3 yellow bananas
- Card 10: 3 yellow bananas
- Card 11: 8 red apples
- Card 12: 8 red roses

The training materials consisted of groups of small objects which were familiar to the children (e.g., 2 red buttons and 1 white button--for a complete listing see Appendix A).

Procedure: Each child was seen by the experimenter on three occasions. In the first session, the child was given the screening pretest. The second session consisted of training for the experimental group and a diversionary activity for the control group. During the third session, the child was presented with the class inclusion posttest. The children in the experimental group were seen in an additional session in which they were administered a

second posttest. Each session lasted from 10-15 minutes. The interval between the first two sessions was two weeks while one week intervals separated each of the succeeding sessions.

Screening Pretest: Preliminary questions were given to ensure that the child understood the relational concepts contained in the class inclusion problems (Griffith, Shantz, and Sigel, 1967). The questions were presented in the form of two story problems which are outlined below:

Story 1: Suppose you have six smarties and I have three smarties. Would we have the same number of smarties? Would you have more smarties? Would I have less smarties?

Story 2: Suppose you have three smarties and I have three smarties. Would you have more smarties? Would I have less smarties? Would we have the same number of smarties?

Additional questions were given to ensure that the child was able to identify the shapes and colours which were used in the items of the class inclusion posttest. In the first four questions, the child was required to pick out the figures which were identical in colour (red, green) or shape (trapezoid, hexagon) to a model. In the final eight questions, the child was required to pick out a figure of a certain colour (red, green, white, yellow and blue) or shape (square, circular, or triangular).

Following the preliminary questions, the four least difficult of the Hatano and Kuhara class inclusion problems were presented (see Table 1).

Table 1

Table of the Class Inclusion Problems Outlined by
Hatano and Kuhara (1971)

-
- (1) Two Dimensional Identification Problems.
 - (2) Some and All Problems
 - (3) Mixed Numerical Comparison Involving Mutually Inclusive or Partly Overlapping Relations
 - (4) Verbal Inclusion Problems
 - (5) Comparison of Two Classes Having a Mutually Implicational Relation
 - (6) Mixed Numerical Comparison Problems Involving Inclusion Relations.
 - (7) Pictorial Class Inclusion Problems.
-

1) Two Dimensional Identification Problems

This set of questions was concerned with whether a child is capable of recognizing that a set of objects can be divided on two dimensions. The experimenter asked the following questions showing a set of figures consisting of 3 white squares (Card No. 3), 2 white squares and 4 blue squares (Card No. 4), 4 blue circles (Card No. 5), and 2 blue circles and 4 blue squares (Card No. 6):

- (a) "Are there any white things that are not squares?"
- (b) "Are there any squares that are not white?" If the child answered "yes" the experimenter said, "Please point out the things that are not white".
- (c) "Are there any blue things that are not circles?" If the child answered "yes" the experimenter said, "Please point out the blue things that are not circles".
- (d) "Are there any circles that are not blue?"

2) Some and All Problems

These questions were concerned with whether class A is some or all of class B. The experimenter showed a set of figures consisting of 3 white squares (Card No. 3), 2 white squares and 4 blue squares (Card No. 4), 4 blue circles (Card No. 5), and 2 blue circles and 4 blue squares (Card No. 6), and asked the following questions:

- (a) "Are all the white things square?"
- (b) "Are all the squares white?"
- (c) "Are all the circles blue?"
- (d) "Are all the blue things circles?"

(3) Mixed Numerical Comparison Involving Mutually Exclusive or Partly Overlapping Relations.

Stimulus card No. 7 on which airplanes (2 blue, 3 red, and 1 yellow) and cars (2 yellow, 1 red and 1 blue) were drawn and presented to the child. The experimenter explained that they were drawings of planes and cars and asked the following questions:

- (a) "Are there more yellow things or more blue things?"
- (b) "Are there more planes or more cars?"
- (c) "Are there more yellow cars or more red things?"

(4) Verbal Inclusion Problems

The experimenter asked the following questions without presenting any materials:

- (a) "Some fish live in the sea and some fish live in rivers. Compare all the fish living in the sea and all the fish living in rivers. Are there more fish living in the sea or more fish living in the rivers?"
- (b) "Compare all the people living in the world and all the men living in the world. Are there more people or more men?"

Instruction: The instruction procedure consisted of asking the child to count the elements of each subclass (e.g., red buttons; white buttons), asking the child to count the elements of the superordinate class (e.g., buttons), and inclusion questions (Seigel, 1975 - personal communication). The logic prompts were comprised of the questions, "Are the A's also B's? Are the A¹'s also B's? Are the B's also A's? Are the B¹'s also A's? (e.g., When the child was shown 2 red buttons and 1 white button he was asked: "How many

red buttons are there? How many white buttons are there? Are the red ones buttons? Are the white ones buttons? Are there more red ones or more buttons? Are there more buttons or more red ones?" (see Appendix 1 for a complete listing). Incorrect responses to the logic prompts were corrected. During the week of instruction, each control subject played a game with the experimenter to equalize the amount of time spent with the experimenter across the experimental and control groups.

Class Inclusion Post Test: The four class inclusion problems presented in the screening pretest were repeated and the three more difficult class inclusion problems (Hatano and Kuhara, 1971) were also presented.

(5) Comparison of Two Classes Having a Mutually Implicational Relation.

In this task, which corresponded to Inhelder and Sinclair's (1969) three stage inclusion problems, two classes having different names but identical numbers are numerically compared. Showing pictures of 8 apples and 2 bananas (Card No. 8) the experimenter asked "Is there more fruit or more things to eat on this card?"

(6) Mixed Numerical Comparison Problems Involving Inclusion Relations

The experimenter presented stimulus Card No. 7 on which airplanes (2 blue, 3 red and 1 yellow) and cars (2 yellow, 1 red and 1 blue) were drawn, and the following questions were asked:

- (a) "Are there more cars or more yellow cars?"
- (b) "Are there more blue things or more cars?"

(c) "Are there more planes or more red planes?"

(7) Pictorial Class Inclusion Problems

This task, consisted of two test items. For these items the child was presented with cards on which 3 bananas (Card No. 9), 3 tulips (Card No. 10), 8 apples (Card No. 11), and 8 roses (Card No. 12) were drawn. A number of preparatory questions were then asked:

Preparatory Questions:

- (a) (pointing to apple cards) "What are these?"
- (b) (pointing to tulip cards) "What are these?"
- (c) (pointing to banana cards) "What are these?"
- (d) (pointing to rose cards) "What are these?"
- (e) "Which ones are fruit? Collect all the fruit you see".
- (f) (covering fruit) "Are these all flowers?"
- (g) "Are there more tulips or more roses?"

A wrong answer to any preparatory question was corrected and the question was repeated. The first test question was then asked.

Test Question 1: "Are there more roses or more flowers?"

Preparatory Questions: (a) (showing fruit only) "Are these all fruit?"

(b) "Are there less apples or less bananas?"

Test Question 2: "Are there less fruits or less bananas?"

Stanford Binet Posttest: The Stanford Binet posttest consisted of subtests from the Stanford Binet Intelligence Scale (1970) designed for different mental age levels. The Stanford Binet tasks consisted of the following:

- (1) The Differences Subtest for the Six Year Level. (e.g., "What is the difference between wood and glass?")
- (2) The Similarities Subtest for the Seven Year Level (e.g., "In what way are wood and coal alike?")
- (3) The Similarities and Differences Subtest for the Eight Year Level (e.g., "In what way are a baseball and an orange alike and how are they different?")

The child was allowed to give an answer to the questions from the Stanford Binet subtests and if he failed to arrive at an appropriate answer, a leading question was asked. The leading questions were directed at examining the characteristics of the objects in the questions which made them similar or different. The test question was then repeated.

CHAPTER III

RESULTS

Treatment of the Data: Performance on the class inclusion posttest was evaluated on the basis of the number of tasks successfully completed. An estimate of the variance among subjects in the experimental and control groups was computed. Fewer children than expected reached criterion on the screening pretest administered in June, 1975. Consequently, it was necessary to test a second group of children in October to ensure a large enough sample size (see Table 2). Variability of the experimental subjects was then compared to variability of the control group by means of an F ratio. Type I error probability was set at .05. Performance on the class inclusion posttest was compared to performance on the Stanford Binet posttest by means of a chi square.

Results: The hypothesis that children who are exposed to instruction demonstrate greater variation in performance than children to whom instruction is not given is supported, $F(36,36) = 1.89, p < .05$. A comparison of Figures 6 and 7 demonstrates that of the children who performed at the same level on the pretest tasks those children who received instruction differed more on the class inclusion posttest than did children who received no instruction.

It had been predicted that the degree to which a child benefited from instruction on the class inclusion tasks would parallel the degree to which he benefited from instruction on the Stanford Binet tasks. A comparison of performance on the class inclusion posttest and performance on the Stanford Binet posttest

Table 2
 Mean Performance and Variance Estimates Computed in
 June and October, 1975 and Pooled Estimate
 of Variance

Group	Month		Pooled
	June	October	
Experimental			
X	3.640	3.923	3.736
S ²	1.440	1.610	1.496
Control			
X	2.640	3.076	2.789
S ²	.777	.841	.798

FIG. 6

30



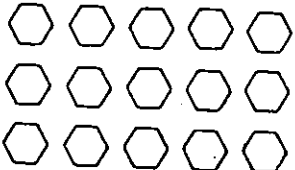
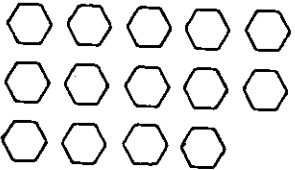

Number of tasks correct	Pre Test	Post Test
VII		
VI		
V		
IV		
III		
II	<div data-bbox="544 1255 829 1360" style="border: 1px solid black; padding: 5px; display: inline-block;"> 38 Subjects in the Control Group </div>	
I		

Fig. 6: Relationship between pretest and post-test results for the no instruction group.

FIG. 7


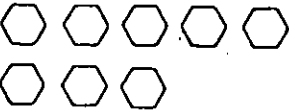
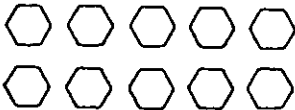
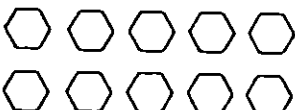
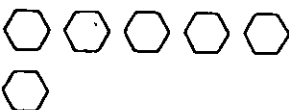
Number of tasks correct	Pre Test	Post Test
VII		
VI		
V		
IV		
III		
II	<div data-bbox="518 1262 805 1367" style="border: 1px solid black; padding: 2px; display: inline-block;"> 38 Subjects in the Experimental Group </div>	
I		

Fig. 7: Relationship between pretest and post-test results for the instruction group.

(after instruction) was made by a chi square test of association. The results failed to support the hypothesis of non-independence between the two measures, $\chi^2(4) = 7.24$; $.10 < p < .25$ (see Table 3). Correlation coefficients were computed as descriptive indices of the relationship between performance on the class inclusion posttest and the Stanford Binet posttest (without instruction) $r = +.406$ and between performance on the class inclusion posttest and the Stanford Binet posttest (with instruction), $r = +.599$. The difference between these correlations however was not significant, $z = 1.061$, $p = .142$.

A t test was carried out to test the differences between the means of the experimental group ($\bar{X} = 3.736$) and the control group ($\bar{X} = 2.789$). The results indicated that the experimental group significantly outperformed the control group, $t(74) = 6.53$; $p < .01$ (see Table 2). It should be noted that the group variances differed significantly and therefore these results need to be interpreted with caution. Hays (1973) argues, however, that with equal sample sizes, heterogeneity of variance has relatively little effect on the t-test result.

Finally, a correlation between age and level of performance indicated no significant relationship for either the control ($r = -.008$) or the experimental ($r = +.149$).

Table 3
Contingency Table for X^2 Performances on Posttest 1
and Posttest 2 (with Instruction)

No. of Items Correct on Posttest 2	No. of Tasks Correct on Posttest 1		
	2-3	4-5	6-7
0-3	✓ 2	0	0
4-7	6	3	3
8-11	7	15	0

Note: maximum score on Posttest 1 = 7

maximum score on Posttest 2 = 11

$$X^2 = 7.24$$

CHAPTER IV

DISCUSSION

The validity of the concept of a zone of proximal development is supported by the confirmation of the main hypothesis. Among the children who were at the same level of development according to performance on the pretest, those who received instruction on the class inclusion tasks demonstrated significantly greater variability on the posttest than children who did not receive such instruction. Thus, the children who received instruction indicated a differential ability to benefit from the instruction.

The attempt to demonstrate that the zone of proximal development is a general measure which is stable over tasks requiring different cognitive abilities was not supported using the method of chi square. The comparison of the class inclusion posttest and the Stanford Binet posttest (with instruction) yielded nonsignificant results. It should be noted, however, that collapsing of adjacent categories was necessary because of the relatively small sample size. Unfortunately, this results in a restriction of range and a decrease in the degree of association that might be demonstrated. A thorough examination of the data also indicates that 10 of the 11 children (27.7% of the experimental group) who reached a level of five or six tasks, successfully completed on the class inclusion posttest also achieved superior performance (9-11 items correct) on the Stanford Binet posttest (with instruction). Thus the performance of the children who received instruction may have been limited by a ceiling effect. In fact, since

one of the items on the Stanford Binet posttest was consistently misinterpreted by the children⁵; a more realistic upper limit of performance on the Stanford Binet posttest would be 10 items correct. Thus, it is quite plausible that a ceiling effect was in operation with respect to performance on the Stanford Binet posttest (with instruction) for those children who derived the most benefit from instruction on the class inclusion tasks.

However, the reliability of the zone of proximal development is indicated by the fact that the relationship between performance on the class inclusion posttest and the Stanford Binet posttest (with instruction) is high ($r = +.599$). Despite the fact that the difference between the correlation of the posttests (with and without instruction) is not significant, the relationship between the class inclusion posttest and the Stanford Binet posttest is greater when instruction is given. Thus there is some support for the hypothesis that the ability to benefit from instruction contributes substantially to the higher correlation. If the variation in the capacity to benefit from instruction were merely associated with mental age the correlation between the class inclusion posttest and the Stanford Binet posttest; with or without instruction, would be expected to be equal.

The strength of the relationship between the class inclusion posttest and the Stanford Binet posttest (with instruction) supports the generality of the zone of proximal development over different

⁵"How are iron and steel the same?" was invariably answered with the comment "But iron is hot."

tasks. The class inclusion tasks were largely non-verbal in nature; often a yes or no answer would suffice. The Stanford Binet tasks, however, were quite dependent on the facility to verbally describe characteristics of objects which rendered them similar or different.

Since the mean performance on the class inclusion posttest was significantly better for the experimental group, the attempt to train class reasoning was successful. This finding is noteworthy in that it lends support to the work of Inhelder et al. (1974) and Hatano and Kuhara (1971) in training on Piagetian tasks, particularly those involving class inclusion reasoning.

The implications of a zone of proximal development are especially extensive in the areas of ability testing and education. The development of an ability test based on the zone of proximal development would certainly place greater emphasis on the process of learning than the standardized test which emphasizes achievement; the product of learning. Such a test might be more educationally relevant than the standardized test because a paradigm of the classroom situation (learning through instruction) would be inherent in the test. The use of standardized tests to identify children who are psychometrically similar has been criticized (Ebel, 1964) because the individual differences of such children are often ignored. A test based on the zone of proximal development would provide a useful supplement to the standardized test since it would determine individual potential to benefit from instruction.

The standardized intelligence test is most widely used to predict academic achievement. Bond (1940) reported correlations

between the Stanford Binet Intelligence Quotient and achievement tests one year later ranging from $+ .43$ to $+ .73$. Thus, the standardized I.Q. score can be considered a fairly good predictor of academic performance. The correlation measures including instruction found in the present study is noteworthy because the selection criterion for subjects in the present study specifically limited the range of achievement to be included. Such reduction in the range of measures is known to reduce the size of a correlation. Even under these circumstances, however, the correlation between the two measures including instruction compares favourably. Given a broader range of achievement and ability levels, even stronger relationships would be expected. Thus, a test based on this kind of measure might predict the capacity to achieve in the educational situation at least as well as the standardized intelligence test when the restriction of a selection criterion does not apply to the subjects.

A standardized test of intelligence such as the Stanford Binet is heavily weighted with verbal abilities (Cronbach, 1960). Because children differ in their exposure to language, it is often difficult to determine whether a child's test performance is a reflection of his intellectual ability or his familiarity with the verbal material involved. A test based on the zone of proximal development offers an alternative approach to this problem by using the instruction situation to familiarize the child with the terms appropriate to the task at hand. However, when the instruction situation concentrates on the vocabulary of an area under study the posttest must be constructed to avoid the possibility of merely testing "response learning".

The standardized test of intelligence has been shown to discriminate children whose environmental experience has been curtailed. However, the use of culture-fair and culture-free tests to combat this problem has not proved to be successful. Ironically, studies have indicated (Coleman and Ward, 1955; and Lusinski, 1968) that a test apparently as culturally loaded as the Stanford Binet is a better predictor of school achievement for lower socioeconomic class children than the so-called "culture-fair" measures. Feuerstein (1972) has suggested that a test-learning-test situation is more successful in determining "learning potential" among the culturally deprived than a culture-fair test. He employed such a paradigm with a number of children from a "disadvantaged" socioethnic group. After they had been exposed to instruction on tests involving abstract, internalized, representational thought, the children made significant gains in performance. The results of Feuerstein's study cannot be used as conclusive support for his hypothesis because he neglected to test an uninstructed control group. However, the results of his work do suggest that an ability test which involves the capacity to benefit from instruction may be helpful in controlling for the variable of cultural experience.

In summary, a test based on the measure of variation in the ability to benefit from instruction may present a valid supplement to the standardized intelligence test because it concentrates on individual differences, provides a realistic approximation of the classroom situation, controls for the variable of experience, and can be addressed to the problem of cultural deprivation.

Vygotsky's initial work with the zone of proximal development was part of an investigation of the relationship between instruction and intellectual development. Vygotsky repeatedly emphasized the importance of instruction in education. The support of the zone of proximal development provides further evidence of the importance of instruction in determining the child's potential to learn.

Vygotsky's emphasis on the importance of instruction stands in contrast to some of the views expressed by Montessori and Piaget. While Montessori's theory and practice of education are sometimes discrepant she is consistent in her assertion that each child is an individual. Each child works at his own pace with materials which are virtually self-corrective. However, Montessori's theory does not make specific allowances for the role of didactic instruction in education. In theory, Montessori is committed to learning which is free and enforced and therefore cannot introduce material which the child does not show a voluntary desire for (Cole, 1974). Although the materials used in the Montessori classroom provide guidance and feedback, the teacher does not directly administer information and instruction. As a result, the child may direct his attention to the most salient aspect of a task; but there is no guarantee that he grasps the principle involved. However, when a child is exposed to didactic instruction, the teacher cannot only direct his attention to all relevant dimensions but can also help him formulate a general rule.

Piaget (1970) considers the role of education to be the adaptation of the child to the adult social environment. Self-activity is considered to be critical to the adaptive process. In Piaget's

view, one of the major sources of learning, if not the most essential one, is the intrinsic activity of the child (Ginsburg and Oppen, 1969). The child must begin by manipulating objects until overt sensorimotor schemes are internalized in the form of thought. The prime objective of a teacher should be to encourage a child's activity and his manipulation and exploration of objects. The child should be provided with a wide variety of interesting materials upon which he may act in order to exploit his potential for learning. Piaget contends that a teacher cannot "impart knowledge" and that when a child's verbalizations are not founded on prior manipulation of the environment they are devoid of understanding. Consequently, Piaget minimizes the role of didactic instruction in education.

The positions of both Piaget and Montessori reflect what is often called the "discovery" approach to education. "Discovery" learning is a transactional process which involves at least two aspects: the assimilation of content of some sort and the operations of cognitive processes required to organize and use this content (Taba, 1963). There has been much controversy over the use of the term "discovery" in the field of education. According to Schulman (1968) those favouring the learning by discovery approach advocate the teaching of broad principles of problem solving through minimal teacher guidance and maximal opportunity for exploration and trial and error on the part of the learner. However, most experimental treatment of the "discovery" approach has dealt with a modified version of the discovery approach which is known as "guided discovery". In guided discovery children are carefully directed down a particular

path along which they are called on to discover the regularities and solutions on their own. They are provided with cues in a programmed manner but the actual statement of the principle of a problem is left to them.

Friedlander (1965) has criticized the "discovery" approach which Schulman described because it presents some very specific problems in education. He questions whether discovery necessarily leads to productive findings and resolutions, and whether the insights which a student develops on his own are more easily remembered than insights he learns from others. He contends that discovery of a crucial relationship is only the first phase of assimilative learning and must be followed by a process of synthesizing in which the new idea is incorporated into a systematic context. It is here that the importance of instruction is emphasized. At this point the teacher can help the student refine the significance of what he has discovered on his own and help him construct an orderly scheme of meaning in which the new knowledge can take its proper place.

The support of the zone of proximal development also provides evidence that instruction must concentrate on individual differences in children. Lesser (1971) discusses the need to adapt instructional strategies--the choice of curriculum, its content, level, sequence, pace, and style of presentation--to the differences which are identified among children.

Lesser encourages teachers to make informal diagnosis and analyses of individual differences to adjust forms and timing of instruction. He claims that through such analysis a teacher may

decide that for a student who has narrowly missed complete understanding of some concept she has moved too rapidly; minor adjustment of instruction may be sufficient. For students who have achieved only a vague grasp, perhaps the idea was too abstract and a large number of concrete examples may be necessary for instruction to succeed. However, if a test based on the zone of proximal development could be employed, a teacher's diagnosis of individual differences may not only become more accurate but may also precede instruction and help determine its course.

The conclusion that children who are initially at the same level of cognitive development on a set of tasks which involve class inclusion reasoning vary in the capacity to benefit from instruction is supported by the results of this study. However, the present study employed a single instructional technique and area of study with a relatively small sample of children. Consequently, the extent to which the conclusion of this study may generalize to other instructional situations is limited. Further consideration of instructional variables as well as the individual characteristics of a child is necessary for a thorough investigation of a child's zone of proximal development. Research in this area may extend to investigating the technique, sequence, and structure of instruction that is most beneficial to a particular child. Information as to how personality variables interact with instructional variables would also be informative.

The discovery of what technique of instruction is most successful with a child may be aided by determining a child's capacity to benefit from instruction. An explicit analysis of the relationship between

technique of instruction and individual differences is provided by Tanaka (1968). In an attempt to teach classification skills to first grade children Tanaka used two instructional strategies: manipulation of objects and verbalizations about pictures. For those children with weak initial classification skills, Tanaka found that the object manipulation was more successful. For children with a higher initial level of classification skill, the verbalization method was superior. Thus, different initial levels of performance indicated a need for different instructional techniques. Similarly, different capacities to benefit from instruction may indicate a need for different instructional techniques.

The setting of instruction is another variable which may interact significantly with a child's capacity to benefit from instruction. Wallace (1965) has found that children who have a history of poor academic achievement are also most responsive to informal instruction from peers. It is possible then that some children have a history of poor academic achievement because they have a small zone of proximal development and therefore find peer instruction more stimulating and effective because it is more closely geared to his needs.

Zone of proximal development may also interact with task sequence and personality variables. Moore, Smith and Teevan (1965) found that low-anxious, low-achieving students learned better when materials were presented in an easy to difficult sequence while high-anxious, high-achieving students did better when materials were presented in a difficult to easy manner. Similarly, children who

benefit from minimal instruction may prove to be additionally challenged by a difficult to easy sequence while children who require extensive instruction may find the order inherent in the easy to difficult sequence more beneficial.

A personality variable such as level of anxiety in a child may also play an important role in the instruction situation. Sarason (1960) found that high-anxious children perform better than low anxious children on simple tasks. However, low-anxious children perform increasingly better than high anxious children as task complexity increases. Level of anxiety may also interact with zone of proximal development in affecting task performance.

Finally, the tasks included in this study do not presume to measure all areas of a child's cognitive functioning. It remains to be seen whether the same zone of proximal development would be shown with tasks which involve different cognitive abilities (e.g., visual spatial abilities) for a particular child.

To summarize, the implications of the zone of proximal development for education include an emphasis on the importance of instruction as opposed to a laissez-faire approach; a concentration on individual differences in education; and modification of instructional strategies and techniques to suit individual needs.

The results of this study then, support a number of general conclusions. Principally, children are found to vary in their zone of proximal development. The zone of proximal development is also found to be a measure which shows some stability over tasks which require different cognitive abilities. Finally, the zone of proximal development should prove to be a useful concept for

educators who are interested in the assessment of ability level and selection of instructional strategy.

REFERENCES

- Ahr, P., and Youniss, J. Reasons for failure on the class inclusion problem. Child Development, 1970, 40, 131-143.
- Band, E. A. Tenth grade abilities and achievements. New York: Teachers College, Columbia University, 1940.
- Brainerd, C., and Kaszar, P. An analysis of two proposed sources of children's class inclusion errors. Developmental Psychology, 1974, 10 (in press).
- Cole, H. Basic ideas of the Montessori Method. In L. Coopersmith and R. Feldman (Eds.), The formative years: principles of early childhood education. San Francisco: Albion Publishing Company, 1974.
- Coleman, W., and Ward, A. A comparison of David Eells and Kuhlman-Finch scores for children from high and low socioeconomic status. Journal of Educational Psychology, 1955, 46, 465-469.
- Cronbach, H. J. Essentials of psychological testing. New York: Harper and Row, 1960.
- Epel, R. L. The social consequences of educational testing. School and Society, 1964, 331-334.
- Feuerstein, R. Cognitive assessment of the socioculturally deprived child. In L. J. Cronbach and P. J. Drenth (Eds.), Mental tests and cultural adaptation. The Hague, Mouton Publishers, 1972.
- Friedlander, B. Z. A psychologist's second thoughts on concepts, curiosity, and discovery in teaching and learning. Harvard Educational Review, 1965, 35, 18-38.

- Ginsburg, H., and Oppen, S. Piaget's theory of intellectual development: an introduction. Englewood-Cliffs, New Jersey: Prentice-Hall, Inc., 1969.
- Griffiths, L., Shantz, C., and Sigel, I. A methodological problem in conservation studies: the use of rational terms. Child Development, 1967, 38, 841-848.
- Hatano, G., and Kuhara, K. Training on class inclusion problems. Japanese Psychological Research, 1971, 14, 61-69.
- Hays, W. L. Statistics for the social sciences. New York: Holt, Rinehart and Winston, 1973.
- Inhelder, B., and Sinclair, H. Learning cognitive structures. In P. H. Mussen, et al. (Eds.), Trends and issues in developmental psychology. New York: Holt, Rinehart and Winston, 1969.
- Inhelder, B., Sinclair, H., and Bovet, M. Learning and the development of cognition. Cambridge, Massachusetts: Harvard University Press, 1974.
- Kalil, K., Youssef, Z., and Lerner, R. Class inclusion failure: cognitive deficit or misleading reference. Child Development 1974, 45, 1122-1126.
- Kohnstamm, G. A. Piaget's analysis of class inclusion: right or wrong? The Hague: Mouton Publishers, 1967.
- Lesser, G. L. Psychology and educational practice. Glenview, Illinois: Scott, Foresman and Company, 1971.
- Lusienski, D. Acculturation testing. In J. Rivoine and I. L. Zimmerman (Eds.), Psychological evaluation in schools and clinics. Springfield, Illinois: Charles C. Thomas Publishers, 1968.

- Montessori, M. The absorbent mind. New York: Holt, Rinehart and Winston, 1967.
- Moore, J., Smith, W., & Teeran, R. Motivational variables in programmed learning. Lewisburg, Penn.: Bucknell University Press, 1965.
- Piaget, J. Science of education and the psychology of the child. New York: Orion Press, 1970.
- Sarason, G. I. Empirical findings and theoretical problems in the use of anxiety scales. Psychological Bulletin, 1960, 57, 403-415.
- Schulman, L. S. Psychological controversies in the teaching of science and mathematics. Science Teacher, 1968, 35, (6), 34-41.
- Toba, Hilda. Learning by discovery: psychological and educational rationale. Elementary School Journal, 1963, 63, 308-316.
- Tanaka, M. N. Classification skills in first grade children: the effect of different instructional methods. Paper presented at the meeting of the American Educational Research Association, 1968.
- Terman, L., & Merrill, M. Stanford-Binet Intelligence Scale. Boston: Houghton, Mifflin and Company, 1960.
- Wallace, W. L. Peer groups and students' achievement. Chicago: Aldine, 1965.

✓ Wohlwill, J. F. Responses to class inclusion question for
verbally and pictorially presented items. Child Development,
39, 449-465.

⌒ Vygotsky, L. S. Thought and language. Cambridge: Massachusetts,
Institute of Technology Press, 1962.

APPENDIX A

Class Inclusion Training Items

Task I - 2 Red Buttons and 1 White Button

- (1) How many red buttons are there?
- (2) How many white buttons are there?
- (3) How many buttons are there?
- (4) Are the red ones buttons?
- (5) Are the white ones buttons?
- (6) Are there more red ones or more buttons?
- (7) Are there more white ones or more buttons?
- (8) Right (feedback) - That's right. There are more buttons because the red ones and the white ones are both buttons.
- (9) Wrong (feedback) - That's wrong. There are more buttons because the red ones and the white ones are both buttons.

Task II - 3 Forks and 4 Spoons

- (1) How many forks are there?
- (2) How many spoons are there?
- (3) How many things to eat with are there?
- (4) Are the forks things to eat with?
- (5) Are the spoons things to eat with?
- (6) Are there more spoons or more things to eat with?
- (7) Are there more things to eat with or more spoons?
- (8) Right (feedback) - That's right. There are more things to eat with because forks and spoons are both things to eat with.
- (9) Wrong (feedback) - That's wrong. There are more things to eat with because forks and spoons are both things to eat with.

Task III - 2 Gumdrops (one colour) and 3 Gumdrops (other colour).

- (1) How many gumdrops (colour 1) are there?
- (2) How many gumdrops (colour 2) are there?
- (3) How many gumdrops are there?
- (4) Are the (colour 1) ones gumdrops?
- (5) Are the (colour 2) ones gumdrops?
- (6) Do you want to eat the (colour 1) ones or the gumdrops?
- (7) Do you want to eat the gumdrops or the (colour 1) ones?
- (8) Right (feedback) - That's right, you'd want to eat the gumdrops because the (colour 1) ones and the (colour 2) ones are both gumdrops.
- (9) Wrong (feedback) - That's wrong, You'd want to eat the gumdrops because the (colour 1) ones and the (colour 2) ones are both gumdrops.

Task IV - 2 Little Plates and 5 Big Plates

- (1) How many little plates are there?
- (2) How many big plates are there?
- (3) How many plates are there?
- (4) Are the little ones plates?
- (5) Are the big ones plates?
- (6) Are there more big ones or more plates?
- (7) Are there more plates or more big ones?
- (8) Right (feedback). That's right. There are more plates because the big ones and the little ones are both plates.
- (9) Wrong (feedback) - That's wrong. There are more plates because the big ones and the little ones are both plates.

Task V - 3 Indians and 7 Cowboys.

- (1) How many Indians are there?
- (2) How many Cowboys are there?
- (3) How many men are there?
- (4) Are the Indians men?
- (5) Are the Cowboys men?
- (6) Are there more Cowboys or more men?
- (7) Are there more men or more Cowboys?
- (8) Right (feedback) - That's right. There are more men because the Cowboys and the Indians are men.
- (9) Wrong (feedback) - That's wrong. There are more men because the Cowboys and the Indians are both men.

Task VI - 2 Yellow and 6 Green Sticks

- (1) How many yellow sticks are there?
- (2) How many green sticks are there?
- (3) How many sticks are there?
- (4) Are the yellow ones sticks?
- (5) Are the green ones sticks?
- (6) Are there more green ones or more sticks?
- (7) Are there more sticks or more green ones?
- (8) Right (feedback) - That's right. There are more sticks because both the green ones and the yellow ones are sticks.
- (9) Wrong (feedback) - That's wrong. There are more sticks because both the green ones and the yellow ones are sticks.

APPENDIX B

Stanford Binet Posttest Training and Test Items

Differences Subtest - 6 year olds

- (1) What is the difference between a bird and a dog?
(a) Training Question: How does a dog move?
- (2) What is the difference between a slipper and a boot?
(a) Training Question: Where do you wear boots? Why?
- (3) What is the difference between wood and glass?
(a) Training Question: What happens to glass when you throw it?

Similarities Subtest - 7 year olds

- (1) In what way are wood and coal the same?
(a) Training Question: What happens to coal when you put it on a fire?
- (2) In what way are an apple and a peach the same?
(a) Training Question: What does a peach look like?
- (3) In what way are an automobile and a ship alike?
(a) Training Question: What do you do with a car?
- (4) In what way are iron and silver the same?
(a) Training Question: What does iron feel like?

Similarities and Differences Subtest - 8 year olds

- (1) In what way are a baseball and an orange alike and how are they different?
(a) Training Question: What does an orange look like?
What do you do with a baseball?

(2) In what way are an airplane and a kite alike and how are they different?


(a) Training Questions: How does a kite move?
What is an airplane made out of?

(3) In what way are an ocean and a river different and how are they the same?

(a) Training Questions: What is in a river?
What size is the ocean?

(4) In what way are a penny and a quarter alike and how are they different?

(a) Training Questions: What does a penny look like?
How much can you buy with a quarter?



VITA AUCTORIS

- 1953 - Born, Toronto, Ontario
- 1958-1970 - Attended elementary and high school.
- 1970 - Enrolled as a student at the University of Windsor, Windsor, Ontario.